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How To Trick Your Sister

by ReadWorks

The plan was perfect. Rick had been working on it all week: in Math class, English class, and History class. He sat in the back of the room, deep in thought. To the teacher, it looked like he was taking notes. In fact, he *was* taking notes-but not on Algebra, *To Kill a Mockingbird,* or the Spanish-American War. Rick was a schemer, and now he had dreamed up the greatest scheme of his career.

He was going to ruin his sister's birthday party.

Rick didn't have anything against Emily. She was a nice enough sister. She helped him do the dishes, she kept out of his room, and on long car trips, she let him sleep when he wanted to sleep. But Rick loved playing tricks, and when it came to tricks, there was no better target than Emily.

She liked her life to be orderly. She liked everything in its place. When she was taking notes in school, she used nine different pens-all different colors-in an organizational scheme so complex, it would take FBI scientists weeks to decode it.

Rick was not like that at all. He was a messy kid. He liked his bedroom to be covered in dirty clothes and crumpled-up paper. He liked his music loud and his fireworks louder. And surprises were his favorite thing in the world.

The notebook he used in the back of math class didn't say "MATH" on it. It said, "Surprises-Top Secret! Do Not Open!" In it were the records of every trick he had ever played. There was the time he made his sister think all her dolls had moved away. There was the time he'd hidden Dad's car keys and made him two hours late for work. And there was his last great accomplishment-the time he disconnected the oven, and made Mom think that Thanksgiving dinner would never be finished.

That last trick would be hard for most kids, but Rick, though he never did great in school, was smart with his hands. His father was a mechanic, and had shown him all sorts of neat things he could do with machines. Rick could fix washing machines, dishwashers, showers and garage door openers. He could also, when it suited him, disconnect them completely.

"I am a mechanical wizard," he wrote in his notebook. "No! A genius. Better yet-an evil genius. "

This was going to be his greatest triumph. All he needed was a remote control, a few bits of radio equipment and two dozen small fireworks. If there were a Nobel Prize for evil, he thought he would win it, for sure.

The night before her party, Emily couldn't sleep. It was always like that when she was excited. She kept playing the party over in her mind. All the girls from her class were coming and everyone was going to have a wonderful time. With her mother's help, Emily had planned everything down to the last detail. She had filled a binder with plans for games they would play, stories she would tell and outfits she might wear. She had settled on a pale green dress with matching sandals. It was a simple outfit, but that was perfect. She didn't want anyone to know how much she was looking forward to this.

The girls at school were nice to Emily, but there were none who would call her their friend. She was a shy person. In class, she always knew the answer, but never raised her hand. When she was with the other girls, she was like that too. Even when she knew the right thing to say, her mouth would freeze. She couldn't say it. At night she would torture herself with the knowledge that she was funny, charming and smart. She just didn't know how to make that side of her come out.

Perhaps it would happen at her party. Perhaps she would emerge from her shell like a very organized butterfly. Perhaps at school the next week, she would have friends.

If the party didn't work, it certainly wouldn't be her fault. This would be the finest birthday party of the season. The napkins would be colorful. The games would be fresh and exciting. And the cupcakes would be out of this world.

"Are you sure you want cupcakes?" her mother had asked. "Maybe I'm old-fashioned, but I don't see what's wrong with a nice ordinary caramel cake. I'll make you one myself! "

"I know you will, Mom," said Emily. "You've made one for me every year since I was born. Caramel cakes are delicious, but they're boring. Cupcakes are popular. Cupcakes are fun. "

Her mom agreed. They would have cupcakes: two dozen of them in every color of the frosting rainbow. To keep Rick away from them, her mother had placed them under lock-and-key. She had

arranged for his friend Andy to come over during the party. They would be in the basement playing video games the entire afternoon. Emily didn't think it was possible for Rick to ruin her party if he wasn't allowed out of the basement.

She hadn't counted on a remote control.

Rick was proud of his handiwork. Each firework was attached to a tiny remote detonator, the size of a pea. He stashed them in the back of the pantry, the morning of the party, before his mother made him go into the basement to hang out with Andy.

"You two just stay down here until all the girls have gone home," his mom said. "I don't want you doing anything that might upset your sister. "

"I promise I won't come through that door until the party is over," said Rick. His mom didn't understand why he was smiling.

In the basement, Mom had laid out a platter of sandwiches, soda, and cookies for Rick and Andy, but Rick was too excited to eat. From upstairs, he heard the telltale signs of a girl's birthday party: screaming, squealing and laughter loud enough to shatter a window.

"It sounds like they're having a lot of fun up there," said Andy, who wished he could be part of the party.

"Not for long," said Rick. "Hand me that step ladder. "

He had promised his mother he wouldn't come through the door, and he was going to keep that promise. There was a small window on the far side of the basement, just big enough for him to crawl through. With Andy holding the ladder, Rick unlatched the window, squirmed through the frame, and crawled into the backyard.

"Wait here," said Rick. "Don't close the window. I'll be back in five minutes. "

"Can I play FIFA?" asked Andy.

"You can play whatever you want! Just don't close this window. "

He army-crawled around the house to the door that led into the kitchen. Through the window, he saw his mother arranging the cupcakes on a tray. It was nearly time to strike.

In Rick's family, the tradition was to sing "Happy Birthday" while the cake was still in the kitchen. Only when the song was over would mom bring out the cupcakes, candles lit, and frosting shimmering. This was Rick's opportunity.

Mom went into the dining room and the singing started. Moving quickly but silently, Rick opened the kitchen door and went to work, nestling a tiny firework in the bottom of each cupcake. He resisted the urge to eat one of the little cakes. This was no time to goof around. By the time the song had finished, the cakes appeared undisturbed, and Rick had disappeared.

"All right girls," said Mom. "Here we go! Cupcakes, just like I promised. "

"I want the green one!" said Rachel McKeown.

"I want the red one!" said Angela Beck.

"I want the pink one and the yellow one and the blue one and the rainbow one!" said Mary Kucan, who really loved cupcakes.

"Hold on, hold on, hold on," said Mom. "There's plenty for everybody. The one with the rainbow is for Emily. "

"Thanks Mom," said Emily, as she placed the cupcake on the plate.

"These look awesome," said Angela.

"Totally," said Rachel.

"I want to eat them all," said Mary. "Can I eat all of them? "

"This is perfect, Mom," said Emily. "Thanks so much. "

And it was perfect. Everyone from school was here, and they were all having a great time. Emily had been funny; she had been fun. "This is the best party any of my friends have ever thrown," Rachel had told her. No one at school had ever called her "friend" before. The party had gone wonderfully, and Rick couldn't spoil it now.

"All right, girls," said Mom. "Dig in. "

And that was when the explosions started. Two dozen little pops-like hail falling on a tin roof-went off, one after the other. When the girls' ears stopped ringing, there was smoke in the air and icing covering every surface: pink icing on the table, green icing on the ceiling and rainbow icing all over Emily's green dress. After a moment, the silence was broken. Emily started to cry.

As the tears began to slip from her eyes, she felt a firm grip on her elbow. "Don't," said Rachel. "Do not cry. We're going to get him. Say it with me. We are going to get him. "

"We are?" said Emily.

"He's pretty handy, isn't he? Are you good with machines too? "

"I guess so. My dad taught us all sorts of things. "

"Then we'll need a little motor and a lot of fishing line. "

"What are we going to do with it? "

"Tell me," said Rachel, with a mischievous grin spreading across her face. "What is your brother's favorite thing in the world? "

It was an hour before Mom let Rick out of the basement. She was furious. But she was so confused and upset, that she didn't even know how to punish him yet.

"Go to your room," she said from the top of the basement stairs.

"Why?" he asked. "What happened? I was down here the whole time. Wasn't I, Andy? "

Andy didn't say anything. He was too smart to get involved in family fights. He slipped out behind Rick's mother, and went to wait for his father to pick him up. Mom stood there, jaw clenched and face red.

"Just go to your room," she said. "Go! "

Rick whistled quietly as he walked to his bedroom, pausing in the dining room to inspect the scene of the carnage. In his head, he began imagining the way he would write this down in his journal of nasty tricks. Never before, he thought, has a birthday party been so thoroughly ruined. This one will go down in history. At the table, Emily and one of the other girls from school-Rachel, maybe?-sat quietly. They said nothing to him as he passed them by, whistling just a teeny bit louder.

He opened his bedroom door and found everything just the way he liked it. Clothes were piled on the floor, dirty cups and bowls were on all the windowsills, and his journal was just where it was supposed to be-hidden behind the bookshelf by the door. As he reached for it, he heard a whirring noise, and the journal jumped away from his hand.

"What the heck?" he said. He grabbed for the journal but it jumped away again, slipping across the floor like a gecko. Someone had tied a string to it, and the string was connected to some unseen machine. He chased the journal across the room, into the hallway and down the stairs. It gained speed as it was dragged into the dining room. He took the corner too fast, slipped on a piece of cake and watched helplessly as his life's work was dragged through gobs of icing.

"Stop it!" he said. "It's getting icing all over! Emily-stop it! "

Emily said nothing, but Rachel allowed herself a tiny smile. By the time Rick was on his feet again, the journal had been dragged into the hallway. He chased it all around the first floor-from the kitchen to the living room and back one last time into the dining room, where he slipped a second time. He followed the book into the den but didn't see where it had gone. Finally, he heard a crackling sound, and saw his journal burning in the fireplace. It was already too late to save.

Rick burst into the dining room, face red with icing and rage.

"You!" he said. "You destroyed my journal. You, you, you! You played a terrible trick on me! "

"I don't know what you're talking about," said Emily, as she licked a bit of icing off her finger. "You can ask my friend, Rachel. We were here the entire time. "

Vocabulary

remote

noun

definition: shortened form of "remote control," a device used to operate a television set or other electronic machine from a distance.

We had to operate the TV manually because we couldn't find the remote.

scheme

noun

definition: a plan or plot.

The outlaw had a scheme to escape from jail and take revenge on the sheriff.

Spanish: plan, ardid

target

noun

definition: someone or something that is made fun of, criticized or scorned; butt.

They made him a target because he wears clothes that are different from theirs.

Spanish: blanco, objetivo

Name: _____ **Date:** _____

1. What trick does Rick play on his sister?

A. He hides her car keys and makes her two hours late for work.

B. He disconnects the oven and makes her think that Thanksgiving dinner will never be finished.

C. He sets off fireworks inside the cupcakes at her birthday party.

D. He attaches a string to her notebook and uses a motor to pull it into the fireplace.

2. What is the resolution at the end of the story?

A. Tears begin to slip from Emily's eyes because the cupcake icing has gotten everywhere.

B. Emily keeps playing the party over in her mind instead of going to sleep.

C. Emily feels a firm grip on her elbow and tells Rachel that she is good with machines.

D. Emily takes revenge on her brother by pulling his journal into the fireplace with a string and motor.

3. Emily is excited for her birthday party.

What evidence from the passage supports this statement?

A. Emily cannot fall asleep the night before the party.

B. Emily helps her brother do the dishes and lets him sleep on long car trips.

C. Emily uses nine different pens to take notes in school.

D. Angela Beck wants to eat the red cupcake.

4. Why does Rick decide to ruin his sister's birthday party?

A. He is a messy kid who likes his bedroom to be covered in dirty clothes.

B. His sister's birthday party is a great opportunity for playing a trick.

C. He can fix washing machines, dishwashers, showers, and garage door openers.

D. He army-crawls around the house to the door that leads to the kitchen.

5. What is this story mostly about?

A. a girl who wants to eat all the cupcakes at someone else's birthday party

B. a trick that a boy plays on his sister and the trick she plays in return

C. a mother who gets mad when her son plays a trick on her daughter

D. a journal that a boy uses to keep a record of the tricks he plays on people

6. Read the following sentences: "He sat in the back of the room, **deep in thought**. To the teacher, it looked like he was taking notes."

What does the phrase **deep in thought** mean?

A. It means that someone is sitting in a short chair very close to the floor.

B. It means that someone is sitting in a tall chair very far from the floor.

C. It means that someone is thinking a lot about something.

D. It means that someone is not thinking very much about something.

7. Choose the answer that best completes the sentence below.

Rick tricks Emily; _____ Emily tricks Rick.

A. in contrast

B. for instance

C. first

D. then

8. What trick does Emily play on Rick?

_____

_____

_____

9. Why does Emily play a trick on Rick? Support your answer with evidence from the story.

10. How does Emily feel at the end of the story? Explain your answer with evidence from the passage.

Music and Your Mind

by Debbie Nevins, Kirsten Weir

Listen up! Music has you in its power-physically and mentally.

New Orleans resident Ashton C., 13, likes to rock out. When he's not practicing guitar or drums, he's often listening to Led Zeppelin, AC/DC, or The Beatles. "I listen to the music over and over and just let it get into my system," he says.

Ashton is more right than he may know. Music really does get into our systems. It affects us physically-loud music can harm our ears, while soft music can help put us to sleep. And it affects us mentally-music can improve our moods. It can also help us memorize information. Think of the ABC song you learned as a child. There's a good reason the alphabet was made into a song. Without the melodic cue, you would have had a much harder time remembering it.

Music: It's Only Human

Why does music have such power over us? After all, it isn't essential as food, water, and air are. We might enjoy it, but we don't need music to live. Or do we?

Music has been important to people as long as humankind has been around. Scientists have discovered ancient flutes made of animal bones that date to prehistoric times. Some researchers think early humans might have made music even before they developed language and speech.

And music exists everywhere humans do, says Diana Deutsch, an expert in music and memory. "People have not found a culture where there isn't music. "

Likewise, you won't find music where there aren't people. Wait-are you wondering about birds? It's true that birdsong sounds musical to our ears. But to the birds, the calls are simply their way of communicating.

In general, all members of a given species make the same sounds. A robin speaks robin. A blackbird speaks blackbird. A sparrow doesn't create its own tone, melody, or pitch. Those chirps, pretty as they are, aren't music.

Only humans make music-it is literally part of us. Our brains are hardwired for it. Scientists don't know why. Perhaps it has to do with music's ability to communicate emotion. Studies have shown that even infants as young as eight months old can tell "happy" music from "sad" music.

Pump It Up, Slow It Down

Music has the power to affect the body. Listening to fast, upbeat songs can make a person's heart rate and breathing rate speed up. That's why fast music is perfect for a workout-as Sarah S., of Deerfield, Ill., knows. "If I have a basketball game, I'll listen to music that will get me pumped up," the 14-year-old says.

Soothing music does the opposite. It brings down heart and breathing rates. Listening to gentle, slow music before bed helps people get a better night's sleep. Music can even reduce pain and depression.

A Sound Track in Your Mind

As the ABC song shows, music is tied to memory. One study in China found that kids who took lessons on musical instruments did better on certain memory tests than kids who didn't play instruments.

And if the sound of an organ playing reminds you of that time your Uncle Mike took you to a big-league baseball game, you know how powerfully music can trigger memories-sometimes even long-lost ones.

"What seems to happen is that a piece of familiar music serves as a sound track for a mental movie that starts playing in our head," says Petr Janata. He is a scientist who studies music and the brain. "It calls back memories of a particular person or place, and you might all of a sudden see that person's face in your mind's eye. "

Scientists are trying to solve the mystery of music's power. They are working to piece together a picture of what happens in the brain when people listen to or play music. So far, they know there's no one music center in our heads-music activates many areas of the brain.

Right now, while your brain is still growing, music plays an important role. Catriona Morrison, a researcher with the University of Leeds in England, found that music leaves its most lasting impression on people around age 14. And the songs you listen to in your teens will probably influence the type of music you listen to for the rest of your life.

Attack of the Earworms

Do songs ever get "stuck in your head"? Those tunes have a name: earworms.

What makes certain jingles so catchy? Nobody knows for

Getty Images

sure, but James Kellaris-also known as "Dr. Earworm"-is trying to find out. Kellaris is a researcher at the University of Cincinnati. He says that almost any song can become an earworm. But simple, repetitive, or surprising songs are the usual culprits.

Kellaris says earworms are more likely to strike if you're stressed or fatigued. So play some calming tunes and get a good night's rest-or you might wake up with a tune such as Subway's "$5 Footlong" song playing on an endless loop in your head!

What's Your Earworm?

Kellaris says some songs, such as "Y.M.C.A.," are common earworms. Sarah S. says she gets jingles from TV commercials stuck in her head. Ashton C. says the singer Lady Gaga is responsible for some of his worst earworms. Michael P., 12, of New Jersey gets tunes from *Hannah Montana* commercials lodged in his brain-and he hates that show. Clearly, earworms are all in the ear of the beholder!

Vocabulary

culture

noun

definition: the language, customs, ideas, and art of a particular group of people.
Respect for Mother Earth is an important part of Iroquois culture.

Spanish: cultura

familiar

adjective

definition: known by many people; easily recognized.
The audience sang along with the familiar song.

Spanish: familiar, conocido

resident

noun

definition: a person who lives in a particular place.
Many of the residents in our apartment building are moving out.

Spanish: residente, vecino

Name: _____ **Date:** _____

1. What is something that only humans make?

A. sound

B. music

C. loud noise

D. soft noise

2. What is an effect of listening to gentle, slow music before bed?

A. getting a better night's sleep

B. falling asleep later than usual

C. waking up early the next morning

D. having pleasant, soothing dreams

3. Music has been around as long as humans have.

What evidence in the article supports this statement?

A. "Scientists have discovered ancient flutes made of animal bones that date to prehistoric times."

B. "In general, all members of a given species make the same sounds."

C. "Studies have shown that even infants as young as eight months old can tell 'happy' music from 'sad' music."

D. "Music has the power to affect the body."

4. What is an example of music affecting people mentally?

A. Music can make a person's heart rate speed up.

B. Music can help people memorize information.

C. Music can harm people's ears.

D. Music can make a person's breathing rate slow down.

5. What is the main idea of this text?

A. All members of a given species make the same sounds.

B. Listening to fast songs can make a person's heart rate speed up.

C. Music is connected to memory.

D. Music affects people physically and mentally.

6. Read these sentences from the text.

"Why does music have such power over us? After all, it isn't essential as food, water, and air are. We might enjoy it, but we don't need music to live. Or do we?"

Based on these sentences, what does the word "essential" mean?

A. strong

B. unimportant

C. necessary

D. enjoyable

7. Choose the answer that best completes the sentence.

There's no one music center in our heads. _____, music activates many areas of the brain.

A. In particular

B. On the contrary

C. Previously

D. In the end

8. According to the text, what can reduce pain and depression?

_____

_____

_____

9. The authors state that music can "help us memorize information." What evidence in the text supports this statement?

10. The authors claim that music is "important to people."

Support this claim with evidence from the text.

Pick Your Portion

by Meredith Matthews

How to right-size your meals

It's an ordinary morning. You wake up and help yourself to a bowl of cereal. But do you ever stop to think about exactly how much you're pouring into the bowl? And if you have pancakes instead, how many should you eat?

For many people, the amount of food they eat-their *portion size*-is decided by their eyes, their stomachs, or both. They might put as much food on their plates as they think they want, and then eat it simply because it's there. Or they might decide to put their forks down only once they begin to feel full. But neither of those is the healthiest way to figure out portion sizes.

Serving Size vs. Portion Size

So how do you know what the right portion size is? Nutrition information on the package is a good place to start. The label shows how much of each nutrient is in a given amount of food, explains Tandalayo Kidd. She's a nutrition expert at Kansas State University in Manhattan. But the serving size on the label is one thing. The amount a person thinks is a portion size might be somewhat different. In other words, the serving size listed on the package may not be the same amount you actually eat.

For example, a 3-ounce package of chips may actually contain three 1-ounce servings. So what happens if you wolf down the whole bag? You guessed it: You've actually eaten three servings of chips, not just one. The same goes for a lot of foods.

Without a nutrition label, it can be hard to tell exactly how much food is the right amount. When you have a slice of lasagna at your grandma's house or a dish of ice cream at a sundae party, how do you know whether you're eating a healthy portion size or going overboard? Nutrition experts have come up with ways to figure out portion size at a glance. Those guidelines won't give you the exact amount for every food, but they are a good estimate.

Portion Distortion

Portion sizes have been getting bigger through the years. Today's 20-ounce soft drink is roughly double the size of the bottle of cola your parents might have had when they were your age. Those types of changes make it easy to ignore the serving size on the label and instead treat the whole package as one serving. (Have you ever put the cap back on a 20-ounce drink to save the rest for the next day?)

Eating or drinking more than one serving at a time means you're getting more calories, according to Kidd. "Increased portion sizes encourage *overconsumption*," she says. Larger portion sizes affect the amount people think they should eat. Brothers Jason J. and Patrick J., of Connecticut, have noticed

that restaurant portions are often a lot bigger than they need to be. Patrick, 11, had an enormous breakfast recently at a diner. It had large portions of pancakes, eggs, toast, and potatoes. "I ate it all, though," he said.

Jason, 9, knows what happens when you fall for that, though. "If you're real hungry, you would probably eat it all," he says. "Then it makes you feel stuffed." But most of the time, the boys agree, that extra food goes to waste.

Large portions are often the norm at fast food restaurants as well. So-called value-sized or supersized meals, which are usually just a few cents more than a regular-sized meal, sure are tempting. They make you think that you are getting more bang for your buck, says Kidd. People like to get the most food possible for the money they are spending. But if you opt for supersized foods and meals, you're also choosing more calories, fat, and carbohydrates. A healthier option is to take advantage of the "value" of a value meal. Order the larger size, but split it with a friend.

Sensible Choices

Whether you're getting takeout, grabbing a snack, or cooking at home, it helps to pay attention to portions. Aim for balance. "You don't always want to be eating big portions all the time, and you don't want to be eating just tiny little portions that give you no protein or nutrients," says Sabrina F., 15, of Missouri.

The solution? Right-size your portion sizes! Sabrina's favorite food is chili. But she makes sure not to pig out when it's on the menu. "I don't usually get too big of a portion," she says. "I don't want to get full before my brain is able to realize that I'm full." That takes about 20 minutes. Eating slowly can help your brain get the message before you've eaten way more than you should.

Knowing what's a healthy portion is helpful when it comes to all types of food, from breakfast to dessert and everything in between. Sabrina's classmate Rita W. knows that. "Serving sizes can make the difference between enjoying a little pie or gaining 5 pounds," Rita says.

A Healthy Portion Looks Like ...

Nutrition expert Tandalayo Kidd offers some serving size guidelines. Use the visual reminders to help you keep your portions in line.

Stephanie Wolfsteiner/Getty Images

Think About ItWhy, do you think, are portions at restaurants often larger than what one person should eat at a time? How can you eat the right amount when you're eating out?

Name: _____ **Date:** _____

1. What is portion size?

A. the amount of food someone eats

B. the amount of nutrients in a given amount of food

C. the number of items that someone orders at a restaurant

D. the number of people you can split a "value-sized" meal with

2. What does the author contrast with portion size?

A. waist size

B. shoe size

C. clothing size

D. serving size

3. Read this sentence from the text.

"Portion sizes have been getting bigger through the years."

What evidence in the text supports this statement?

A. "When you have a slice of lasagna at your grandma's house or a dish of ice cream at a sundae party, how do you know whether you're eating a healthy portion size or going overboard?"

B. "Today's 20-ounce soft drink is roughly double the size of the bottle of cola your parents might have had when they were your age."

C. "So-called value-sized or supersized meals, which are usually just a few cents more than a regular-sized meal, sure are tempting."

D. "Knowing what's a healthy portion is helpful when it comes to all types of food, from breakfast to dessert and everything in between."

4. Read these sentences from the text.

"Large portions are often the norm at fast food restaurants as well. So-called value-sized or supersized meals, which are usually just a few cents more than a regular-sized meal, sure are tempting. They make you think that you are getting more bang for your buck, says Kidd. People like to get the most food possible for the money they are spending. But if you opt for supersized foods and meals, you're also choosing more calories, fat, and carbohydrates. A healthier option is to take advantage of the 'value' of a value meal. Order the larger size, but split it with a friend."

Based on this paragraph, what can you infer about consuming calories, fat, and carbohydrates?

A. Consuming lots of calories and fat is healthy, but consuming lots of carbohydrates is unhealthy.

B. Consuming lots of calories, fat, and carbohydrates has no effect on a person's health.

C. Consuming lots of calories, fat, and carbohydrates is unhealthy.

D. Consuming lots of calories, fat, and carbohydrates is healthy.

5. What is the main idea of this text?

A. If you are eating food that comes in a package, you should look at the nutrition label to figure out what the right portion size is.

B. Nutrition experts have come up with ways for people to figure out portion size when eating food without a nutrition label.

C. People should pay attention to serving size as well as portion size to make sure they are eating a healthy amount of food.

D. So-called value-sized or supersized meals contain more calories, fat, and carbohydrates than regular-sized meals do.

6. Read these sentences from the text.

"Without a nutrition label, it can be hard to tell exactly how much food is the right amount. When you have a slice of lasagna at your grandma's house or a dish of ice cream at a sundae party, how do you know whether you're eating a healthy portion size or going overboard?"

What does the phrase "going overboard" mean here?

A. trying too hard
B. falling off the side of a ship
C. eating a healthy amount
D. eating too much

7. Read these sentences from the text.

"Whether you're getting takeout, grabbing a snack, or cooking at home, it helps to pay attention to portions. Aim for balance. 'You don't always want to be eating big portions all the time, and you don't want to be eating just tiny little portions that give you no protein or nutrients,' says Sabrina F., 15, of Missouri.

The solution? Right-size your portion sizes!"

How could the last two sentences best be combined?

A. The solution is right-size your portion sizes?
B. The solution being to right-size your portion sizes.
C. The solution was to right-size your portion sizes.
D. The solution is to right-size your portion sizes.

8. What have Jason and Patrick noticed about portions of food at restaurants?

9. Read these sentences from the text.

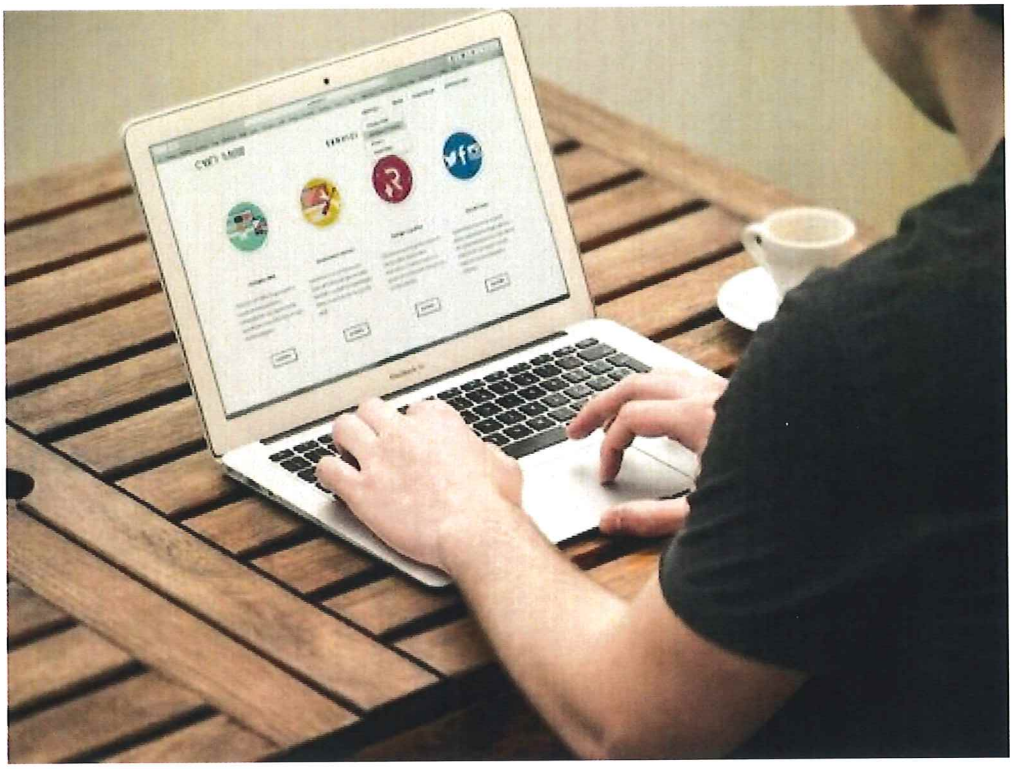
"Portion sizes have been getting bigger through the years. Today's 20-ounce soft drink is roughly double the size of the bottle of cola your parents might have had when they were your age. Those types of changes make it easy to ignore the serving size on the label and instead treat the whole package as one serving. (Have you ever put the cap back on a 20-ounce drink to save the rest for the next day?)"

Based on this paragraph, what can you conclude about the effect that bigger portion sizes have had on the amount that people eat and drink?

10. Explain whether people are more likely to eat too much or too little.

Support your answer with evidence from the text.

News Debate: Virtual Ed



Do cyber schools make the grade?

Students in Caldwell, Idaho, can attend class in their pajamas! At Vallivue Virtual Academy, courses are taught online. Students work at home with parents, who serve as learning coaches. A certified teacher oversees the students' progress.

The cyber school was launched as a free option for students in kindergarten through grade 8 who have trouble succeeding in the district's traditional public school. Supporters of the program say that virtual schools help students avoid the social pressures that can interfere with learning. In addition, supporters argue, online courses provide kids with more focused instruction and course options than they can get in a typical school.

Not everyone gives cyber schools a passing grade, however. Some educators argue that online learning makes it hard for students to make friends. Many parents also feel that cyber schools put unrealistic time demands on them because they have to oversee their kids' daily work.

Are virtual schools a valid option? *Current Events* student reporters Sophia Platcow and Peter Brosnan each log in on a side.

Crash Course to Failure

Technology can benefit education, but it shouldn't take over education. Students who go to virtual schools will miss many of the benefits of being in a real school.

If kids attend school online, they will miss out on important social interactions. Payton Mcdonough, 13, a seventh grader from Glencoe, Ill., agrees. "I don't know how I could sit at a computer all day without actually interacting with my peers and teachers," he says.

In addition, virtual schools don't have enough structure. Students who take online courses can set their own schedules, which will cause problems for students who have trouble staying motivated.

Furthermore, online schooling puts stress on parents because they have to supervise what their kids do at home. Many parents have full-time jobs. How are they going to run their children's education, excel in their jobs, and take care of their other responsibilities at home?

Virtual schools will make it harder for students to learn and will put too much pressure on parents.

It's Time for Tech

In this ever-changing age of technology, it is important for students to learn to work in the virtual world.

Virtual learning does not need to replace classroom learning entirely, but it can help students work at their own pace. If students struggle with subjects, they can take those courses online and spend more time on them. Valerie VanSelous, a teacher from Hopewell Township, N.J., agrees. "Teachers, students, and parents need to embrace new technology and not be afraid of it. Offering different teaching aids just might be the key to unlocking a student's potential. "

Virtual schools can also offer students much more flexible schedules. Students often juggle extracurricular activities, sports, and schoolwork, and cyber schools could help them manage everything.

Finally, attending virtual school can prepare students for college and for work after graduation. "We need to be responsible for working on our own," says Angela Goscilo, a senior from Pound Ridge, N.Y. "We need to develop technology skills that will help us in whatever we do. Getting an early start is a good idea. "

Name: _____ Date: _____

1. What is Vallivue Virtual Academy?

A. a private school in Glencoe, Illinois

B. a charter school in Hopewell Township, New Jersey

C. a traditional public school in Caldwell, Idaho

D. a cyber school where courses are taught online

2. What argument is presented in this text?

A. an argument about prayer in schools

B. an argument about virtual schools

C. an argument about whether school should be year-round

D. an argument about what classes students should be required to take

3. Virtual schools are bad for kids.

What evidence in the text supports this conclusion?

A. Virtual schools provide kids with more focused instruction than they get in a typical school.

B. Virtual schools provide kids with more course options than they get in a typical school.

C. Students who attend virtual schools can set their own schedules, which will cause problems for students who have trouble staying motivated.

D. Attending virtual schools can prepare students for college and work after graduation by training them to work independently.

4. Virtual schools are good for kids.

What evidence in the text supports this conclusion?

A. Virtual schools help students avoid the social pressures that can interfere with learning.

B. If kids attend virtual schools, they will miss out on important social interactions.

C. Virtual schooling puts stress on parents because they have to supervise what their kids do at home.

D. A cyber school for students in kindergarten through eighth grade was launched in Caldwell, Idaho.

5. What is the main idea of this text?

A. Students in Caldwell, Idaho, can attend class in their pajamas.

B. Students who go to virtual schools will miss many of the benefits of being in a real school.

C. It is important for students to learn to work in the virtual world.

D. There are various arguments for and against virtual schools.

6. Read these sentences from the text.

"Not everyone gives cyber schools a passing grade, however. Some educators argue that online learning makes it hard for students to make friends. Many parents also feel that cyber schools put unrealistic time demands on them because they have to oversee their kids' daily work."

What does the statement "Not everyone gives cyber schools a passing grade" mean here?

A. Not everyone approves of cyber schools.

B. Not everyone has given cyber schools a test.

C. Not everyone has attended a cyber school.

D. Not everyone cares about students in cyber schools.

7. Read these sentences from the text.

"If kids attend school online, they will miss out on important social interactions. Payton Mcdonough, 13, a seventh grader from Glencoe, Ill., agrees. 'I don't know how I could sit at a computer all day without actually interacting with my peers and teachers,' he says.

In addition, virtual schools don't have enough structure. Students who take online courses can set their own schedules, which will cause problems for students who have trouble staying motivated."

What word or phrase could best replace "in addition" at the beginning of the second paragraph?

A. First
B. Also
C. Instead
D. In contrast

8. Why does virtual schooling put stress on parents?

9. What is different about the number of course options kids get in virtual schools compared to typical schools?

10. Using evidence from the text, make an argument for or against virtual schools.

The Wolf Within

We love dogs, all types of dogs: small dogs, big dogs, yappy dogs, lap dogs. Each year we spend billions of dollars on our canine pals, making sure our lovable mutts have enough to eat and lots of toys to play with.

For their part, dogs love us. They lick our faces, protect our homes, and come when we call them (sometimes).

But where did our favorite four-legged companions come from? How and when did dogs get to be our best friends? Some scientists believe they have found some of the answers.

From Wolf to Woof

Scientists have long known that dogs evolved from wolves. Just when the transformation from wolf to

dog actually took place, however, remained a mystery.

Some said dogs evolved as a separate species 135,000 years ago in two parts of the world. One group of dogs developed in Europe and Asia from Asian wolves. Another group evolved in North, Central, and South America from American wolves.

Now, researchers say, those theories are wrong. New studies suggest that *domesticated*, or tamed, dogs first appeared 15,000 years ago in eastern Asia. They also say that every modern dog, from the Taco Bell Chihuahua to Frank, the adorable pug in the movie *Men in Black II*, descended from approximately five female Asian wolves, the mothers of all modern dogs.

Old Bones

How did scientists come to those conclusions? Scientist Jennifer Leonard and a team of researchers began investigating the origins of dogs by collecting the bones of canines that once lived in North, Central, and South America before Christopher Columbus arrived in 1492.

Researchers then extracted a bit of DNA from the cells in those bones. DNA is the substance that makes up the genes of living things. Genes determine a dog's inherited characteristics, such as eye and fur color.

The scientists then compared the DNA samples to the DNA of modern dogs and wolves not only in North and South America, but also in Europe and Asia. Scientists found that the genes of the ancient American dogs were similar to the genes of dogs born in Europe and Asia. Scientists also concluded that every breed of dog, from English setters to Labrador retrievers, descended from wolves that lived in Europe and Asia and migrated to North and South America.

Land Bridge

Scientists suspect dogs first set paw in North America by following settlers across a land bridge that once linked northern Asia and North America.

"We can't say in detail how [the dogs got to America]; that's something for the future," said Peter Savolainen, a scientist in Sweden. "But what's certain is that by 9,000 years ago, [dogs] were in America and all over Europe and Asia. "

Good Friends

No one knows exactly how dogs became domesticated. Some researchers believe that they accomplished that task themselves over a number of generations by hanging around human campsites sniffing for scraps of food. Those that were not afraid of people ate well, survived, and multiplied.

Other researchers say that humans manipulated every aspect of canine behavior by breeding dogs for certain traits.

Either way, dogs developed an uncanny ability to pick up human signals, endearing the pups to humans, scientists say. As the years passed, humans and dogs became fast friends, a relationship that has lasted thousands of years.

Today, there are 78.2 million owned dogs in the United States. In a recent survey of U.S. dog owners, 94 percent said they own dogs for companionship.

"He's really a good friend," 11-year-old Kerry Knott said about her family's Weimaraner. "I try to look out for him. "

Vocabulary

descend

verb

definition: to be related by blood through several generations.
He descends from African kings.
Spanish: descender de
forms: descended, descending, descends

generation

noun

definition: the period of time between the birth of parents and the birth of their children.
Technology has changed a lot in one generation.
Spanish: generación

inherit

verb

definition: to receive through a parent's genes.
She inherited those blue eyes from her father.
Spanish: heredar
forms: inherited, inheriting, inherits

Name: _____ **Date:** _____

1. According to new studies, what did every modern dog descend from?

A. the Taco Bell Chihuahua

B. English setters and Labrador retrievers

C. American wolves in North, Central, and South America

D. approximately five female Asian wolves

2. What does the author describe in the section "From Wolf to Woof"?

A. The author describes how dogs that were not afraid of people ate well, survived, and multiplied.

B. The author describes how researchers say some theories about the way in which dogs evolved from wolves are wrong.

C. The author describes how researchers extracted DNA from the cells in the bones of dogs.

D. The author describes how genes determine a dog's inherited characteristics, such as eye and fur colors.

3. Read these sentences from the text.

"Some [scientists] said dogs evolved as two separate species 135,000 years ago in two parts of the world. Now, researchers say, those theories are wrong."

What evidence in the text supports the conclusion that those theories are wrong?

A. Each year we spend billions of dollars on our canine pals.

B. Asian wolves came to the Americas with Christopher Columbus in 1492.

C. Scientists found that the genes of the ancient American dogs were similar to the genes of dogs born in Europe and Asia.

D. Five female Asian wolves developed an uncanny ability to pick up human signals.

4. Scientists have long known that dogs evolved from wolves. But no one knows exactly how dogs became domesticated.

Based on these sentences, what can you infer about wolves?

A. Wolves are not domesticated.

B. Wolves became extinct.

C. Wolves come when people call them.

D. Wolves were raised by scientists.

5. What is the main idea of this text?

A. Christopher Columbus arrived in the Americas in 1492.

B. Researchers say every modern dog, including American dogs, descended from Asian wolves.

C. A land bridge once linked northern Asia and North America.

D. Dogs are the most popular type of pet in the United States.

6. Read these sentences from the text.

"Scientists have long known that dogs evolved from wolves. Just when the transformation from wolf to dog actually took place, however, remained a mystery."

Based on these sentences, what does the word "evolve" most likely mean?

A. to develop and change

B. to die off completely

C. to outlive

D. to tame

7. Read this sentence from the text.

"Scientists suspect dogs first set paw in North America by following settlers across a land bridge that once linked northern Asia and North America."

What word or phrase could replace "once linked" without changing the meaning of the sentence?

A. later linked
B. always linked
C. still links
D. used to link

8. Scientists used to think dogs evolved in two different groups in which two parts of the world?

9. According to new studies by scientists, how do the genes of ancient American dogs compare to the genes of dogs born in Europe and Asia?

10. Read these sentences from the text:

> Some [scientists] said dogs evolved as a separate species 135,000 years ago in two parts of the world. One group of dogs developed in Europe and Asia from Asian wolves. Another group evolved in North, Central, and South America from American wolves. Now, researchers say, those theories are wrong.

Explain how what scientists learned about the genes of ancient American dogs and the genes of dogs born in Europe and Asia affected their theories about how dogs evolved.

Support your answer with evidence from the text.

Music Scores

Photos.com

Learning to play music is linked to improved academic test scores.

Got music? Learning to play music is linked to improved academic test scores. More than 200 second graders were studied. Some were trained on piano keyboard and math software. Others used only the software. After six months, the piano players scored higher on math tests. It seems that making music taps into parts of the brain involved with reasoning, say researchers.

Musical middle and high school students score well too. The College Entrance Examination Board compared students with no music background to student musicians. Students in music programs scored 63 points higher on verbal and 44 points higher on math.

UCLA examined the test scores of 25,000 students in grades 8 to 12 over a period of 10 years. Researchers found that students with a high interest in instrumental music scored higher in math knowhow than did others.

Can't Get that Song Out of My Head

Do you "want some baby back ribs"? Is it "a small world after all"? "Gimme a break." Some advertising jingles and songs really stick with you. The sheer repetition of the words and music has something to do with it. But musicians are even more likely to have a hard time getting a tune out of their heads. Doctors say that's because musicians' brains are hooked up in a special way.

Some people are really wired for sound. Psychologists have even identified a condition in which people experience "musical hallucinations." These hallucinations cause people to hear songs playing in their heads. Many times the tunes are familiar; other times, they're new. Composers report experiencing "piped-in" sound before creating their masterpieces. The parts of the mind that are busy when listening to music are the same that become active when hearing your own private song. So it could be that regions of the brain search for a song-and make their own when none is available.

Operation Song

You see super cool TV surgeons cranking the tunes while they work. Did you ever wonder if the music had any effect on patients? Researchers wondered, so they put patients and music to the test.

A team of researchers studied groups of surgery patients. All patients had parts of their bodies numbed. They were all given a device to control the amount of pain-relieving sedative they received. All were awake through the process.

The patients were divided into three categories.

- One group brought their favorite CDs and listened through headphones.
- The second group heard "white noise," or background noise meant to drown out other sounds.
- The last group heard only operating-room noise.

The result? Patients who listened to music used less sedation. Those who listened to their favorite songs were calmer. The effect may be because the music blocked out the noises of the operating room, say doctors. *Source: Yale University, American University of Beirut Medical Center*

Vocabulary

category

noun

definition: a particular section of a main group; class.
The books in the library are divided into many categories.
Spanish: categoría
forms: categories

compare

verb

definition: to note or describe the similarities or differences of.
The teacher compared the climate in the U.S. with the climate in Mexico.
Spanish: comparar, equiparar
forms: compared, compares, comparing

divide

verb

definition: When you divide something, you separate it into parts.

Spanish: dividir, separar, repartir
forms: divided, divides, dividing

Name: _____ **Date:** _____

1. Which parts of the brain does making music tap into?

A. the parts involved with advertising

B. the parts involved with reasoning

C. the parts involved with moving

D. the parts involved with sleeping

2. What is a possible effect of learning to play music?

A. wanting some baby back ribs

B. having parts of your body numbed

C. getting a tune out of your head

D. improving your academic test scores

3. Playing music most likely has an impact on a person's brain. What evidence from the text supports this conclusion?

A. "[M]usicians are even more likely to have a hard time getting a tune out of their heads. Doctors say that's because musicians' brains are hooked up in a special way."

B. "The College Entrance Examination Board compared students with no music background to student musicians."

C. "In the absence of music, some people hear songs playing in their heads. Many times the tunes are familiar; other times, they're new."

D. "Did you ever wonder if the music had any effect on patients [in surgery]? Researchers wondered, so they put patients and music to the test."

4. What is one positive effect that listening to music may have on people?

A. It may help students perform better on social studies exams.

B. It may help students perform better on physical tasks.

C. It may help patients in surgery stay calmer or use less sedation.

D. It may help surgeons perform difficult operations more quickly.

5. What is the main idea of this text?

A. Playing and listening to music can affect a person in many ways.

B. More than 200 second graders were trained to play the piano.

C. A team of researchers studied groups of surgery patients.

D. Some people hear songs playing in their heads, even in the absence of music.

6. Read these sentences from the text.

"UCLA examined the test scores of 25,000 students in grades 8 to 12 over a period of 10 years. Researchers found that students with a high interest in instrumental music scored higher in math knowhow than did others."

Based on these sentences, what does the word "examine" mean?

A. to change or adjust slightly

B. to copy or imitate

C. to study closely and carefully

D. to increase or improve

7. Choose the answer that best completes the sentence.

The parts of the brain that are busy when listening to music are the same parts that become active when hearing one's own private song. _____, it is possible that these regions of the brain make up those private songs when none are available.

A. Although

B. Therefore

C. Unless

D. Despite

8. What do some people hear when they experience "musical hallucinations"?

9. The College Entrance Examination Board compared the test scores of students with no music background to the scores of student musicians. What did they find out about the test scores of these students?

10. How might a musician experience life differently than someone who does not play or listen to music?

Support your answer with evidence from the text.

The Mountain

by ReadWorks

There are four peaks to climb until Manny reaches the top of the mountain. Each ledge is thinner and more dangerous than the last. Thankfully, he has a strong cane. He uses the cane to pull himself up. The climb is cold and snowy.

Day turns to night and back to day again. A strong gust of wind threatens to blow him off-course. But he persists.

The last thing Manny remembers is opening his eyes at the bottom of the mountain. He doesn't remember how he got there. To make things even stranger, he is wearing a fancy tuxedo.

The woman he loves is at the top of the mountain, waiting. He can hear her sweet voice, singing.

He remembers that she is waiting for him, but he doesn't remember anything else. Manny guesses he must have had an accident.

Maybe I hit my head and now I have amnesia! he thinks.

The snow is thick and cold. It gets in his mouth as he climbs. He must be hungry because it tastes sweet like sugar.

"Hello! Is anyone there?" Manny asks.

"Hello! Is anyone there?" he hears back. It's the sound of his own voice-an echo coming back at him.

"I love you! I'm waiting for you!" he hears. Now this, this is not *his* voice. This is the sound of his love calling for him.

He climbs higher and higher. Closer and closer. His arms ache from pulling. His tuxedo is covered in snow. Manny is soaking wet and exhausted. But he is also determined to get to the top.

"I love you! I'm coming!" he calls back.

He hears what he thinks is the faint sound of laughter. Deep and booming. The laughter of the gods?

Suddenly, the mountain is flooded with light. It's as if the sun were behind a door that was flung open suddenly.

The mountain begins to spin, and Manny hangs on with all his might.

"Why is this happening?" he cries. But no answer comes.

The mountain spins and spins. The room spins and spins. It's bright and then dark again. He sees trees and bright lights. Manny closes his eyes and falls off the mountain. He fears this could be the end.

When he lands, it is warm and soft. He feels himself lifted through the air. It is as if fate has saved him. The next words he hears are:

"Whoops, that was a close call. We almost lost our groom! "

"Good catch!" says another voice.

Manny opens his eyes and find himself on top of the mountain. Bella! The woman he loves! He rubs the snow from his eyes. The whirlwind had somehow picked him up and placed him right next to her.

Bella stands in a pile of white snow, wearing a beautiful wedding dress. Manny laughs because he's soaking wet and dirty, covered in sticky snow.

He kisses her and she giggles. "You taste like candy!" she says. "I'm so glad you're back! I thought you would miss the wedding! "

"Wedding?" Manny says. "I don't remember! Are we getting married? "

"Oh no! Not us," Bella says, laughing. "Them! "

She points to the sky, and for the first time he sees everything. There is a skylight and sunshine.

There is music playing. And people. Giant people!

Manny screams and falls back into the snow. Giants! As tall as the mountain! Taller! They come by and put their faces, with huge eyeballs as big as Manny's head, right up to him.

He thinks back to the laughter he heard before and the sunlight, suddenly so bright. Gods! It's all the work of Gods.

Suddenly, he is lifted up into the air. A giant hand is coming for him. This is surely the end now. A giant eye, a giant mouth. He is about to be eaten!

And then he sees it, a giant... napkin?

He hears Bella laughing below him as the soft napkin cleans his ears, his face, and his suit. When he is completely clean, he is placed back on top of the mountain's snowy peak. He stands upright next to Bella, and she holds his hand. The giant walks away as if nothing unusual at all has happened.

"You look beautiful," Bella says. "All clean! Are you ready? "

Music starts to play. Manny hears a voice say: "Introducing the bride and groom! "

The mountain is moving through the air, soaring, rolling. Bella grabs his hand tightly and whispers, "Get ready. "

One of the giants leans down and pats his head. He notices she looks just like Bella. She's dressed in a beautiful white gown. This giant is also a bride.

"You're beautiful, little man!" the giant says. At that, she takes out a giant knife.

The mountain tips slightly, as if a slice is being cut out of it. He sees the bride feeding cake to the groom. The groom takes a big bite, and she smears frosting all over his face.

That's why the snow tasted so sweet, Manny thinks. *It's not snow at all. It's cake frosting!*

The snowy mountain is wheeled back into the corner, and Bella and Manny are finally alone together.

"I love you!" Manny says, and he takes her hand and kisses her sweetly. The kiss is every bit as sweet as the cake they are standing on. Two wedding cake toppers in love.

Vocabulary

groom
noun

definition: a man who is about to be or has just been married.
Spanish: novio

peak
noun

definition: the top part of a mountain that rises to a point, or such a mountain itself.
The mountain peaks were covered with snow.
Spanish: cumbre, cima, pico, cúspide

persist
verb

definition: to continue in a course of action or hold on to a belief in a firm, steady way.
My mother persisted in refusing to let me go.
She persists in believing in creatures from outer space.
Spanish: persistir
forms: persisted, persisting, persists

Name: _____ **Date:** _____

1. What is "the mountain" in the story?

A. a wedding cake

B. a real mountain

C. a table

D. a cupcake

2. Where does the story take place?

A. on a mountain

B. in a bakery

C. at a wedding

D. on Mount Olympus

3. The "mountain" in the story is not a normal mountain. What evidence from the story supports this conclusion?

A. The "mountain" has four peaks.

B. The "snow" tastes sweet like sugar.

C. There are strong gusts of wind.

D. Manny is wearing a tuxedo.

4. Read the following sentences:

"Manny closes his eyes and falls off the mountain. He fears this could be the end.

"When he lands, it is warm and soft. He feels himself lifted through the air. It is as if fate has saved him. The next words he hears are:

"'Whoops, that was a close call. We almost lost our groom!'"

What inference can be made about what happens in these sentences?

A. Manny falls off the cake and lands on the floor.

B. Manny falls off the mountain and lands in the snow.

C. Manny falls off the mountain and has a hallucination.

D. Manny falls off the cake and is caught by a human.

5. What is this story mostly about?

A. a dangerous, snowy mountain

B. Manny and Bella's wedding

C. the wedding of two gods

D. two wedding cake toppers in love

6. Read the following sentences:

"He remembers that she is waiting for him, but he doesn't remember anything else. Manny guesses he must have had an accident.

*"Maybe I hit my head and now I have **amnesia**!* he thinks."

What does "**amnesia**" mean as used in this sentence?

A. blood loss

B. an accident

C. memory loss

D. an injury

7. Choose the answer that best completes the sentence below.

At the beginning of the story, the setting appears to be on a mountain, _____ by the end of the story, this is not the case.

A. but

B. so

C. also

D. after

8. Who is getting married in the story?

9. Why are Manny and Bella wearing wedding clothing?

10. In the story, all is not as it originally seems. As the story progresses, the author gradually gives the reader more details and reveals what the story is really about.

Identify and explain the key points in the story where the reader is given clues about what the story is really about.

Space Junk

by Josh Adler

Many people know that trash is a big problem on planet Earth. What many people don't know is that trash has become a problem in outer space too. Years of space exploration have left tons of "space junk" in orbit around the planet.

According to *BBC News*, there are more than 22,000 pieces of junk in space around the earth. And these are just the items that we can see from the surface of the earth by telescopes or radars. There are also millions of smaller pieces of junk that we can't see.

Objects, like bits of old space rockets or satellites, move around the planet at very high speeds, so fast that even a very small piece can break important satellites or become dangerous to people, particularly astronauts. If the tiniest piece of junk crashed into a spacecraft, it could damage the vehicle. That's because the faster an object moves, the greater the impact if the object collides with something else.

To make things worse, when two objects in space collide, the two objects break into many smaller

pieces. This happened in 2009 when a working United States satellite collided with a Russian satellite that was no longer functioning. The collision caused the satellites to break into more than 2,000 pieces, increasing the items of space junk.

To help minimize additional space junk, countries around the world have agreed to limit the time their space tools stay in orbit to 25 years. Each tool must be built to fall safely into the earth's atmosphere, or the mass of gases that surround the earth, after that. In the upper parts of the atmosphere, it will burn up.

Many scientists are also proposing different ways to clean up space junk. In England a metal harpoon is being tested that can be fired into space trash, grip the trash, and then pull the space junk into the earth's atmosphere where it would burn up.

The Germans have been planning a space mission with robots that would collect pieces of space trash and bring them back to Earth so that they can be safely destroyed.

In 2007 the Chinese tried to blow up one of its older satellites with a missile. Unfortunately, the explosion only created thousands of smaller pieces, adding junk in space!

"In our opinion the problem is very challenging, and it's quite urgent as well," said Marco Castronuovo, an Italian Space Agency researcher who is working to solve the problem. One reason that it's urgent is that countries are sending more and more objects into space. Many of these objects are tools that help people use their cell phones or computers.

"The time to act is now; as we go farther in time we will need to remove more and more fragments," he says.

Vocabulary

collide

verb

definition: to strike or bump into one another with force.
The cars collided in the icy parking lot.

Spanish: colisionar, chocar
forms: collided, collides, colliding

orbit

noun

definition: the curved path in which a planet, satellite, or spacecraft moves in a circle around another body.
They steered the spacecraft to cross the orbit of the satellite.

Spanish: órbita

satellite

noun

definition: a spacecraft that is sent into orbit around a planet or other heavenly body to gather or send back information.

Spanish: satélite

Name: _____ **Date:** _____

1. What has left tons of "space junk" in orbit around the earth?

A. robots sent on space missions

B. years of space exploration

C. lack of recycling

D. missiles in outer space

2. Countries around the world have agreed to limit the time their space tools stay in orbit to 25 years. As explained in the passage, what problem does this solution address?

A. the increasing amount of space junk in orbit around the earth

B. space agencies exploring space

C. Chinese efforts to blow up a satellite

D. objects moving around the planet at very high speeds

3. Trash has become a problem in outer space too.

What evidence from the text best supports this statement?

A. The Chinese tried to blow up one of its satellites with a missile in 2007.

B. In England, a metal harpoon is being tested that can be fired into space, gripping space trash and pulling it back into the earth's atmosphere to burn up.

C. The Germans have been planning a space mission with robots to collect some space trash and bring it back to Earth.

D. According to*BBC News*, there are more than 22,000 pieces of junk in space around the earth.

4. Why have countries agreed to build space tools that must fall safely into the earth's atmosphere?

A. so that the tools can remove pollution from the atmosphere after returning from space

B. so that the tools burn up in the atmosphere and don't become space junk

C. so that the tools pollute the atmosphere instead of outer space

D. so that the tools can analyze the different gases that make up the atmosphere after returning from space

5. What was the passage mostly about?

A. different missions scientists are trying in space

B. the effects that tiny pieces of space junk could have on the earth

C. the problem of space junk and scientists' attempts to solve this problem

D. the problem of trash on planet Earth

6. Read the following sentences: "'In our opinion the problem is very challenging and it's quite urgent as well,' said Marco Castronuovo, an Italian Space Agency researcher who is working to solve the problem. One reason that it's **urgent** is that countries are sending more and more objects into space. Many of these objects are tools that help people use their cell phones or computers."

What does the word **urgent** most nearly mean?

A. easy to solve

B. unnecessary

C. needs immediate attention

D. minor

7. Choose the answer that best completes the sentence below.

Years of space exploration have left tons of "space junk," _____ many scientists are trying to find a way to clean up outer space.

A. so

B. instead

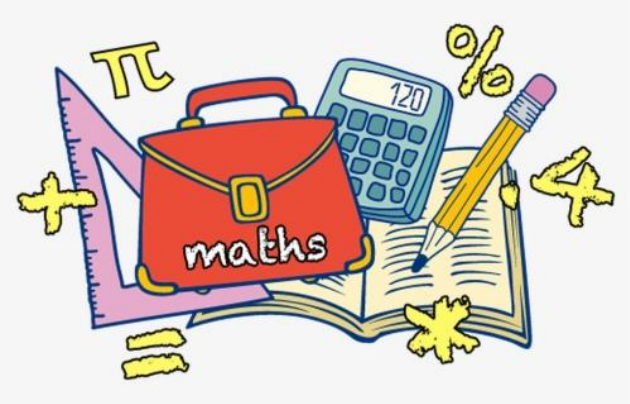
C. because

D. similarly

8. What did the 2009 collision of a United States satellite and a Russian satellite cause?

9. What have the Germans done to help clean up space junk?

10. Different countries have explored or are exploring different methods to clean up space junk. Explain why some methods may be more effective than others. Use evidence from the text to support your answer.



Middle School Math
Jan 4th – Jan 29th

Middle School Math Learning Plan		
Date	**Topic/Standard**	**Instructional Activity**
Week of Jan 4th	6.EEI.B.5: Understand that if any solutions exist, the solution set for an equation or inequality consists of values that make the equation or inequality true. 6.EEI.C.9: Identify and describe relationships between two variables that change in relationship to one another.	Students complete the Practice worksheet and Puzzle. • Solving Equations Using Addition or Subtraction • Solving Equations Using Multiplication or Division
Week of Jan 11th	6.EEI.C.9: Identify and describe relationships between two variables that change in relationship to one another. 6.EEI.B.8 Recognize that inequalities may have infinitely many solutions.	Students complete the Practice worksheet and Puzzle. • Writing Equations in Two Variables • Writing and Graphing inequalities
Week of Jan 18th	6.EEI.B.8 Recognize that inequalities may have infinitely many solutions.	Students complete the Practice worksheet and Puzzle. • Solving Inequalities Using Addition and Subtraction
Week of Jan 25th	6.EEI.B.8 Recognize that inequalities may have infinitely many solutions.	Students complete the Practice worksheet and Puzzle. • Solving Inequalities Using Multiplication and Division.

Name_____ Date _____

7.2 Practice B

Name_____ Date _____

Tell whether the given value is a solution of the equation.

1. $2.5w = 12.5;\ w = 5$

2. $\frac{y}{8} = 7;\ y = 64$

3. $39 = 3.9t;\ t = 10$

4. $\frac{1}{4} = \frac{1}{8}m;\ m = 2$

Write the word sentence as an equation. Then solve the equation.

5. A number a decreased by 13.4 is 2.6.

6. 27 less than a number h equals 3.5.

7. 46 equals 2.5 more than a number z.

8. The sum of a number b and 4.7 equals 10.9.

Solve the equation. Check your solution.

9. $x - 72 = 136$

10. $251 = 148 + j$

11. $\frac{4}{5} + a = 1$

12. $n - 10 = 13 + 5$

13. $v + 17 - 11 = 65$

14. $47 - 15 + c = 79$

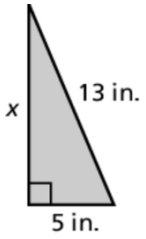
15. $7 + 57 = 3 + y$

16. $30 + 12 = e - 42$

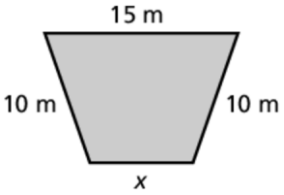
17. $21 - 16 + \ell = 14 - 4$

Write and solve an addition equation to find x.

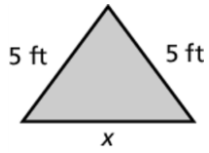
18. Perimeter = 30 in.



19. Perimeter = 43 m



20. Perimeter = 16 ft



21. You are grocery shopping. You have $12.

a. Write and solve three equations to find the cost m of the milk, the cost c of the cereal, and the cost e of the eggs.

b. How much money do you have left if you purchase one of each item?

22. A jacket is on sale for $10 off. You have a coupon worth $5.80 that brings the cost of the jacket down to $33.19. Write and solve an equation to find the original cost c of the jacket.

Name _____ Date _____

7.2 Puzzle Time

What Do Kitty Cats Like To Eat For Breakfast?

Write the letter of each answer in the box containing the exercise number.

Solve the equation. Check your solution.

1. $p - 8 = 4$

2. $k - 2 = 12$

3. $9 = h - 15$

4. $y + 4 = 7$

5. $z + 5 = 21$

6. $63 = r + 31$

7. $x - 25 = 16$

8. $26 = m + 18$

9. $\frac{2}{3} = a - \frac{2}{3}$

10. $f + \frac{1}{4} = \frac{7}{8}$

11. $2.3 = q - 3.6$

12. $j + 4.4 = 16.2$

Answers

K. 16

I. $\frac{5}{8}$

E. 24

S. 14

R. 5.9

C. 41

I. 32

P. 12

S. 8

M. 3

E. 11.8

I. $1\frac{1}{3}$

4	10	7	12		5	11	9	2	1	6	3	8

Name_____ Date _____

7.3 Practice A

Solve the equation. Check your solution.

1. $\frac{x}{2} = 9$

2. $4 = \frac{t}{4}$

3. $\frac{3w}{20} = 12$

4. $5s \div 7 = 30$

5. $5a = 15$

6. $8 \bullet d = 40$

7. $60 = 20m$

8. $7g = 14$

9. $9y = 72$

10. $3 \bullet n = 63$

11. $4 = \frac{v}{11}$

12. $\frac{c}{7} = 5$

13. $\frac{5b}{2} = 27.5$

14. $2h \div 15 = 20$

15. $24k = 60$

16. $210 = 7r$

Describe and correct the error in solving the equation.

17.

$$\frac{x}{9} = 3$$
$$9 \bullet \frac{x}{9} = 3$$
$$x = 3$$

18.

$$4 \bullet z = 32$$
$$\frac{4 \bullet z}{4} = 4 \bullet 32$$
$$z = 128$$

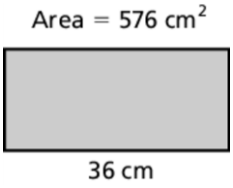
19. A teacher tells 36 students to form 4 equal groups. Write and solve a multiplication equation to find how many students s there should be in each group.

20. You have been saving \$12 each week for many weeks. One day, you decide to count your savings and find that you have \$384. Write and solve a multiplication equation to find how many weeks w you have been saving.

21. A 14-inch pepperoni pizza is sliced into 8 equal pieces. One slice contains 352 calories. Write and solve a division equation to find how many calories c there are in the whole pizza.

22. In a cheerleading competition, each team receives scores in eight categories. One team has a mean score of 7.25 in the eight categories. Write and solve an equation to find the team's total score s.

23. Write and solve an equation to find the width w of the rectangle. Explain how you know what units to use with the answer.



Name _____ Date _____

7.3 Puzzle Time

What Did The Dirt Say When It Began To Rain?

A	**B**	**C**	**D**	**E**	**F**
G	**H**	**I**	**J**	**K**	**L**
M	**N**	**O**	**P**		

Complete each exercise. Find the answer in the answer column. Write the word under the answer in the box containing the exercise letter.

7 **NAME**	**12** **UP**
56 **WILL**	**6.5** **CHANGE**
54 **IF**	**125** **RAIN**
9 **MUD**	**110** **BE**
10 **MY**	**42** **THIS**
13 **WILL**	**8** **KEEPS**
2 **CALLED**	**60** **I**
40 **HEAVY**	**70** **AND**

Solve the equation. Check your solution.

A. $\frac{a}{9} = 6$

B. $7 = \frac{z}{6}$

C. $y \div 4 = 10$

D. $25 = \frac{k}{5}$

E. $2s = 16$

F. $8 \bullet t = 96$

G. $50 = 5x$

H. $56 = 8k$

I. $4b = 52$

J. $39 = 6 \bullet c$

K. $14 = n \div 5$

L. $10 = v \div 6$

M. $x \div 16 = 3.5$

N. $\frac{w}{25} = 4.4$

O. $11.5 \bullet d = 23$

P. $4.5v = 40.5$

Name_____ Date _____

7.4 Practice A

Write a formula for the given measure. Tell what each variable represents. Identify which variable depends on which in the formula.

1. The perimeter of a rectangle with a length of 4 meters

2. The area of a triangle with base length of 10 feet

Tell whether the ordered pair is a solution of the equation.

3. $y = x; (2, 3)$

4. $y = 8x; (0, 0)$

5. $y = 3x - 2; (1, 1)$

6. $y = 4x + 1; (1, 5)$

Identify the independent and dependent variables.

7. The equation $P = 2\ell + 20$ gives the perimeter P (in inches) of a rectangular box with a length of l feet.

8. The equation $k = 88p$ gives the total number of keys k for p pianos.

9. You are hosting a party. You are providing 3 food items. Each guest brings 2 food items.

a. Write an equation in two variables that represents the total number of food items.

b. Identify the independent and dependent variables.

10. Your choir has 300 tickets to sell. You are responsible for distributing 10 tickets to each choir member to sell.

a. Write an equation in two variables that represents the remaining number of tickets to distribute.

b. Identify the independent and dependent variables.

Fill in the blank so that the ordered pair is a solution of the equation.

11. $y = 7x - 5; (2, \square)$

12. $y = 15 - 3x; (\square, 6)$

13. Write an equation in two variables that has (1, 3) as a solution.

14. Write another equation in two variables that also has (1, 3) as a solution.

Name _____ Date _____

7.4 Puzzle Time

Which Are The Strongest Shellfish On The Beach?

Write the letter of each answer in the box containing the exercise number.

Tell whether the ordered pair is a solution of the equation.

1. $y = 6x; (0, 3)$

R. Yes **S.** No

2. $y = 4x; (1, 4)$

U. Yes **V.** No

3. $y = 3x - 7; (4, 5)$

E. Yes **F.** No

4. $y = x + 8; (2, 12)$

R. Yes **S.** No

5. $y = 9x - 9; (1, 0)$

L. Yes **M.** No

Identify the independent and dependent variables.

6. The equation $A = 32\ell$ gives the area A in square feet of a rectangular concession stand with a length of ℓ feet.

S. Independent: ℓ; Dependent: A **T.** Independent: A; Dependent: ℓ

7. The equation $C = 15p + 100$ gives the total cost C in dollars of the annual banquet with p people in attendance.

L. Independent: C; Dependent: p **M.** Ind

7	2	6	4	3	5	1

Name_____ Date _____

7.5 Practice A

Write the word sentence as an inequality.

1. 2 is more than a number v.

2. A number h is at most 15.

3. A number p is less than $\frac{1}{2}$.

4. 12 is fewer than a number n.

5. $\frac{3}{5}$ is no less than a number a.

6. A number b is no more than 17.

7. 6 plus a number x is at least 12.

8. A number k minus 7 is greater than 10.

Tell whether the given value is a solution of the inequality.

9. $y \leq 11;\ y = 8$

10. $q + 1 \geq 7;\ q = 3$

11. $4 < u - 9;\ u = 13$

12. $5m < 72;\ m = 15$

13. $\frac{7}{8} \leq 2c;\ c = 3$

14. $10 \geq g + 3;\ g = 7$

Graph the inequality on a number line.

15. $k > 1$

16. $w \leq 5$

17. $r < 0$

18. $t \geq \frac{1}{3}$

19. $s > 6$

20. $z \leq -\frac{3}{2}$

21. $2.5 < n$

22. $-\frac{2}{3} < x$

23. $3 \geq a$

24. A lifeboat can carry up to 24 people. Write an inequality to represent this situation.

25. A USB flash drive costs \$16. You have \$50.

a. Write an inequality to represent the number of USB flash drives you can buy.

b. Can you buy 4 USB flash drives? Explain.

26. A produce box can hold no more than 25 pounds of potatoes.

a. Write and graph an inequality to represent this situation.

b. Is 9.8 a solution of the inequality?

c. Name a number that is *not* a solution of the inequality and explain your answer.

Name _____ Date _____

7.5 Puzzle Time

What Kind Of Cheese Comes With A House?

Write the letter of each answer in the box containing the exercise number.

Write the word sentence as an inequality.

1. A number x is more than 15.

2. A number b is less than 23.

3. A number y is at most 8.

4. Three plus a number a is greater than or equal to 19.

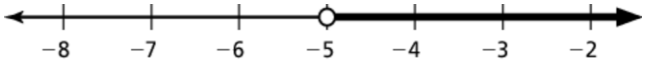
Tell whether the given value is a solution of the inequality.

5. $\frac{a}{4} > 5;\ a = 28$

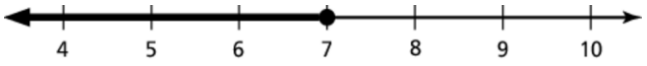
6. $z + 4.5 \leq 13;\ z = 9.5$

Write an inequality that represents the graph.

7.



8.



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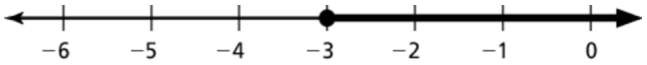


Match each inequality with its graph.

10. $x < \frac{4}{5}$

11. $a \geq -3$

12. $p \leq 2.6$

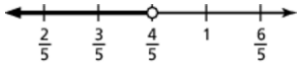
13. $y > -\frac{2}{3}$

Answers

E. $x > -5$ **C.** $y \leq 8$

T. $x \geq -3$

H.

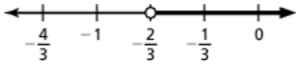


E. $x > 15$ **A.** no

G.

E. $3 + a \geq 19$

S.



O. $b < 23$

C. $x \leq 7$

T.

E. yes

8	2	12	9	6	11	5		3	10	1	7	13	4

Name _____ Date _____

7.6 Practice A

Solve the inequality. Graph the solution.

1. $n - 9 \geq 2$

2. $v + 10 \leq 14$

3. $p + \frac{1}{4} < \frac{5}{4}$

4. $x - 3 > 8$

5. $20 < k + 15$

6. $\frac{4}{5} \leq m - \frac{1}{5}$

7. $12 \geq h - 8$

8. $4.4 > 2.4 + b$

9. $w - 36 \leq 64$

10. $a + 16 \geq 25$

11. $r + \frac{2}{3} > \frac{8}{3}$

12. $y - 19 < 51$

Write the word sentence as an inequality. Then solve the inequality.

13. 6 more than a number is at most 10.

14. Four less than a number is more than 3.

15. 0.6 is no less than 2.4 subtracted from a number.

16. The sum of a number and 14 is at least 18.

Describe and correct the error in solving the inequality.

17.

$$\begin{array}{rr} 3 > g - 4 & \\ \underline{+4} & \underline{+4} \\ 7 < g & \end{array}$$

18.

$$\begin{array}{rr} x + 5 \geq 11 & \\ \underline{-5} & \underline{+5} \\ x \geq 16 & \end{array}$$

19. You can spend at most \$10 at the mall. You want to buy a book that costs \$6.75 and a cold drink. Write and solve an inequality to represent the amount of money you can spend on your cold drink.

20. An order from an online bookstore takes at least four weeks to arrive. You ordered some books online nine days ago. Write and solve an inequality to represent the possible number of days it will take for your books to arrive.

21. The school auditorium can hold at most 480 people. There were 185 advance tickets sold for the school play. Write and solve an inequality to represent the number of people who can attend the play if all the people who bought advance tickets attend the play.

Name _____ Date _____

7.6 Puzzle Time

A Man Went To the Rocket Station And Asked For A Ticket To The Moon…

A	B	C	D	E	F
G	H	I	J	K	L

Complete each exercise. Find the answer in the answer column. Write the word under the answer in the box containing the exercise letter.

Solve the inequality. Graph the solution.

A. $x - 5 < 6$

B. $7 + x > 9$

C. $5 \geq x - 7$

D. $12 \leq x + 3$

E. $20 > 14 + x$

F. $39 + x \leq 56$

G. $x - 23 < 87$

H. $x - 19 \geq 19$

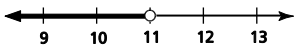
I. $8.4 < x + 4.2$

J. $14.9 \geq x - 7.5$

K. $\frac{7}{8} \leq \frac{1}{4} + x$

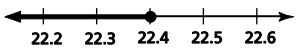
L. $\frac{1}{2} + x > \frac{2}{3}$

$x < 11$



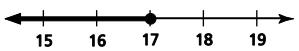
I'M

$x \leq 22.4$



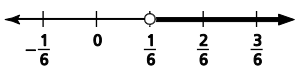
FULL

$x \leq 17$



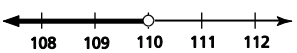
ATTENDANT

$x > \frac{1}{6}$



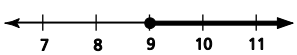
NOW

$x < 110$



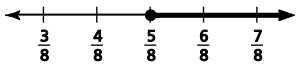
THE

$x \geq 9$



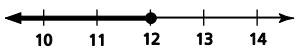
SAID

$x \geq \frac{5}{8}$



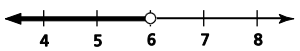
RIGHT

$x \leq 12$



SIR

$x < 6$

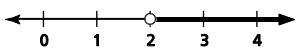


THE

$x \geq 38$

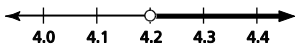
MOON

$x > 2$



SORRY

$x > 4.2$



IS

Name _____ Date _____

7.7 Practice A

Solve the inequality. Graph the solution.

1. $\frac{b}{3} > 6$

2. $2w < 16$

3. $7p \leq 70$

4. $n \div 3 \geq 12$

5. $200 < 10x$

6. $55 > 11a$

7. $21 \geq \frac{g}{4}$

8. $17 \leq \frac{k}{9}$

9. $h \div 4 \leq 0$

10. $5v \geq 125$

11. $8t > 24$

12. $\frac{2}{5}m < 14$

13. $13y \geq 104$

14. $\frac{3r}{4} \leq 45$

15. $\frac{c}{6} < 13$

16. $4s > 28$

Write the word sentence as an inequality. Then solve the inequality.

17. A number q divided by 14 is no less than 4.

18. The product of 21 and a number u is at most 126.

19. The quotient of a number z and 7 is at least 12.

20. A number a divided by 22 is greater than 5.

21. A number g multiplied by 13 is no more than 117.

Describe and correct the error in solving the inequality.

22.

$$5x < 10$$
$$\frac{5x}{5} < \frac{10}{10}$$
$$x < 1$$

23.

$$2n \geq 28$$
$$2n - 2 \geq 28 - 2$$
$$n \geq 26$$

24. A wheelbarrow can carry up to 300 pounds of weight. A bag of soil weighs 20 pounds. Write and solve an inequality to represent the number of bags of soil the wheelbarrow can carry.

25. A table is 3 feet wide. The length of the table can be adjusted as needed. You need at least 24 square feet of space on the table. Write and solve an inequality to represent the minimum length the table should have.

26. A step on a stairway is at least 8 inches high. Write and solve an inequality to represent the minimum number of steps between floors that are 10 feet apart.

Name _____ Date _____

7.7 Puzzle Time

How Many Paws Does A Bear Have?

Write the letter of each answer in the box containing the exercise number.

Solve the inequality. Graph the solution.

1. $\frac{x}{9} < 5$

2. $x \div 7 > 3$

3. $\frac{x}{4} \geq 16$

4. $11x < 99$

5. $6 \bullet x \geq 30$

6. $8x \leq 64$

7. $\frac{1}{5}x > 14$

8. $\frac{3}{4}x < 24$

9. $\frac{7}{9}x \geq 63$

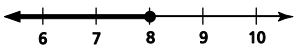
10. $\frac{1}{2}x \leq 55$

11. $\frac{5}{6}x > 25$

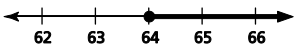
12. $8x < 96$

Answers

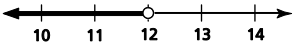
M. $x \leq 8$



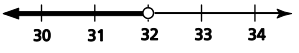
N. $x \geq 64$



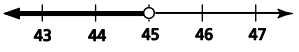
A. $x < 12$



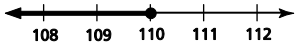
W. $x < 32$



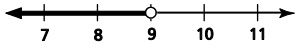
A. $x < 45$



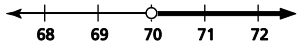
O. $x \leq 110$



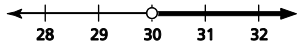
W. $x < 9$



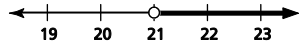
D. $x > 70$



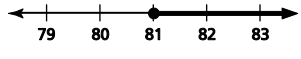
N. $x > 30$



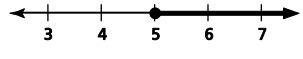
P. $x > 21$



A. $x \geq 81$



E. $x \geq 5$



10	3	5		2	12	8		9	11	7		6	1	4

St. Louis Public Schools
Continuous Learning Kits
Middle School Science

Welcome to 6th Grade Science Materials for January, STUDENTS!

Students are encouraged to maintain contact with their home school and classroom teacher(s). If you have not already done so, please visit your school website to access individual teacher web pages for specific learning/assignment information. If you cannot reach your teacher and have elected to use these resources, please be mindful that some learning activities may require students to reply online, while others may require students to respond using paper and pencil. In the event online access is not available and the teacher cannot be reached, responses should be recorded on paper and completed work should be dropped off at your child's school. Please contact your child's school for the dates and times to drop off your child's work.

The pdf file of all the materials in the January kit is the same as Unit 1, Lessons 2 and 3 from student workbook for Module K.

	Standard / Lesson Objective *What will you know and be able to do at the conclusion of this lesson?*	**Resources & Assessment** *What print and electronic resources are available to support your learning? What needs to be turned in for assessment?*
Week 1	**MS-PS2-4** I can compare and contrast mass and weight and relate the weight of objects to understand the gravitational force between 2 objects	Module K, Unit 1, Lesson 2, Engage + Exploration 1
Week 2	**MS-PS2-4** I can use evidence of surface variations to explain how it affects the friction forces in a system model. I can make an argument about what factors affect the air resistance in a system model	Module K, Unit 1, Lesson 2, Exploration 2 (pg. 32-33, 35) Module K, Unit 1, Lesson 2, Exploration 3 (pg. 36, 38)
Week 3	**MS-PS2-4** I can compare and contrast mass and weight and relate the weight of objects to understand the gravitational force between 2 objects I can use evidence of surface variations to explain how it affects the friction forces in a system model. I can make an argument about what factors affect the air resistance in a system model	Module K, Unit 1, Lesson 2, Take It Further + Lesson Self-Check Module K, Unit 1, Lesson 3, Engage
Week 4	**MS-PS2-1, MS-PS2-2** I can analyze motion of various systems and describe it in terms of time, speed, and acceleration. I can explain the changes in motion by controlling exerted forces	Module K, Unit 1 Lesson 3, Explorations 1 + 2

LESSON 2

Gravity and Friction

Part of the thrill of ski jumping and other extreme sports comes from the weightless feeling as you fall through the air.

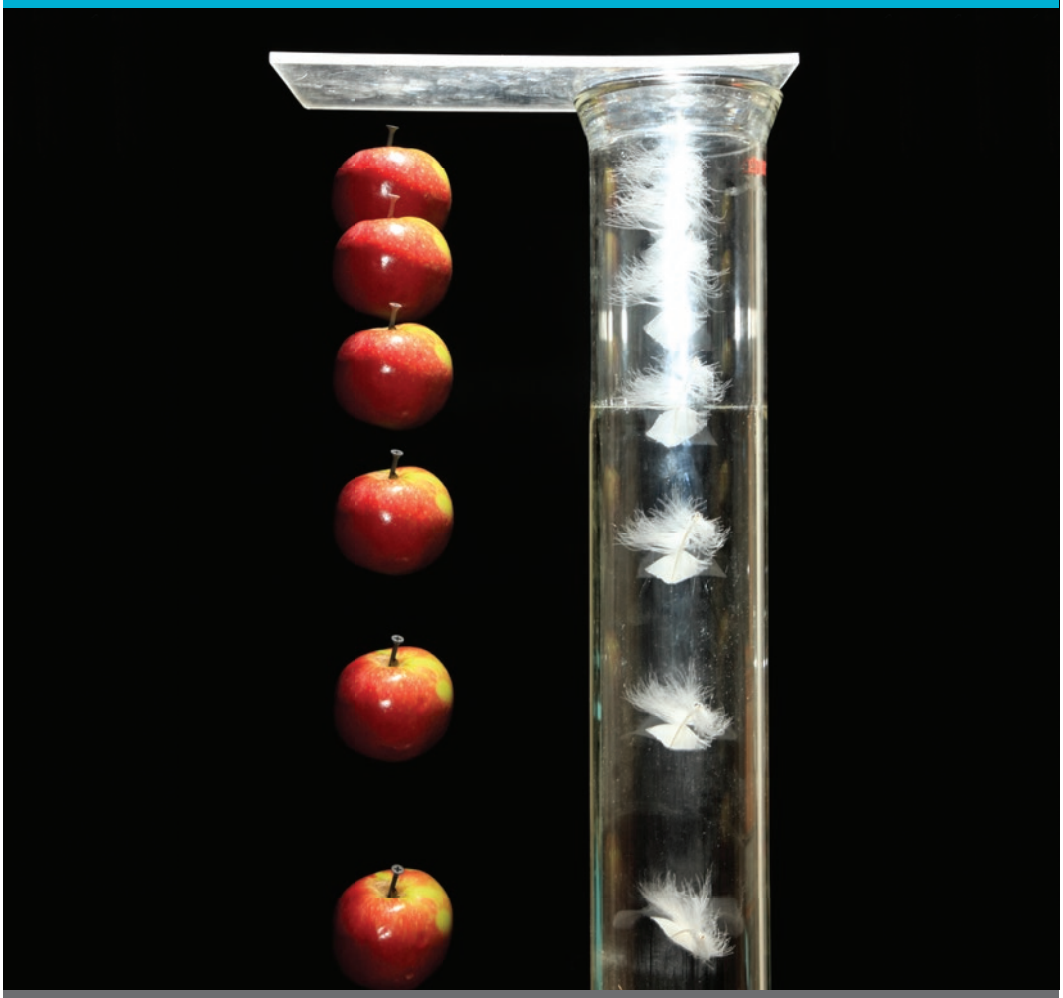
By the end of this lesson . . .

you will be able to use evidence to support an argument that interactions involving gravity or friction depend on the properties of objects.

Go online to view the digital version of the Hands-On Lab for this lesson and to download additional lab resources.

CAN YOU EXPLAIN IT?

Why did the two objects fall together?



See an apple and a feather fall from the same height at the same time. Notice that both objects fall equal distances during each time increment.

1. Do the apple and feather in the image fall as you would expect them to fall? How is the motion different or the same as your expectations?

EVIDENCE NOTEBOOK As you explore the lesson, gather evidence to help explain how forces affect the motion of falling objects.

Exploring Gravity

When you throw a ball into the air, knock a spoon off a table, or drop a pencil, you know what's going to happen. In fact, you have probably been aware for a long time that, unless acted on by another force, objects always fall down. This happens because of gravity.

Do you think this dog has ever studied gravity? He sure seems to know that the ball is going to fall—and where it is going to land!

2. Act Work with a group to create a one-act play about gravity. Perform the play for your class. Summarize your play in the space below.

Gravity

For many years, scientists observed the motion of falling objects and the motions of planets. Although they couldn't see gravity, they could see its effects. These observations led scientists to develop models of gravity. **Gravity** is a force of attraction between objects due to their masses. Because gravity exists between objects even when they are not touching, it is called a noncontact force. Gravity is always an attractive force because it always pulls objects toward each other.

A Robot on the Moon

The mass of this robot on the moon is 50 kg, and its weight is about 81 N.

A Robot on Earth

The mass of the same robot on Earth is 50 kg, and its weight is about 490 N.

3. Look at the images of the robot on the moon and on Earth. What do you notice about the robot's mass and weight? Explain your observations.

Weight

Mass is the amount of matter in an object. *Weight* is a measure of the pull of gravity on that mass. Weight is a force. Think of it this way: An object is made up of a certain amount of matter, so its mass is constant. The object has a certain weight due to the force of gravity. If the force of gravity decreases, the weight of the object decreases. If the force of gravity increases, the weight of the object increases.

Mass and weight are measured using different units. A common unit for mass in the metric system is the gram (g) or the kilogram (kg). Scientists measure forces with newtons, a unit named after Isaac Newton. An apple with a mass of about 102 g weighs one newton (1 N) on Earth. The same apple would weigh 0.16 N on the moon.

4. Do the Math A scientific instrument has a mass of 54 kg, and its weight on Earth is about 529 N. Jupiter's gravity is about 2.3 times stronger than Earth's gravity. Use this information to calculate the mass and weight of the instrument if it were on the surface of Jupiter.

Gravity near Earth

It is important to know that the gravitational force Earth exerts on you is equal to the gravitational force you exert on Earth. But because your mass is so much smaller, the effect of that gravitational force is much greater on you.

The pull of objects toward Earth is not the only gravitational force on Earth. Every object exerts a gravitational force on every other object. Why do you not normally notice the gravitational pull of other objects? Most objects on Earth have too little mass to exert enough force for us to notice effects. However, the moon and Earth are both large objects with a lot of mass, so the gravitational force between them is large. The tides occur because of gravity and the moon. The force of gravity between Earth and the moon is what holds the moon in orbit around Earth. An *orbit* is a curved path that objects take around a star, planet, or moon. Notice that the surface of Earth is not a perfect sphere. What happens to the force of gravity on an object in a canyon or on top of a mountain?

The surface gravity of the moon is one-sixth of Earth's.

5. Objects near Earth's surface are attracted toward Earth's center / surface. Because of this, if you dig a hole in Earth's surface and drop an object into the hole, the object will continue to fall until it reaches the original surface level / bottom of the hole.

6. **Collaborate** Working with a partner, imagine that you are able to dig a tunnel through the center of Earth to the opposite surface. Describe how gravity would affect you if you jumped into the tunnel. What would happen as you pass the center of Earth?

Hands-On Lab

Investigate Falling Objects: Mass

Predict how changing the mass of an object affects how it falls. Test your predictions and record your observations.

MATERIALS

- bottle, plastic, empty, with cap
- funnel (optional)
- marbles or sand
- meterstick
- pillow
- stopwatch or timer
- video camera (optional)

Procedure and Analysis

STEP 1 Fill a plastic bottle about one-quarter of its volume with sand or marbles. Make sure to close the lid to contain the sand or marbles.

STEP 2 Drop the bottle from a height of one meter onto the pillow. Record the time it takes for the bottle to reach the ground. Repeat this action three more times.

STEP 3 Compare the times for each of the attempts in Step 2. Did the bottle take the same amount of time to fall from the same height every attempt? Explain.

STEP 4 Predict what will happen if you fill the bottle one-half its volume with sand or marbles and drop it from the same height as in Step 2.

STEP 5 Fill the plastic bottle half-way. Drop the bottle onto the pillow from the same height as in Step 2. Record the time it takes for the bottle to reach the ground. Repeat this action three more times.

STEP 6 Did your observations support your predictions? If not, what was different?

STEP 7 Based on your observations, what can you conclude about the relationship between an object's mass and the rate at which it falls?

EVIDENCE NOTEBOOK

7. How do your observations in this activity help you interpret the image at the beginning of this lesson of the apple and feather falling? Record your evidence.

Determine the Force of Gravity

When we think about gravity, we usually think about the force that makes objects fall and keeps us from floating off into space. While those effects of gravity are important in everyday life, Isaac Newton described gravity as a force that every mass exerts on every other mass. This model also allowed him to mathematically describe the force two objects exert on one another. The strength of the force between two objects depends on the masses of the objects and on the distance between them.

Effect of Mass on Gravity

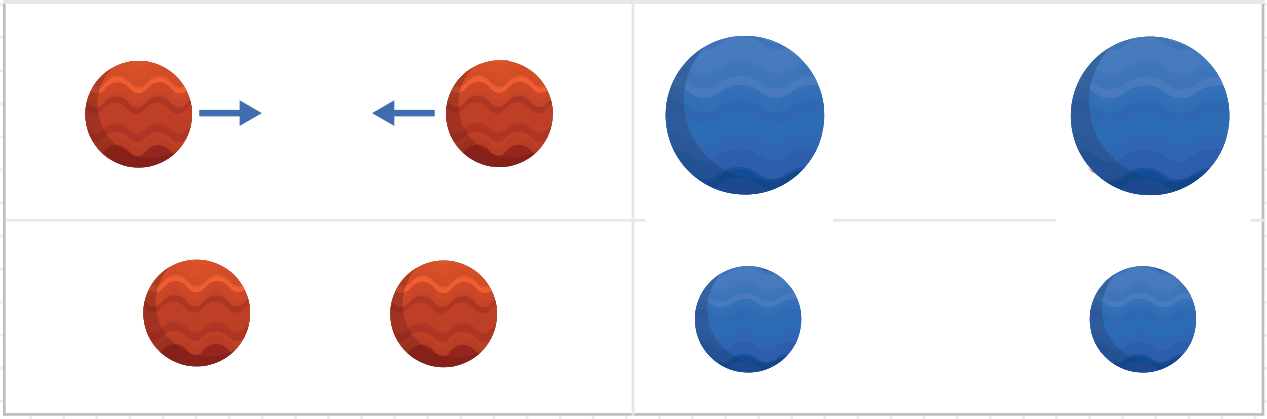
Imagine a universe that contains only two objects. Newton showed that the gravitational force between them could be calculated using their masses and the distance between them. If both objects have the same mass, it makes sense that the force each exerts on the other is the same strength. If we increase the mass of both objects while keeping the distance the same, the gravitational force increases. The force of gravity on both objects is equal in strength. If we change the mass of only one of the objects, will both experience the same gravitational force? Yes, the force depends on both masses, and both objects always exert the same amount of force on each other. If we increase the mass of one or both objects, the force between them is stronger. If we decrease the mass of one or both objects, the force is weaker.

Effect of Distance on Gravity

For large objects such as stars and planets, the distance between two objects is measured from the center of one to the center of the other. Imagine that we could easily change the distance between two massive objects while keeping their masses the same. If two objects are moved farther apart, the force they exert on each other decreases. If two objects are moved closer together, the force increases. That is why rockets must travel many kilometers above Earth's surface to break free of Earth's gravity. Even though objects such as Earth and the sun are very far apart, because they are so massive, the gravitational attraction between the two affects their motions. For less massive objects, the gravitational attraction may be very weak, even when the objects are very near. You will feel the gravitational attraction toward Earth more than the gravitational attraction to a person standing next to you.

Diagram of Gravitational Force

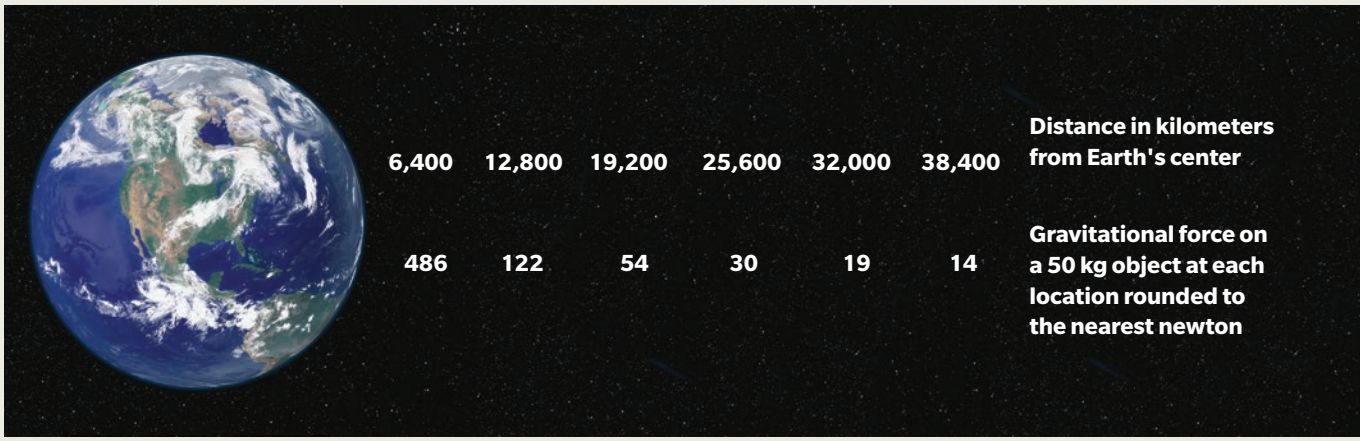
8. Draw the force arrows to model each scenario correctly. The first scenario has been done for you.



Language SmArts

Analyze Gravitational Force

The graphic shows the force of Earth's gravity on a 50 kg object at different distances from Earth. Analyze the information in the image to answer the following questions.



9. In the image, the mass of the object remains constant/changes constantly. As the distance from Earth's center increases, the gravitational force on the object increases/decreases.

10. You and your friend are having a discussion about weight. He claims that he weighs less on the 100th floor of a building than he does on the ground floor. Is he correct? Support your answer with evidence.

11. If a 50 kg object is at a location 25,600 km from Earth's center, what is the gravitational force exerted by the object on Earth? In what direction does that force act? Support your answer with evidence.

Exploring Friction

These students are demonstrating the floating rice flask trick. One student is able to lift the flask filled with rice by inserting a chopstick into it. When the other student tries, the chopstick slides out and leaves the flask on the table. See whether you can figure out the forces involved in this mysterious phenomenon.

Explore ONLINE!

Friction

The key to this trick is friction. **Friction** is a contact force that resists motion between two objects. The flask that cannot be picked up is loosely filled with rice. The flask that is picked up is tightly packed with rice. The tightly packed rice creates more friction when the chopstick is inserted. This friction between the rice and chopstick allows the flask to be lifted. Try it yourself!

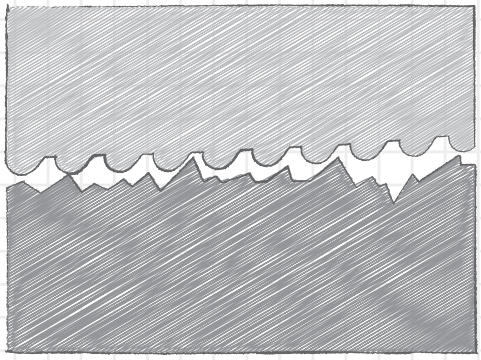
If you have ever tried to push a heavy box across a rough floor, you have experienced friction. Friction is the resistance you feel when you try to push the box. If the box were empty, there would be less friction, and you could more easily push the box. If the floor were smooth, there would also be less friction, and you could more easily push the box.

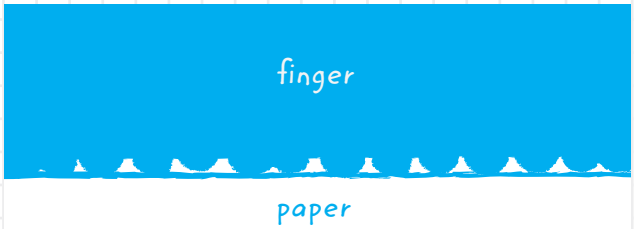
12. Two similar-size friends encounter a long hallway with a smooth tiled floor. One girl is barefoot and the other is wearing socks on her feet. Apply what you already know about friction to predict which girl would slide farther down the hallway.

Is It Smooth or Rough?

The surface of any object—including paper—is uneven. Look at the magnification of each object and think about how each surface would feel against your finger.

13. Draw Examine the model showing the interaction between the surface of a finger and the surface of the wood. Friction is created when the hills and valleys of one surface stick to the ridges and valleys of another surface. Choose one of the other surfaces above, and draw a model of the interaction between it and a finger.





The Effect of Surface Variation on Friction

The friction between two objects depends on several factors. One of the factors is how smooth or rough the surfaces are. A smooth surface creates less friction than a rough surface. Why do rough surfaces have more friction than smooth surfaces? The microscopic hills and valleys of the rough surface are more likely to catch on opposing hills and valleys. This is what increases friction. The smooth surface has lower hills and shallower valleys, so when an object slides across it, there is less for the object to catch on. With less opposition, the object slides easily across the surface.

Hands-On Lab

Investigate Friction

Plan an investigation to support the claim that the types of surfaces affect the amount of friction between two objects.

MATERIALS

- book, lightweight
- paper clips, large
- sandpaper
- string (1 m)
- washers, metal
- waxed paper

Procedure and Analysis

STEP 1 What information do you need to support the claim that the types of surfaces in contact affect the amount of friction between two objects?

STEP 2 Describe how you will investigate this claim. Include your experimental setup, independent and dependent variables, and what data you will collect. Have your teacher approve your plan.

STEP 3 Carry out your investigation. Record your data on a separate sheet of paper.

STEP 4 Explain how your data support the claim.

Friction Affects Motion

Friction opposes motion. Your investigation should show that friction changes between different surfaces. Friction between two surfaces also changes if those surfaces are pressed together more firmly. You may also notice that friction between two surfaces that are not moving is greater than friction between the same two surfaces that are moving. For this reason, the amount of force needed to start an object sliding will keep it sliding.

Depending on the situation you may want to increase or decrease the friction between two surfaces to control the movement between the surfaces. For example, you need friction to keep you stable when you walk, so more friction is desired. The hinges of a door, however, should move freely, so less friction is preferred.

Reducing Friction

Parts that squeak or that don't move freely are showing signs of too much friction. For example, if your bike is difficult to pedal, too much friction between the chain and the gears might be the cause. One way you can reduce the friction is by adding a lubricant, such as oil or grease, to one or both surfaces. The lubricant makes the surfaces smoother so that the parts slide against each other more easily. Now your bike should be easier to pedal!

You also can reduce friction by replacing sliding friction with rolling friction. If you place that heavy box you want to move on a cart with wheels, the box is easier to move. Inline skates move quickly and smoothly across a surface because ball bearings—smooth metal balls between the wheel and the fixed axle of the skate—reduce friction.

Oil is applied to a bike chain to reduce friction between the chain and gears.

Increasing Friction

If there is too little friction, something may move too easily. Picture a car spinning its wheels because there is too little friction between the tire and the road. Rock climbers use special shoes to increase the friction between the shoe and the rock. This increased friction allows climbers to stand on fairly steep rocky surfaces.

Another way to increase friction is to increase the weight of an object. A heavier object exerts a greater force and therefore has more friction. Some people use this fact to prevent their cars from slipping on ice by adding heavy items to the trunk of the car. The increased weight results in greater friction, so the car will not slide as easily.

Climbers wear special shoes to increase friction between the shoe and the rock.

14. For each scenario described below, choose whether friction is increased or decreased.

A. Ugh! This pan is really dirty. I'm going to have to press down really hard with the scrubber. increased friction/ decreased friction

B. Oh no! My bedroom door is squeaking. I'm going to use some spray lubricant on the hinges. increased friction/ decreased friction

C. This cabinet is really heavy and I can't move it. I'll put it on a cart. increased friction/ decreased friction

D. These shoes are really slippery on this floor. I'll put on shoes with rubber soles. increased friction/ decreased friction

Evaluate Friction

15. Collaborate With a partner, discuss how friction affects moving parts on a bicycle. What parts are designed to increase friction? What parts reduce friction? Include suggestions for reducing or increasing friction to properly maintain a bicycle.

Analyzing Forces Acting on Falling Objects

You know that objects fall because gravity pulls objects toward Earth. But do all objects fall to Earth exactly the same way? What are the factors that determine how forces act on falling objects? To investigate this, drop two sheets of paper—one crumpled in a tight ball and the other kept flat. The flat paper falls more slowly than the crumpled paper because of air resistance. Air resistance is the force that opposes the motion of objects through air. So, regardless of an object's mass, the more air resistance there is, the more slowly the object will fall.

16. This skydiver jumps out of an airplane high in the sky. What do you think will happen after the skydiver jumps out of the plane? What will happen after the skydiver opens the parachute?

Hands-On Lab

Investigate Falling Objects: Air Resistance

Design a parachute that will slow the fall of an object.

MATERIALS

- clothespin, wooden, or small action figure toy
- parachute materials
- stopwatch
- string
- tape

Procedure

STEP 1 Drop a clothespin or toy figure, and observe how it falls. Examine the materials available and design a parachute to slow the fall of your clothespin or action figure toy. Describe or sketch your design.

STEP 2 Build your parachute.

STEP 3 Test your parachute by dropping the clothespin or toy figure with the parachute and measuring how long it takes to hit the ground. Perform several trials from the same height to make sure your measurements are accurate. Record your results.

Analysis

STEP 4 Compare your design and fall time with those of other groups. Which design fell the slowest? Which factors affected the parachute's ability to slow the fall of the clothespin or action figure toy?

Air Resistance and Falling Objects

Air resistance is friction between a moving object and the air around the object. One way to think about air resistance is to imagine yourself walking through a crowded room. You bump into people, and every collision slows you down. These people and collisions are similar to how air molecules interact with an object to create air resistance. To reduce the frequency of collisions, you might try to make yourself smaller or walk more slowly. Now imagine walking in an empty room. You can walk with your arms outspread without colliding with anything. The amount of air resistance acting on an object depends on the size, shape, and speed of the object and the density of air. The *density* of air is the number of air molecules in a given volume.

17. To slow down the fall of an object, you want to increase / decrease the air resistance. To speed up the fall of an object, you want to increase / decrease the air resistance. Removing air to create a vacuum, like in space, increases / decreases the amount of air resistance acting on a moving object.

EVIDENCE NOTEBOOK

18. Compare the falling objects that you observed and the objects shown in the photo at the beginning of this lesson. How might your observations be used to explain how forces affect falling objects? Record your evidence.

Engineer It

Improve a Parachute

You know objects fall because the force of gravity attracts all matter on Earth toward the center of Earth. Other forces, such as air resistance, can be used to slow the fall of an object.

These skydivers are jumping out of a plane one after another. Notice how the parachutes affect how the skydivers fall.

19. An engineer is developing a new parachute. She conducts a test of a prototype. During the product testing, the object attached to the parachute falls too quickly. How might she redesign the parachute so that the object falls more slowly? Select the correct statements.

A. Make the parachute less massive, because heavier objects fall faster than lighter objects.

B. Make the parachute wider to increase air resistance.

C. No redesign will help. The force on the object due to gravity does not change, so the object will always fall at the same rate.

D. Increase the surface area of the parachute. Increasing the surface area will increase the air resistance and slow the object's fall.

Continue Your Exploration

Name: **Date:**

Check out the path below or go online to choose one of the other paths shown.

Gravity and Space-Time

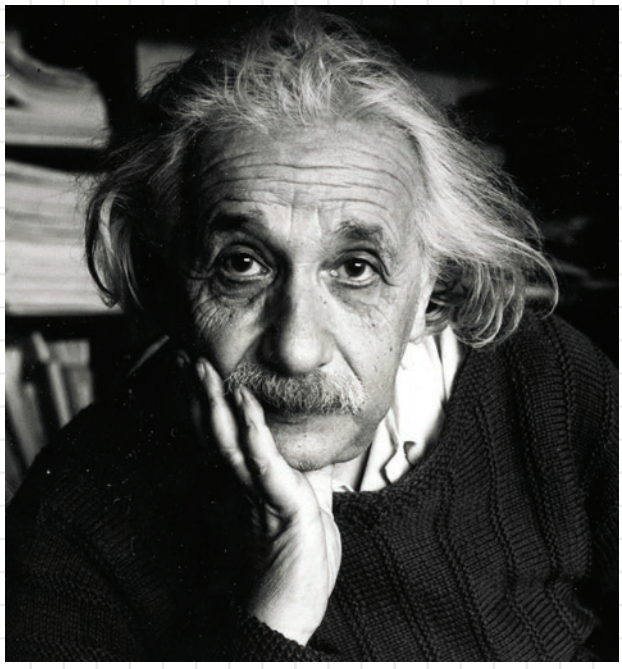
- **Snowboarding and Forces**
- **Propose Your Own Path**

Go online to choose one of these other paths.

After Isaac Newton published his work on gravity in 1687, there were still a lot of unanswered questions: What causes gravity? Why does gravity always pull objects together when other forces can also push objects apart? Gravity is one of the biggest mysteries in science. In 1915, Albert Einstein published a theory that described gravity in a new way. Einstein explained that space and time are woven together like fabric and that massive objects cause this space-time to dimple or dent.

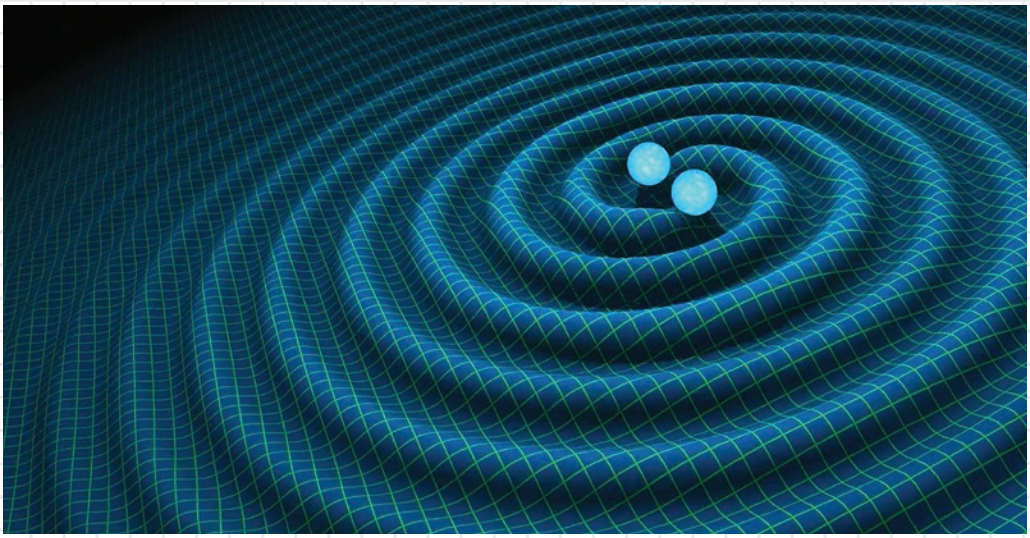
Einstein's theory helped to explain Newton's observations. It also explained some things better than Newton's laws, such as the amount that light bends when it travels past massive objects like the sun. Scientists today are still finding evidence for Einstein's ideas about gravity, such as the recent discovery of gravitational waves. Newton's ideas are still useful for explaining most cases of motion. Like Newton before him, Einstein opened the way to new discoveries in science.

Sir Isaac Newton worked as a servant to pay for college.



Albert Einstein has a crater on the moon named after him.

Continue Your Exploration



An artist's impression of gravitational waves generated by a binary neutron star system.

1. Picture setting a bowling ball on a trampoline. Describe or sketch what might happen.

2. Next picture holding a second bowling ball a short distance above the first and dropping it onto the top of the first bowling ball. Describe or sketch what you might observe.

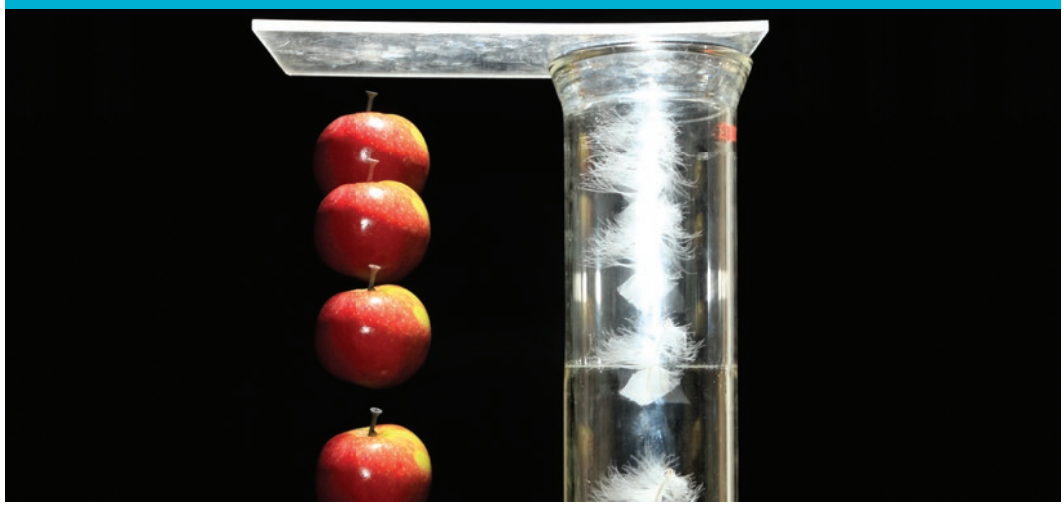
3. In the scenario above, the trampoline models space-time. The bowling balls model the collision of two black holes. The vibrations represent the gravitational waves. Identify one limitation of this model.

4. Collaborate Together with a partner, research the National Science Foundation's Laser Interferometer Gravitational-Wave Observatory (LIGO). Create a visual presentation that includes a timeline of the program as well as the location and history of each ground-based observatory. Remember to include any plans for future observatories and next steps in the ongoing research.

Can You Explain It?

Name: **Date:**

Why did the two objects fall together?



EVIDENCE NOTEBOOK

Refer to the notes in your Evidence Notebook to help you construct an explanation that describes why the apple and feather fall at the same rate.

1. State your claim. Make sure your claim fully explains why the two objects fall together.

2. Summarize the evidence you have gathered to support your claim and explain your reasoning.

Checkpoints

Answer the following questions to check your understanding of the lesson.

Use the photo to answer Questions 3 and 4.

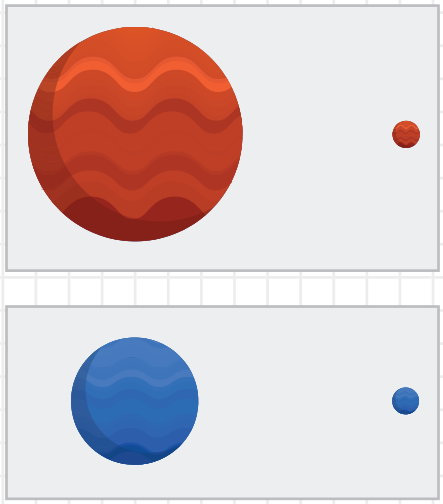
3. If all three balls have the same mass and size, which statements are true?

- **A.** Gravity exerts almost the same force on all three balls.
- **B.** Each ball is equally attracted by gravity to the other balls and to Earth.
- **C.** Gravity is acting on the two balls in the air but not the ball in the juggler's hand.
- **D.** All the balls experience similar amounts of air resistance as they move.

4. The juggler replaces the balls with scarves. How would the motion of the scarves be different from the motion of the balls? Explain.

- **A.** The scarves would fall slower because they are lighter than the balls.
- **B.** The scarves would fall slower because they have more air resistance than the balls.
- **C.** The scarves will fall in the same time as the balls because gravity attracts all objects the same.

Use the diagrams to answer Questions 5 and 6.



5. The diagrams show two planets of different masses with identical orbiting satellites. Select all the conditions that would increase the gravitational force between each pair.

- **A.** Move the satellites closer to the planet.
- **B.** Move the satellites farther from the planet.
- **C.** Add mass to the satellites.
- **D.** Remove mass from the satellites.

6. The density of the planets and satellites shown are the same. The gravitational force between the red planet and its satellite is more / less than the gravitational force between the blue planet and its satellite. This is because the combined mass of the red planet and its satellite is greater / less than the combined mass of the blue planet and its satellite, and the distances between each planet and its satellite are different / equal.

Interactive Review

Complete this section to review the main concepts of the lesson.

Gravity is a noncontact force that depends on the masses of objects and the distance between them.

A. Describe two ways you can increase the gravitational force between two objects.

Friction is a contact force that opposes motion.

B. Describe a situation where more friction is desirable and a situation where less friction is desirable.

Air resistance is a type of friction that occurs between air and moving objects.

C. Describe the forces that act on a skydiver before and after the parachute is opened.

LESSON 3

Newton's Laws of Motion

This longboarder may not realize it, but he is using several laws of motion to get to his destination.

By the end of this lesson . . .

you will be able to model and describe how unbalanced forces cause changes in motion.

Go online to view the digital version of the Hands-On Lab for this lesson and to download additional lab resources.

CAN YOU EXPLAIN IT?

Why does the golf tee fall into the bottle when the hoop is pulled?

Observe carefully to see how the person can get the golf tee to drop straight into the bottle. Consider what forces act on the golf tee during this event.

Explore ONLINE!

1. What forces are acting on the golf tee when it is at rest on the hoop? What forces are acting on the golf tee when it is falling in the bottle?

EVIDENCE NOTEBOOK As you explore the lesson, gather evidence to help explain the motion of the golf tee.

Describing Motion

Diving into a pool, pedaling a bike, jumping over a puddle, sinking into a comfy chair, biting into a crisp apple—these are all types of motion. **Motion** is a change in an object's position over time. Position describes an object's location. Suppose you were diving into that pool. One moment you are standing tall on the edge of the diving board, and the next moment you are in the air above the water. Finally, you enter the water. During the dive, you were in motion because your position changed over time.

Explore ONLINE!

A flock of thousands of starlings fly in formation.

2. The starlings flying in formation are / are not in motion. The birds' positions are changing over time. The flock's position can be described as being above / below the clouds and above / below the ground.

3. Discuss With a partner, debate whether the couple in the photograph is in motion. Support your claim with evidence. Record the main points of your discussion.

This couple rides a train to get to their destination.

Motion and Reference Points

How can you tell if something you see is moving? You are actually comparing the object's position to that of another object that appears to stay in place. The object that appears to stay in place is called a **reference point**. You can measure the object's motion as its change in position relative to the reference point. You can choose any point you like, as long as you specify what it is. Often it makes sense to choose a set of objects that are all stationary with respect to each other. This set of objects is known as a *reference frame.* In the train example, you could say that the man and woman are in motion because they are moving relative to the scenery outside the train. However, if you used the train car as your reference frame, you could say that they are not moving.

4. You are sitting in a crowded movie theater waiting for friends. The following are ways that you could describe your location within the theater using reference points. Which descriptions may be unreliable because of the reference point?

A. I am sitting near a theater worker, fifth seat from the side.

B. I am in the fifth row from the back, tenth seat from the right side.

C. I am in the sixth row from the front, tenth seat from the right side.

D. I am in the sixth row, east of the man in a red shirt.

The scout uses radar to measure how fast a ball is pitched.

5. The radar device detects the motion of the ball and calculates its speed relative to the pitcher / the batter / home plate / the radar device.

Speed, Distance, and Time

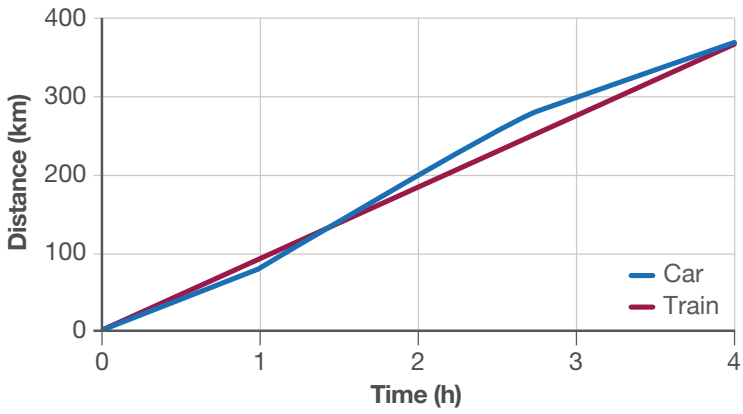
If an object's position changes, you know that motion took place but not how quickly the object changed position. The **speed** of an object is a measure of the distance an object moves in a given amount of time. The unit of speed is distance per time, for example, meters per second or miles per hour. The choice of what units to use when measuring motion is arbitrary but must be specified so the data can be shared with others. The radar device measures the speed of an object over a very short period of time. The actual speed of an object may vary widely or stay relatively constant. We may calculate the average speed of an object over a longer period of time, depending on the equipment available and desired information.

Average Speed

As described previously, knowing that the position of an object has changed tells you that the object moved, but it does not tell you how quickly. Look at the two images of the cars on a track at two different times. You can see that between the first and second image, the red car's position has changed, but this is not enough information to know the speed of the car. Speed involves two quantities: distance traveled and time traveled. So in order to calculate the speed of the red car, we need to know how much time passed between the first image and the second image. We also need to know the distance traveled by the red car during that time. If we know the red car traveled 16 feet during the two seconds between the images, we can calculate the speed of the red car as eight feet per second. But did the red car travel at exactly eight feet per second the entire time? Probably not. This speed is the average speed of the red car during those two seconds. The actual speed of the car during this time may have varied.

Distance vs. Time

The speed of an object can be determined from a graph of distance traveled over time. The blue line in the graph shows the total distance traveled by a car during a four-hour period. The red line shows the distance traveled by a train moving at a constant speed during the same four-hour period.



6. Do the Math Use the graph to determine the average speed of the car for the first hour of the trip and for the entire four-hour time period. The total distance traveled for each time period can be read from the blue line on the graph. Estimate the distance traveled to the nearest 10 kilometers.

$$\text{average speed} = \frac{\text{distance traveled}}{\text{travel time}}$$

$$\text{average speed during first hour} = \frac{80\ \text{km}}{1\ \text{h}} = \boxed{80}\ \text{km/h}$$

$$\text{average speed for 4 hours} = \frac{\boxed{}\ \text{km}}{\boxed{}\ \text{h}} = \boxed{}\ \text{km/h}$$

Velocity

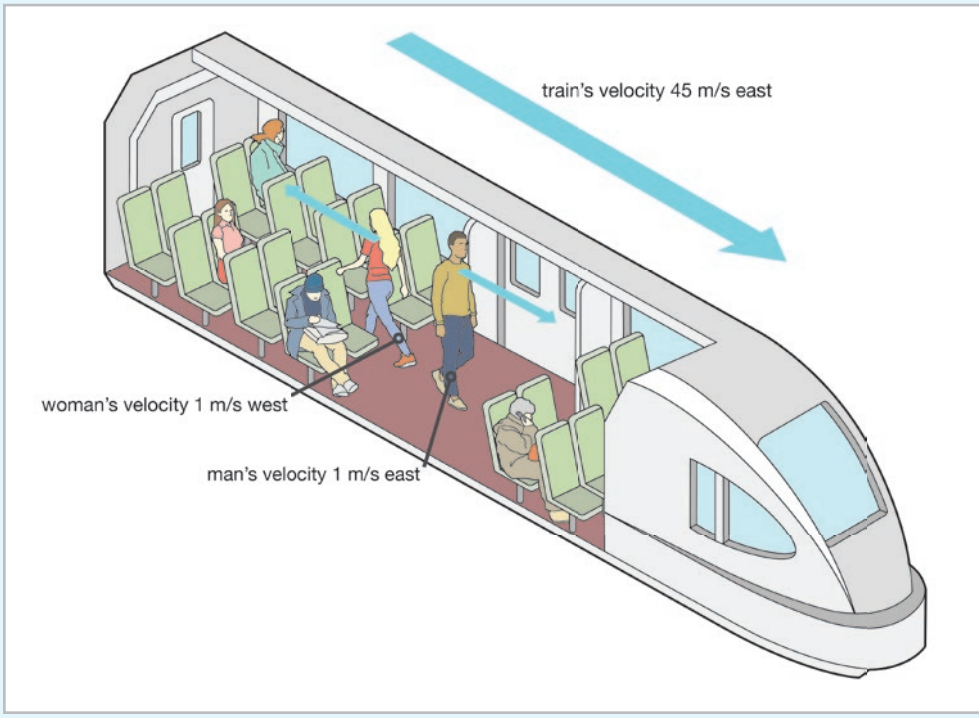
Sometimes it is necessary to know both the speed of an object and which way it is going. The **velocity** of an object is a quantity that describes the speed of the object and its direction of travel. You can think of velocity as the rate of change of an object's position in a reference frame. An object's velocity is constant only if its speed *and* direction do not change. Therefore, constant velocity is always motion along a straight line. If either an object's speed *or* direction changes, its velocity changes. To indicate the direction of velocity, we use positive and negative numbers. If an object moves in the positive direction, we use a positive number to represent the velocity. If an object moves in the opposite direction, the velocity will be negative. Any direction can be positive or negative, but the choice must be consistent. For example, if a ball thrown upwards has a positive velocity when it travels upwards, it must have a negative velocity when it falls.

7. A bus travels north along a straight stretch of road. Its velocity is a constant 15 m/s. Another bus travels south on the same road at the same speed. What is the velocity of the second bus?

Do the Math

Calculate Resultant Velocity

Suppose you are riding on a train. The train is moving in relation to the ground. If you stand up and walk down the aisle while the train is moving, then you are moving relative to the train and to the ground. To find your velocity relative to the ground, add your velocity relative to the train with the train's velocity relative to the ground. Remember if the velocities are in opposite directions, one will be positive and the other negative.



The diagram shows a train car moving at a velocity of 45 m/s to the east. Two passengers are walking on the train. The passengers' velocities relative to the train are shown.

8. Look at the train in the diagram. If the train is moving in the positive direction, calculate the velocities of the man and woman walking in the train relative to the ground.

Acceleration

The rate at which velocity changes is called **acceleration**. Velocity is the rate of change of position; its units are distance per time. If the velocity is measured in meters per second, the acceleration might be measured in meters per second per second, or m/s^2. An object accelerates if its speed, direction, or both change. Like velocity, the direction of acceleration is indicated by using positive and negative numbers. If an object has a positive velocity and its speed increases, it has a positive acceleration. If an object is moving in the positive direction and its speed decreases, it has a negative acceleration. Average acceleration may be calculated in a way similar to average velocity.

9. Do the Math Calculate the average acceleration of the cyclist in the image by using this equation:

$$\text{average acceleration} = \frac{\text{final velocity} - \text{starting velocity}}{\text{time it takes to change velocity}}$$

Use the velocity at 1 second as the starting velocity and the velocity at 5 seconds as the final velocity. South is the positive direction.

$$\text{average acceleration} = \frac{\square}{\square} = \frac{\square}{\square} = \square \text{ m/s}^2 \text{ south}$$

Measure the Motion of a Storm

You might have heard a meteorologist say that a storm is heading east into your area at 40 km/h. What do you know about the motion of the storm?

10. The speed / velocity of the storm was given as 40 km/h east. This is the speed / velocity because it includes the direction in which the storm is moving in addition to how quickly it is moving. The meteorologist's statement does / does not include whether the storm is accelerating.

Analyzing Newton's First Law of Motion

Imagine that you are playing baseball. The pitch comes in, and—crack—you hit the ball! But instead of the ball flying off the bat, the ball just drops to the ground. Would that really happen? No! The baseball will move away when you hit it with a bat. You know from experiences like this that the force exerted on an object is related to the motion of the object in some way. In 1686, Sir Isaac Newton explained the relationship between force and motion with a set of three laws of motion.

Newton's First Law of Motion

Newton's first law of motion states that, unless acted on by an unbalanced force, an object at rest stays at rest and an object in motion stays in motion at a constant velocity. In other words, if the forces on an object are balanced, the object will not accelerate. Like velocity and acceleration, forces have direction. A force in one direction will have an opposite sign from a force acting in the opposite direction. To find the net force on an object, add the forces. If the forces on an object are balanced, the net force on the object is 0 newtons (N). If the forces on an object are not balanced, the object will accelerate.

11. A force acting on an object in the upward direction is 3 N. The force that would balance this force could be written as _____. We know these forces will balance because 3 N + (_____) = _____. The balancing force acts in the _____ direction.

The bowling ball quickly moves toward the pins.

12. Look at the photo of the bowling ball and pins. What do you think will happen next?

Objects at Rest

An object whose position is not changing relative to a reference point is said to be at rest. The golf ball balanced on the tee is an example of an object at rest. The upward force from the tee on the golf ball balances the downward force of gravity on the ball. When the ball is at rest on the tee, there are no unbalanced forces acting on the golf ball. Newton's first law says the golf ball will stay at rest until an unbalanced force acts on the ball. When the moving golf club strikes the ball, it applies an unbalanced force to the golf ball. The ball then moves in the same direction as the unbalanced force.

An Object at Rest

The golf ball begins at rest on the tee. When the golf club strikes the ball with an unbalanced force, the ball begins moving in the direction of the force.

Objects in Motion

Newton's first law also says that objects in motion stay in motion with a constant velocity unless they are acted on by an unbalanced force. Recall that if an object moves at a constant velocity, both its speed and direction do not change. Imagine that you are driving a bumper car at an amusement park. Your ride is pleasant—and your velocity is constant—as long as you are driving in an open space. But the name of the game is bumper cars! Eventually, another car hits you, exerting an unbalanced force on your car. As a result, your bumper car stops moving. Note that the *car* stops moving, but not you! You continue to move forward in your seat until the unbalanced force from your seat belt stops you.

An Object in Motion

Bumper cars demonstrate how an unbalanced force can change the motion of a moving object.

Friction and Newton's First Law

Imagine a baseball player sliding into second base. The player must run quickly before sliding and she can only slide for a short distance before stopping. Newton's first law says that an unbalanced force must act on the player to make her stop. What is the unbalanced force that causes the player to stop sliding? Friction. Friction is a force that occurs when surfaces are in contact. The force of friction always opposes motion. To balance the force of friction, it is often necessary for a force to be applied to an object to keep the object moving at a constant velocity.

Explore ONLINE!

13. Look at the photo of the penguins sliding on the frozen ground. Use Newton's first law of motion to explain the motion of the penguins.

Emperor penguins slide on the frozen ground in Antarctica.

14. Act Imagine the penguins in the photo decide to put on a performance on ice. Perform a dance routine or slapstick routine as if you were one of the penguins. Include the effects of Newton's first law in your routine.

Inertia and Newton's First Law

Newton's first law of motion is sometimes called the *law of inertia*. **Inertia** is the tendency of objects to resist any change in motion. Because of inertia, an object at rest will remain at rest unless a force makes it move. Likewise, inertia is the reason a moving object stays in motion with the same velocity unless a force changes its speed or direction.

15. Imagine that a passenger sets a phone on the dashboard of a car. There is little friction between the phone and the dashboard. The car moves at a constant velocity and then turns. What do you expect to happen to the phone when the car turns?

A. The phone will stay in the same position relative to the dashboard and turn with the car because of friction.

B. The phone will continue to move in a straight line because of inertia. The force of friction is not enough to change the motion of the phone.

C. The phone will move in a straight line because a force is pushing the phone in a straight line.

D. The phone will stay in the same position relative to the dashboard and turn with the car because of inertia.

Mass and Inertia

Objects with more mass have more inertia than objects with less mass. In fact, mass is a measure of inertia. More force is needed to overcome the inertia of a massive object to change its motion than is needed to cause the same change in the motion of a less massive object. Remember that an increase in velocity, a decrease in velocity, or a change of direction are all types of acceleration. Imagine how much force you need to pick up a bucket full of water compared to an empty bucket. You need more force because the full bucket has more inertia.

16. A person on a bicycle and a person driving a car are at rest at a stop light. The light turns green and both the cyclist and car begin to move. You would expect the bicycle / car to accelerate more quickly because the car has less / more mass than the bicycle, and thus less / more inertia.

EVIDENCE NOTEBOOK

17. How does Newton's first law apply to the motion of the golf tee that falls from the hoop into the bottle? Record your evidence.

Engineer It

Design Vehicles for Safety

Engineers study impacts that we might experience in a vehicle in order to improve our safety. Think about a bumper car collision and how it relates to a collision of a road vehicle. What additional safety equipment is available in a standard vehicle compared to a bumper car? Why do we have additional safety equipment in vehicles?

18. How does the airbag in the photo affect the motion of the driver in the car? Would this airbag protect the driver from a sideways collision? Explain your answer.

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Welcome to 7th Grade Science Materials for January, STUDENTS!

Students are encouraged to maintain contact with their home school and classroom teacher(s). If you have not already done so, please visit your school website to access individual teacher web pages for specific learning/assignment information. If you cannot reach your teacher and have elected to use these resources, please be mindful that some learning activities may require students to reply online, while others may require students to respond using paper and pencil. In the event online access is not available and the teacher cannot be reached, responses should be recorded on paper and completed work should be dropped off at your child's school. Please contact your child's school for the dates and times to drop off your child's work.

The pdf file of all the materials in the January kit is the same as Unit 1 and 2 from student workbook for Module B.

	Standard / Lesson Objective *What will you know and be able to do at the conclusion of this lesson?*	**Resources & Assessment** *What print and electronic resources are available to support your learning? What needs to be turned in for assessment?*
Week 1	**6-8.LS1.A.2 / MS-LS1-2** I can use and develop a model of cells to describe the structure and function of various parts of cells	Module B, Unit 1, Lesson 2, Engage, Exploration 1 Exploration 2 (pg. 25, 28)
Week 2	**6-8.LS1.A.2 / MS-LS1-2** I can use and develop a model of cells and its parts to infer about scale and proportions	Module B, Unit 1, Lesson 2, Exploration 3 Module B, Unit 1, Lesson 2, Take It Further + Lesson Self-Check
Week 3	**6-8.LS1.A.2 / MS-LS1-2** I can use and develop a model of cells to describe the structure and function of various parts of cells I can use and develop a model of cells and its parts to infer about scale and proportions	Module B, Unit 1 Review **Enrichment:** Module B Unit 1 Performance Task
Week 4	**6-8.LS1.A.3 / MS-LS1-3** I can explain the relationship between structure and function in tissue as systems. I can use evidence to explain the relationship between structure and function in organs as systems	Module B, Unit 2 Lesson 1, Engage + Explorations 1 (48-50) Module B, Unit 2, Lesson 1, Exploration 2

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The pdf file of all the materials in the January kit is the same as Unit 1 from student workbook for Module D.

	Standard / Lesson Objective *What will you know and be able to do at the conclusion of this lesson?*	**Resources & Assessment** *What print and electronic resources are available to support your learning? What needs to be turned in for assessment?*
Week 1	**6-8.LS4.A.1 (MS-LS4-1) and (MS-LS4-2)** I can use evidence on patterns in anatomical similarities and differences of organism to explain how life evolved on Earth	Mod D, Unit 1, Lesson 2, Engage + Exploration 1
Week 2	**6-8.LS4.A.1 (MS-LS4-1) and (MS-LS4-2)** I can identify patterns in data to make inferences on number and diversity of life throughout life on Earth	Mod D, Unit 1, Lesson 2, Exploration 2 Mod D, Unit 1, Lesson 2 Take It Further, Lesson Self-Check
Week 3	**6-8.LS4.A.1 (MS-LS4-1) and (MS-LS4-2)** I can use evidence on patterns in anatomical similarities and differences of organism to trace common ancestry I can analyze empirical data on patterns of similarities in fossil record to infer evolutionary relationships among species	Mod D, Unit 1, Lesson 3, Engage + Exploration 1 (pg. 47-52) Mod D, Unit 1, Lesson 3, Exploration 2
Week 4	**6-8.LS4.A.1 (MS-LS4-1) and (MS-LS4-2)** I can use evidence on patterns in anatomical similarities and differences of organism to trace common ancestry I can analyze empirical data on patterns of similarities in fossil record to infer evolutionary relationships among species	Mod D, Unit 1, Lesson 3 Take it Further, Lesson Self-Check Mod D, Unit 1 Review **Enrichment:** Mod D Unit 1 Performance Task

LESSON 2

Patterns of Change in Life on Earth

Titanis walleri, or Waller's terror bird, was flightless. It could grow up to 1.8 m (5.9 feet) tall, about the same height as an adult human. It lived from about 5 to 2 million years ago.

By the end of this lesson . . .

you will be able to analyze patterns in the fossil record to explain how life changed over time.

Go online to view the digital version of the Hands-On Lab for this lesson and to download additional lab resources.

CAN YOU EXPLAIN IT?

What can explain the formation of a rock layer with no fossils in between rock layers with different types of fossils?

Major changes to populations of organisms and environments happened in the past. Such events from the past are recorded in rock layers as part of the fossil record.

1. What is needed for a fossil to form? Select all that apply.

A. The organism must first get stuck in rock.

B. The soft tissue of the dead organism must be eaten by scavengers before the bones can be preserved.

C. The tracks or burrows of an organism must be filled with sediments before they are disturbed.

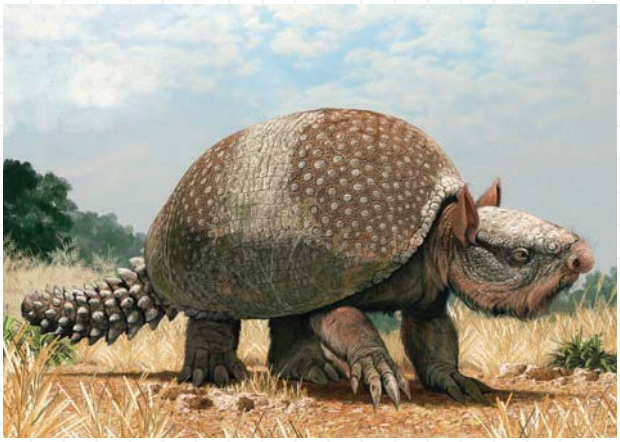
D. The organism's body must be covered by sediment or another substance before its body decays.

2. What are some reasons why a rock layer may not have any fossils?

EVIDENCE NOTEBOOK As you explore the lesson, gather evidence to help explain why a fossil-free rock layer might exist between layers with fossils.

Analyzing Evidence About the History of Life

Only a small percentage of the organisms that ever lived fossilized. Yet, these fossils help scientists learn about how life on Earth changed over time. Fossils show where and when certain extinct organisms lived. They also show patterns in how the body plans of organisms changed over time. Fossils can provide information about past environments. They can even give clues to how extinct species interacted. The fossil record also shows patterns in how species appeared and disappeared throughout Earth's history.



Glyptodonts were about the size of a small car. They ate plants and lived among early humans before the Ice Age.

The insect-eating armadillo shares many features with its extinct relative, the glyptodont. However, it is much smaller.

3. Compare the armadillo to the glyptodont (GLIP•tuh•dahnt). What similarities provide evidence that they might be related?

Evidence of Earliest Life Forms

Charles Walcott was an American paleontologist who, in 1909, discovered many well-preserved fossils of ancient sea organisms near Mount Burgess, Canada. The fossils were preserved in layers of shale left by an ancient ocean. The soft tissues of many of the fossilized organisms in the Burgess Shale were preserved in great detail.

Scientists used a method of radiometric dating to find the absolute age of nearby igneous rock layers. These layers contain a type of potassium that changes into argon at a constant rate. Scientists measure how much potassium in the rock has changed to argon. From this measurement, they can determine when the igneous rock formed. After finding the age of the igneous rock, they used relative dating to determine that the Burgess Shale fossils are over 500 million years old. This seems quite old. But, the earliest evidence for life dates back about 3.8 *billion* years! The earliest organisms were single cells, which rarely formed fossils. Evidence of these earliest cells was found in rock samples with high levels of a type of carbon only found in living things.

Traces of Carbon from Cells

There are different types of carbon atoms. But living organisms use only one of these types. Scientists detected high levels of this type of carbon in ancient rock compared to other types of carbon. They concluded that there was life on Earth at the time this ancient rock formed 3.8 billion years ago. Fossilized cells were not found in this rock, only chemical evidence of life. This is an example of *inference*, using evidence to draw conclusions when direct observation of a process or event is not possible. These rocks contain the earliest known evidence of life on Earth.

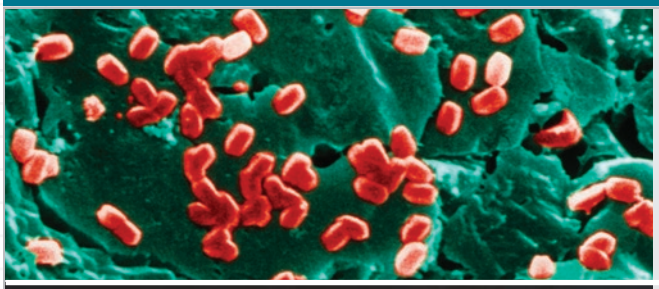
Many types of scientists work together to collect evidence of ancient life. Chemists isolate certain chemicals from rock samples to analyze them. Biologists study how living things use chemicals in their bodies. Geologists determine the ages of rocks and what Earth conditions may have caused them to form. Paleontologists find and study fossils.

The ratio of different types of carbon in these 3.8-billion-year-old rocks in Greenland is interpreted as evidence of life on Earth at the time the rocks formed.

Fossil Evidence

The earliest fossilized cells scientists have found are about 3.5 billion years old. The fossils are of a type of *cyanobacteria*, a single-celled life form that makes its own food by photosynthesis. In Greek, *cyano-* means "blue." The bacteria left traces of the blue-green pigment protein that gives them their name. The cyanobacteria also left behind stromatolite formations. *Stromatolites* are layered mounds, columns, or sheets of calcium-rich sedimentary rock. They are made of layers of bacteria and sediment.

Evidence of Ancient Cellular Life



Ancient Cyanobacteria Fossils of bacteria similar to these were found in ancient stromatolites from Western Australia. The stromatolites were about 3.5 billion years old. Cyanobacteria are a type of bacteria that capture the energy of sunlight and release oxygen during photosynthesis. They helped create an oxygen-rich atmosphere on ancient Earth.

Stromatolite Growth Patterns Notice the light and dark layers of this stromatolite. They are caused by the growth patterns of cyanobacteria that were on Earth when each layer was formed. The bacteria release white-colored calcium compounds that mix with soil or sand deposits. Over time, the layers harden into rock.

Modern Stromatolites These stromatolites line the sea floor of Shark Bay in Western Australia. They are usually columns or domes because the cyanobacteria that form them group together in mat-like sheets. New groups form mats on top of the sediment deposits trapped by older groups.

4. Do the Math Scientists estimate that Earth is 4.54 billion years old. Chemical evidence of life appears in the fossil record 3.8 billion years ago. What percentage of Earth's history was without life? Write a formula for the calculation using variables you define. Then use your formula to find the answer.

5. Think about the process of identifying the age of the earliest fossils. How does it show how scientists use evidence and logic to answer scientific questions?

Evidence of Change Over Time

For more than 2 billion years, only single-celled life existed on Earth. That changed about 540 million years ago, during the Cambrian Era. Scientists found a large increase in the number and types of fossils in rock layers that formed during this time. Cambrian organisms looked very different from living things today. Many Cambrian species, such as *Marrella*, were arthropods. *Arthropods* are a group of invertebrate animals that have segmented bodies. Cambrian arthropods are now extinct. But arthropods such as ants and lobsters are alive today. Scientists observe a large increase in the variety of fossils formed during this time, so this time is often called the *Cambrian explosion*.

Marrella is the most common fossil found in Burgess Shale.

Many scientists think the Cambrian explosion happened because of increased oxygen levels in the air from cyanobacteria and new interactions among organisms. The fossil record shows that many Cambrian animals had hard outer shells. These shells could protect the animals from predators. Scientists infer that the rise of the first predators on Earth led to a greater diversity of life forms. Over many generations, populations developed a variety of behaviors and characteristics, such as hard outer shells, in response to the action of predators. The fossil record of the Cambrian explosion gives scientists a way to investigate how life changes over time.

6. What evidence from the fossil record supports the observation that life changes over time? Select all that apply.

- **A.** more fossils of the same species found in several rock layers
- **B.** increased numbers of fossils of different species found in younger rock layers
- **C.** several rock layers that do not contain fossils
- **D.** fossils of distant relatives of a modern species found in ancient rock layers

EVIDENCE NOTEBOOK

7. What does a rock layer with very few fossils suggest about conditions in that region when the rock layer formed? Record your evidence.

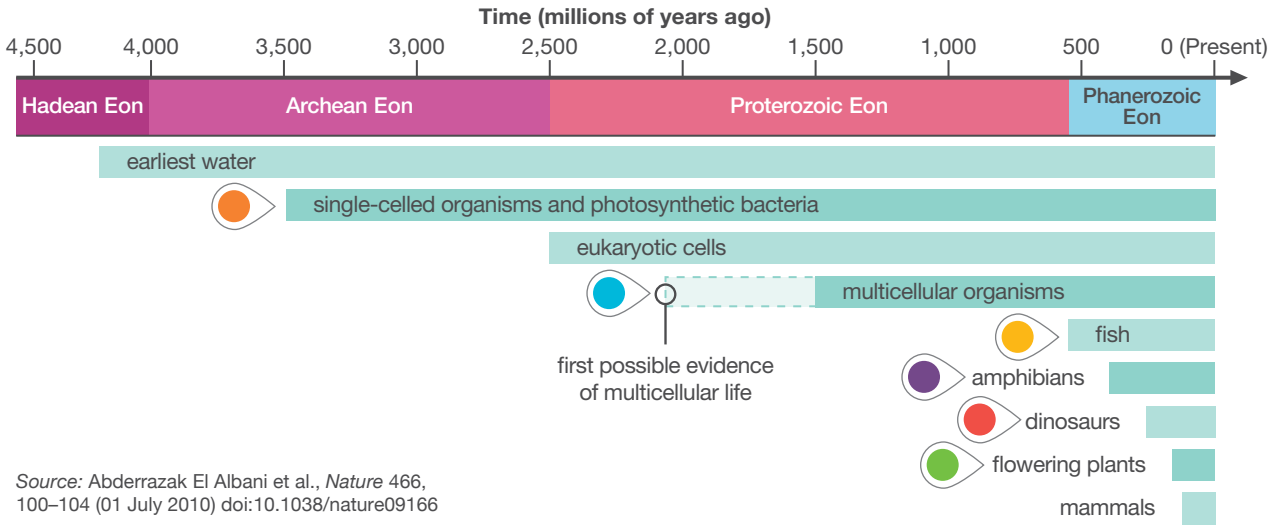
Increasing Complexity of Fossils

Scientists find that more recent rock layers contain fossils that have more complex bodies and physical features than earlier fossils. Multicellular organisms first appeared in the fossil record more than 600 million years ago (mya). Jawless fish appeared in the fossil record about 500 mya. Fish with jaws appeared nearly 400 mya. Later rock layers include amphibians and then reptiles and mammals. Birds appeared more recently. This evidence suggests that new physical features, such as feet and lungs, enabled organisms to live in new habitats. Once living in these new habitats, populations became more different from each other over many generations.

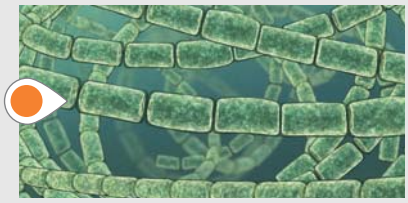
The fossils of organisms with simpler body plans are also found in younger rock layers along with more complex fossils. Scientists infer that while life changes over time on Earth, not all populations change at the same rate. For example, there is no evidence that modern bacteria are any more complex than bacteria found in ancient rock layers.

The Increase in the Complexity of Life on Earth Over Time

Scientists use fossil evidence to determine the periods of major changes in the body plans of organisms. They also use this evidence to infer likely causes for the changes.

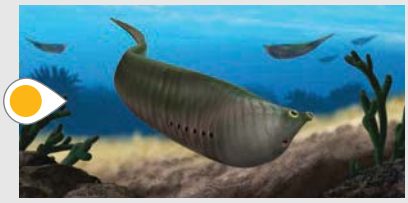


Source: Abderrazak El Albani et al., *Nature* 466, 100–104 (01 July 2010) doi:10.1038/nature09166



The earliest life forms were single cells. These cells could perform only the most basic life functions.

The *Dickinsonia* genus included some of the first complex multicellular organisms, which lived about 600 mya.



Metaspriggina, a genus of the earliest fish, lived about 505 mya. They had gills, worm-like bodies, and large eyes.

Members of the *Cacops* genus lived about 280 mya. They evolved from fish with bony fins and lung-like organs.

The *Captorhinus* genus, the first reptiles to live on land, date back to 300 mya. They were similar to lizards.

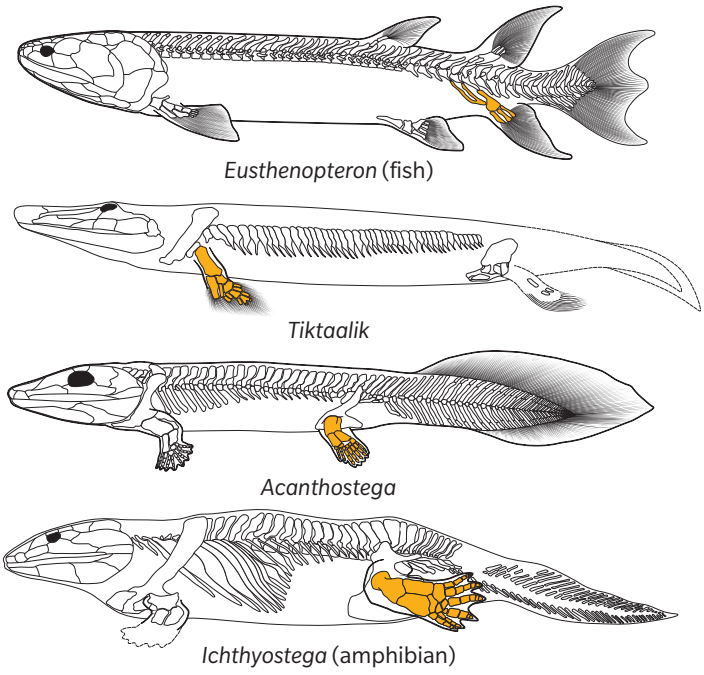
Seed plants of the *Archaeosperma* genus lived about 375 mya. They gave rise to flowering plants160 mya.

Transitional Fossils

Using evidence from the fossil record, scientists conclude that life began in the oceans. Early fish-like organisms gave rise to fish, which gave rise to the ancestor common to amphibians. To determine how changes like these occur in nature, scientists look for *transitional fossils*. These are fossils of organisms that have body structures that are found both in an ancestral species and in its descendants. For example, when scientists investigated the origins of amphibians, they hypothesized that there might have been an organism that had traits of both fish and amphibians. This hypothesis was supported with the discovery of a fossil called *Tiktaalik*. *Tiktaalik* lived in the water. It had bones in its fins that were very similar to the wrist and foot bones of amphibians.

Fossil Evidence of the Transition from Ocean to Land

The fossil of *Tiktaalik* is a transitional fossil in the evolution of amphibians from their fish ancestors. It has both fish and amphibian characteristics.

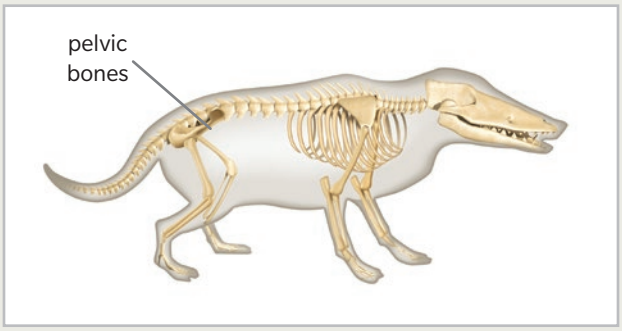


8. At some point in the past, the bones in the fins of a population of fish became larger and longer. The bones became able to support the weight of the organisms when they were out of water. This happened over many generations. What other changes over time would be needed for fish to live out of the water?

9. Biological structures often have shapes (form) that enable organisms to perform particular tasks (function). How do transitional fossils, such as *Tiktaalik*, show that form is connected to function in living things?

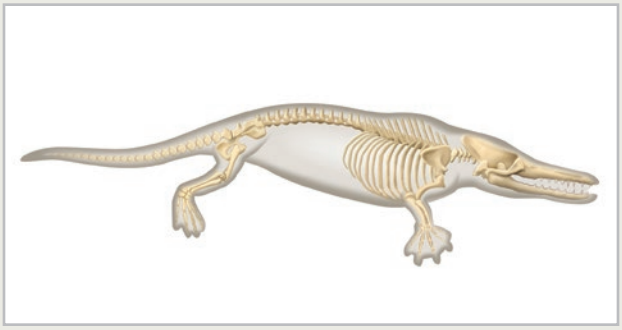
Infer How Features Changed Over Time

Whales swim and live in the ocean. Yet, they are mammals. They have traits similar to those of mammals that live on land. They give birth to live young, feed their young with milk, and have hair. Evidence from the fossil record supports the theory that the ancestors of whales lived on land before they moved into water. Over time, several body structures, such as the skull, hips, and legs, changed. These changes made the structures better adapted to swimming than walking.

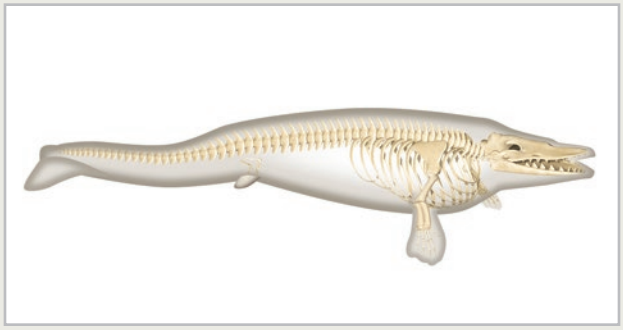


Pakicetus inachus lived around 50 million years ago.

Ambulocetus natans lived 50–45 million years ago.

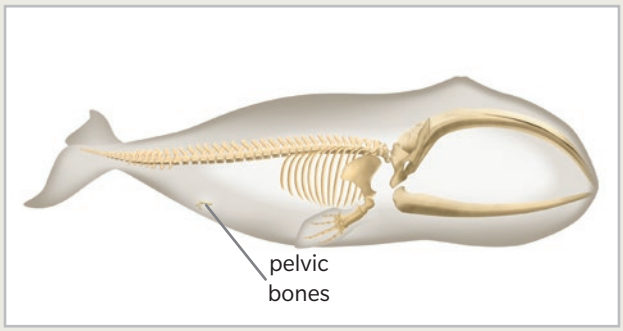


Kutchicetus minimus lived 46–43 million years ago.



Dorudon atrox lived 40–34 million years ago.

10. Hind legs are connected to pelvic bones, which are important for walking. Modern whales have relatively small pelvic bones. Construct an explanation for how the pelvic bones of whales' ancestors changed over time.



The modern bowhead whale is a living species that has been on Earth for 35 million years.

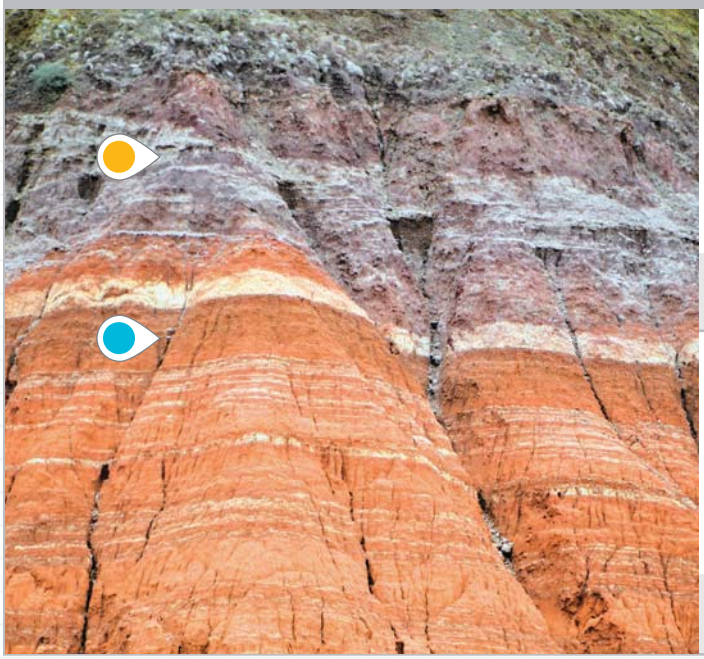
11. The form of a body structure is related to its function. Given this, how can you tell that *Pakicetus inachus* most likely lived on land and that *Dorudon atrox* lived in water?

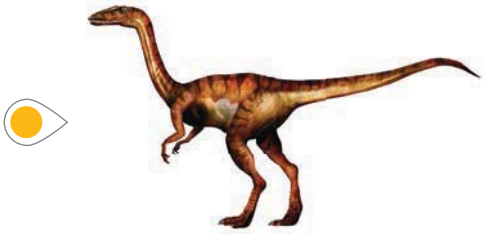
Analyzing Patterns in the Number of Life Forms Over Time

The fossil record shows changes in species and increases in biodiversity over time. It also shows the loss of certain species over time. When a species dies out, its fossils no longer occur in the fossil record. Scientists observe that the loss of species from the fossil record seems to happen at a regular rate. Yet, there have been time periods during Earth's history when the rate of species loss was very high.

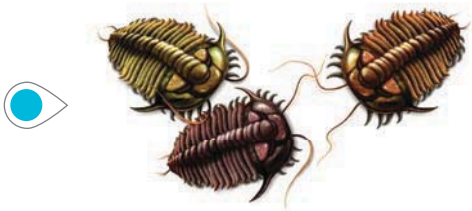
Identifying Extinction Events in the Fossil Record

Geologic time periods are identified by major changes in the fossil record. The side of this cliff in Palo Duro Canyon State Park in Texas includes the Permian-Triassic (P-T) extinction boundary. The P-T mass extinction happened about 248 million years ago.





Coelophysis fossils appear after the P-T extinction. They were a genus of small, meat-eating dinosaurs.



Trilobite fossils are found in the fossil record before the P-T extinction. They are not found afterward.

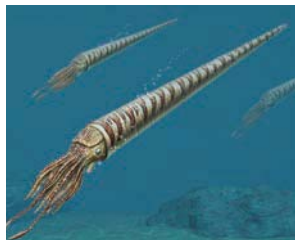
12. Explain one inference you can make about fossils from the information in the rock layer images.

Extinction

An **extinction** occurs when a species dies out and there are no members of the species left on Earth. The fossil record shows an extinction when a species is no longer found in sedimentary rock layers. For example, trilobites were once very common marine arthropods. They disappeared from the fossil record after the Permian-Triassic extinction, which indicates that trilobites became extinct.

A *mass extinction* happens when whole groups of related species die out at about the same time. Mass extinctions appear to be caused by large changes to the environment. When so many organisms die, there are many new opportunities for surviving species to use ecosystem resources. They then thrive and change over time. The numbers of new species found in the fossil record after each mass extinction eventually increases over time.

The Five Mass Extinction Events on Earth

Extinction event	Proposed cause	Organisms affected	An organism that went extinct
Ordovician-Silurian, 443 million years ago	Rapid shifts in tectonic plates; climate change, which lead to the formation of glaciers that caused sea levels to drop	Up to 85% of all species; 45%–60% of families of marine organisms died out	*Orthoceras* 
Late Devonian, 354 million years ago	Possibly a large comet strike; possible decrease in global temperatures due to dust and debris from comet strike; drop in sea levels	70%–80% of all species; marine life affected more than freshwater and land organisms	*Dunkleosteus* 
Permian-Triassic, 248 million years ago	Volcanic eruptions, release of methane from the sea floor; low oxygen levels in oceans, drop in sea levels	Largest extinction; about 80%–85% of all marine and land vertebrate species died out, including all trilobites and many insect species	*Dimetrodon* 
Triassic-Jurassic, 200 million years ago	Poorly understood; possibly an extreme decrease in sea level and lower oxygen levels in oceans	About 50% of all species disappeared; end of mammal-like reptiles, leaving mainly dinosaurs	*Typothorax* 
Cretaceous-Tertiary, 65 million years ago	Volcanic eruptions and climate cooling; drop in sea levels; large asteroid or comet strike	47% of marine life and 18% of land vertebrates died, including non-avian dinosaurs; mainly turtles, small reptiles, birds, and mammals left	*Quetzalcoatlus* 

13. Mass extinctions are caused by global / regional environmental changes. During a mass extinction event, biodiversity in the fossil record increases / decreases.

Do the Math

Analyze Extinction Data

Scientists compare rock layers before and after a mass extinction to estimate the number of affected species. They make estimates from several rock layer samples. Then they compare the loss of species to the normal rate of extinction that happens as life changes over time. This allows scientists to estimate the percentage of species on Earth affected by a mass extinction. The number of extinctions over time can be graphed. These graphs show a relatively constant extinction rate, broken up by large changes in the number of families of organisms lost during mass extinction events.

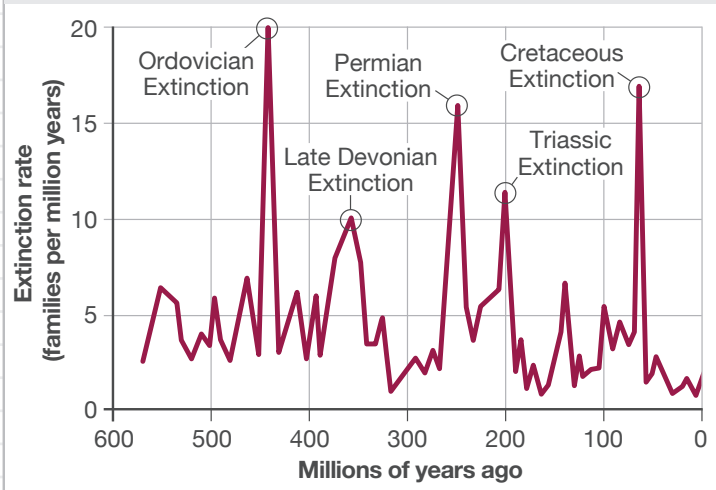
14. Describe the trends you see in each graph. What is the relationship between mass extinctions and biodiversity over time?

15. Does the top graph provide evidence that extinctions are a normal part of Earth's history? Explain your reasoning.

16. Mass extinctions do / do not cause permanent reductions in biodiversity on Earth. After each extinction event, the number of families increases / decreases rapidly over time.

Extinction Rate Over Time

The fossil record shows five mass extinctions. During each one, more than half of Earth's species went extinct.



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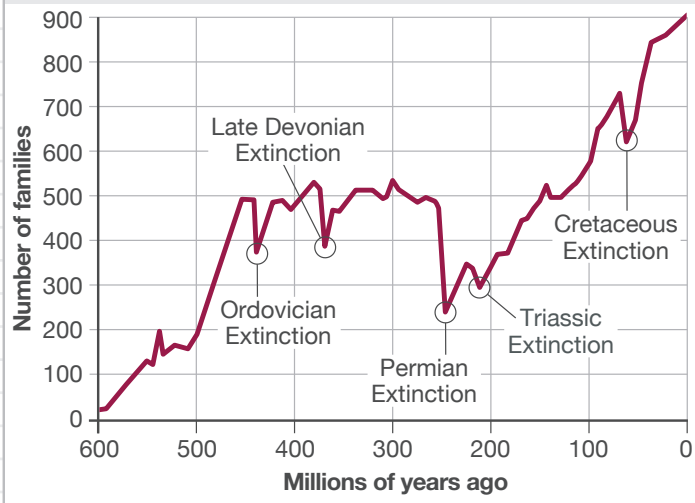
Diversity of Marine Organisms Over Time

Each mass extinction greatly reduced biodiversity. Yet, the species that remained expanded and diverged over time.



Credit: Adapted from "A kinetic model of Phanerozoic taxonomic diversity" by J. John Sepkoski, from *Paleobiology* 10(2), 246-267. Reproduced with permission.

Patterns in Extinction and Biodiversity Data

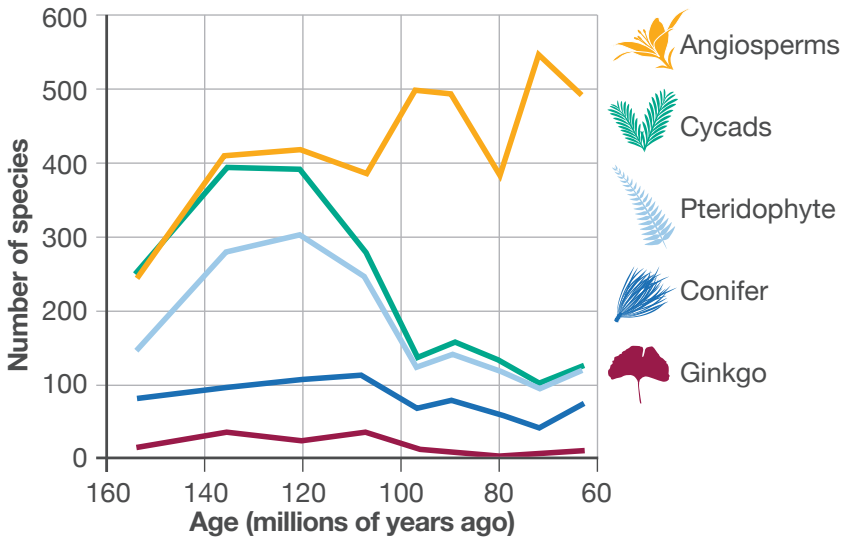
The *Alphadon* was a small mammal that survived the K-Pg extinction. It likely did so by burrowing underground to avoid the dangerous conditions.

Scientists want to find the causes of mass extinctions. To do this, they analyze rock layers before, during, and after an extinction event. For example, when studying the Cretaceous-Paleogene, or K-Pg, mass extinction, they looked at the rock layers laid down at the beginning of this extinction. They discovered unusual amounts of a metal called *iridium* in one rock layer in many different places of Earth. Iridium is rare on Earth. But it is common in asteroids. They also discovered tiny glass formations that are often found near craters caused by meteorite impacts. The high temperature caused by the impact melts sand. Glass spheres and other shapes form from the melted sand. Scientists used this evidence to infer that a very large meteorite struck Earth. It caused large-scale changes to Earth's environment. Large animal species were affected the most. Nearly all dinosaurs disappeared from the fossil record at this time. Fossil evidence shows that small mammals that could burrow to avoid the hot temperatures that resulted from the impact survived. It also shows that surviving species spread and diversified. Mass extinctions such as this are followed by periods of rapid growth in Earth's biodiversity.

17. Observe the patterns in plant diversity shown in the graph. How might species of flowering plants have survived the K-Pg extinction?

Plant Diversification Over Time

Mass extinctions also affect plant species. Some plant families decline after extinction events. Other plant families increase in number afterward. Angiosperms, or flowering plants, are a family that diversified over time.



Credit: Adapted from "Quantitative analyses of the early angiosperm radiation" by Scott Lidgard and Peter R. Crane, from *Nature*. Adapted by permission from Macmillan Publishers Ltd: *Nature* (331), 344. Copyright © 1988.

Hands-On Lab

Model Analysis of the Fossil Record

You will analyze fossil data to identify evidence of extinction and the appearance of new species over time

Scientists compare fossil evidence from different places on Earth. They observe certain fossil types in the same rock layers across multiple locations. In some layers, they observe the disappearance of certain fossil types. In some layers, they observe the appearance of new fossil types. By determining the relative age of rock layers that contain fossils, scientists can identify these patterns of appearance and disappearance in the fossil record.

MATERIALS

- colored pencils
- scissors

Procedure

STEP 1 On a separate sheet of paper, copy the *Sedimentary Rock Layers from Four Locations* shown on the next page. Be sure to include the symbols that represent different types of fossils. Cut out the rock sequence from each location. Then line them up so that rock layers with similar compositions are side by side.

STEP 2 Analyze the fossil types found in different layers. Identify the species that appear to have gone extinct based on these fossil data.

STEP 3 Complete the table by drawing the symbols of three different fossils.

Fossil from oldest layer	Fossil from youngest layer	Fossil species that goes extinct

Analysis

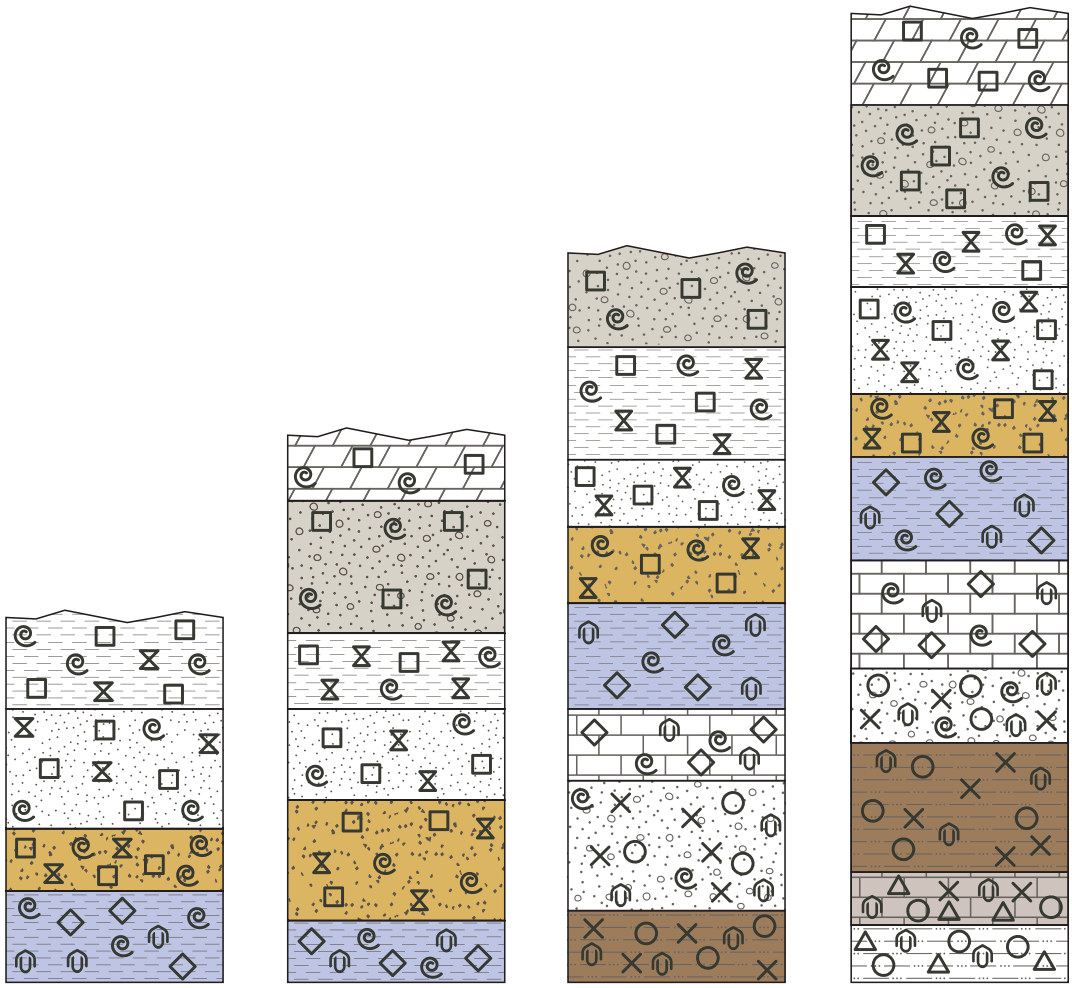
STEP 4 What patterns in the rock layer fossils helped you identify an extinction?

STEP 5 Why is it necessary to see a similar pattern of change in fossils from several places in order to conclude that an extinction happened?

STEP 6 Analyze the fossil types found in the youngest rock layer. Which of these fossil species appeared first in the fossil record? Which one appeared more recently? How do you know?

Sedimentary Rock Layers from Four Locations

The different colors represent different types of sedimentary rock. The symbols within the rock layers represent different types of fossils



EVIDENCE NOTEBOOK

18. Why might different types of fossils be found in rock layers that come before and after a rock layer that contains no fossils? Record your evidence.

19. Engineer It Computed tomography (CT) scanners can give information about the inside of fragile bones, such as the skull of an early human ancestor. The CT images are a series of x-ray images that can be "stacked" to form a 3D virtual model. These virtual models can then be used to make physical 3D models of either the fossils or what was inside them. How can CT scanners solve the problem of damaging delicate fossils?

Language SmArts

Explain Inferences from Fossil Record Evidence

Ancient insects grew very large during the Carboniferous Period, about 320 million years ago. Scientists believe this was due in part to air that was high in oxygen. *Meganeura* was an ancestor of dragonflies. It had a wingspan over two feet wide!

Scientists have found thick coal deposits in Carboniferous rocks near *Meganeura* fossils. Coal deposits form from large amounts of decaying plant material. Such large amounts of plant material generally require warm and wet conditions.

Meganeura used its spiny legs to catch insects, lizards, and mammals living near ponds. Scientists think that insects grew so large because of the high oxygen levels in the air.

20. What modern organisms have an ecological role around ponds today that is similar to the role of *Meganeura* during the Carboniferous Period? Explain your answer.

21. Write a series of logical steps that you could use to infer the type of climate that existed during *Meganeura's* time.

Continue Your Exploration

Name: **Date:**

Check out the path below or go online to choose one of the other paths shown.

Prediction of a Transitional Fossil

- **Hands-On Labs**
- **Reconstruct the Past from Physical Evidence**
- **Propose Your Own Path**

Go online to choose one of these other paths.

Transitional fossils are an important part of the fossil record. But how do scientists know how to spot a transitional fossil? They make hypotheses about the types of organisms that may have descended from earlier organisms and given rise to more recent organisms.

Scientists studied both ancient fish and amphibian fossils. They then predicted that an organism that shared some features in common with both fish and amphibian families likely lived in the past. They identified certain features that the hypothetical species—a "fishapod"—might have, such as a fish with feet. Their predictions were confirmed when fossils of the "fishapod" *Tiktaalik roseae* were found. The fossils showed that *Tiktaalik* had a skull and ribs like land animals. It also had several fish features, including fins and scales.

Tiktaalik roseae was found in the Canadian Arctic. Scientists found the front end of *Tiktaalik* 10 years before finding the hind end in different rock.

Continue Your Exploration

1. In order for *Tiktaalik* to be considered a transitional fossil, when does it need to have appeared in the fossil record?
   - **A.** before fish and amphibians
   - **B.** after amphibians
   - **C.** at the same time as amphibians
   - **D.** between fish and amphibians

2. It took more than 3 billion years for life to spread from the oceans onto land. All organisms that lived on land evolved during the 550 million years that followed. How might this relatively rapid diversification of land species be explained?
   - **A.** The move to land environments led to more changes in species over time.
   - **B.** The move to land environments led to fewer changes in species over time.
   - **C.** Spreading to land did not affect the amount of change in species over time.
   - **D.** The change in environments resulted in lower biodiversity.

3. Draw a simple sketch of a transitional fossil that might link feathered, tree-climbing reptiles to early birds. Label the features that connect the fossil to the reptile and to the bird.

4. **Collaborate** Work with a small group to research another transitional fossil discovery. What evidence did scientists provide to support the identification of the transitional fossil? Present your findings to the class.

Can You Explain It?

Name: **Date:**

What can explain the formation of a rock layer with no fossils in between rock layers with different types of fossils?

EVIDENCE NOTEBOOK

Refer to the notes in your Evidence Notebook to help you construct an explanation for how a rock layer with no fossils might have formed between rock layers with different types of fossils.

1. State your claim. Make sure your claim fully explains how a rock layer with no fossils might have formed between rock layers with different types of fossils.

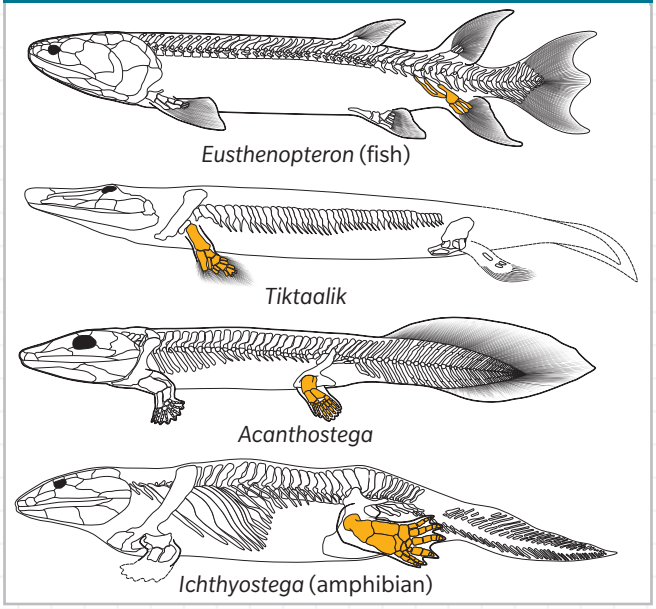
2. Summarize the evidence you have gathered to support your claim and explain your reasoning.

Checkpoints

Answer the following questions to check your understanding of the lesson.

Use the diagram to answer Question 3.

The Transition from Water to Land



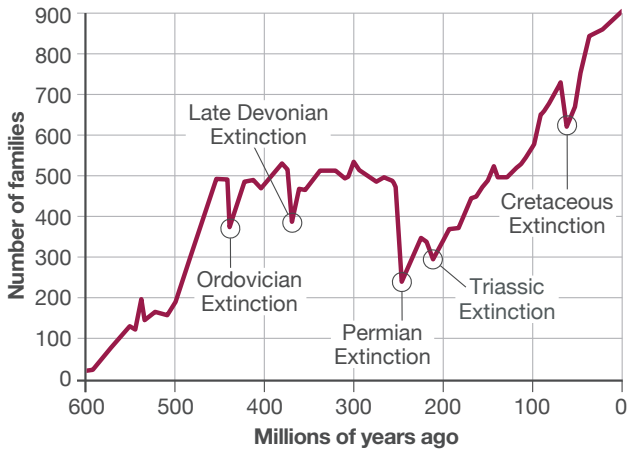
3. How are the bones in the fin structure of the *Tiktaalik* evidence of a transition from fish to amphibian? Select all that apply.

- **A.** It has fins like a fish.
- **B.** It has limb bones like an amphibian.
- **C.** It is older than fish fossils.
- **D.** The limb bones do not look as developed as they do in the amphibian.

4. Organisms with more complex body plans are more likely to be found in older / younger rock layers. This observation supports the general pattern of increasing / decreasing complexity of physical structures in fossilized organisms.

Use the graph to answer Question 5.

Mass Extinctions on Earth Over Time



Credit: Adapted from "A kinetic model of Phanerozoic taxonomic diversity" by J. John Sepkoski, from *Paleobiology* 10(2), 246-267. Reproduced with permission.

5. Based on the graph, biodiversity increases / decreases during a mass extinction event and then increases / decreases after the event. In general, biodiversity on Earth increases / stays the same over time.

6. What types of evidence allow scientists to infer that single-celled life likely existed 3.8 billion years ago? Select all that apply.

- **A.** transitional fossils in ancient rocks
- **B.** certain forms of carbon in ancient rock
- **C.** fossil evidence, such as stromatolites
- **D.** evidence of extinction events

Interactive Review

Complete this page to review the main concepts of the lesson.

Scientists use the fossil record to identify patterns of change in life on Earth. They use evidence to infer possible causes of the changes they observe.

A. What types of changes are recorded in the fossil record?

The fossil record provides evidence of five mass extinctions. Scientists compare fossils found in rock layers to find evidence about how organisms were affected by extinction events.

B. Draw a sketch of rock layers that includes evidence of an extinction. Use symbols to represent species that existed before, during, and after the extinction event.

LESSON 3

Evidence of Common Ancestry

This is a 9.5 day-old mouse embryo. It has yet to grow organ systems, but it has a head, a tail, and tiny limb buds. Its heart is developing in the larger bulge below its head.

By the end of this lesson . . .

you will be able to analyze data to provide evidence for evolutionary relationships among organisms.

Go online to view the digital version of the Hands-On Lab for this lesson and to download additional lab resources.

CAN YOU EXPLAIN IT?

What evidence supports a relationship between extinct and modern birds?

The fossil on the left is of an extinct bird genus called *Confuciusornis* that lived over 100 million years ago. The x-ray on the right shows the skeleton of a living crow species, *Corvus frugilegus*.

1. What similarities and differences can you observe from these photos?

2. Based on the fossil organism's body structures, how do you think it moved?

EVIDENCE NOTEBOOK As you explore this lesson, gather evidence to help explain the relationship between extinct and modern birds.

Identifying Similarities Among Organisms

What would you think if you planted a sunflower seed and it grew into an oak tree? You would probably be very surprised! Of course, that would never actually happen. You know that sunflower seeds grow into sunflower plants. Oak tree seeds, or acorns, grow into oak trees. This is an example of a consistent and observable pattern in nature: Offspring look similar to their parents. A key assumption of science is the idea that natural systems have consistent, observable, and measurable patterns. These patterns and events happen in the same way today as they did in the past.

Explore ONLINE!

The baby elephant has a combination of genes from each parent. This is true of all offspring of living things that reproduce sexually. Because of this genetic recombination, the elephant will not be identical to either of its parents.

3. Would a baby elephant be more likely to look like its parent or to look like one of its great-great-great-grandparents? Explain your reasoning.

Living Organisms Reproduce and Pass on Traits

Organisms reproduce today just as they did in the past. In fact, organisms must reproduce or else life would no longer exist! We know that the offspring of sunflowers look similar to sunflowers, not oak trees. And the offspring of elephants look similar to elephants, not zebras. Offspring look similar to their parents because heritable traits are passed down from generation to generation. These heritable traits are encoded in genetic material called *DNA*. Genetic material is passed from generation to generation through the same processes today as it was in the past.

Evolution is the process of biological change by which populations become different from their ancestors over many generations. Differences develop in populations due to changes in the genetic material of individuals and the genetic make-up of populations. These changes build up over time, so the more recently two species shared a common ancestor, the more closely related those species are to each other. A **common ancestor** is an ancient species from which two or more species evolved.

Evolution of Populations over Time

Whales and fish have similar body shapes. However, they are not closely related. Whales share a more recent common ancestor with land animals than they do with fish. In fact, whales' closest living relatives are hippos! Whales are very different from fish. They have lungs, nourish developing young inside the female's body, and produce milk. These characteristics are different from those of fish, but they are shared with mammals such as hippos.

Scientists learn about evolutionary relationships in many ways. They use a variety of evidence, including fossil evidence. They also analyze body structures and genetic evidence. All of these types of evidence support the hypothesis that modern whales evolved from hoofed mammals called *Anthracotheres* that lived on land.

Most Recent Common Ancestor of Whales and Hippopotamuses

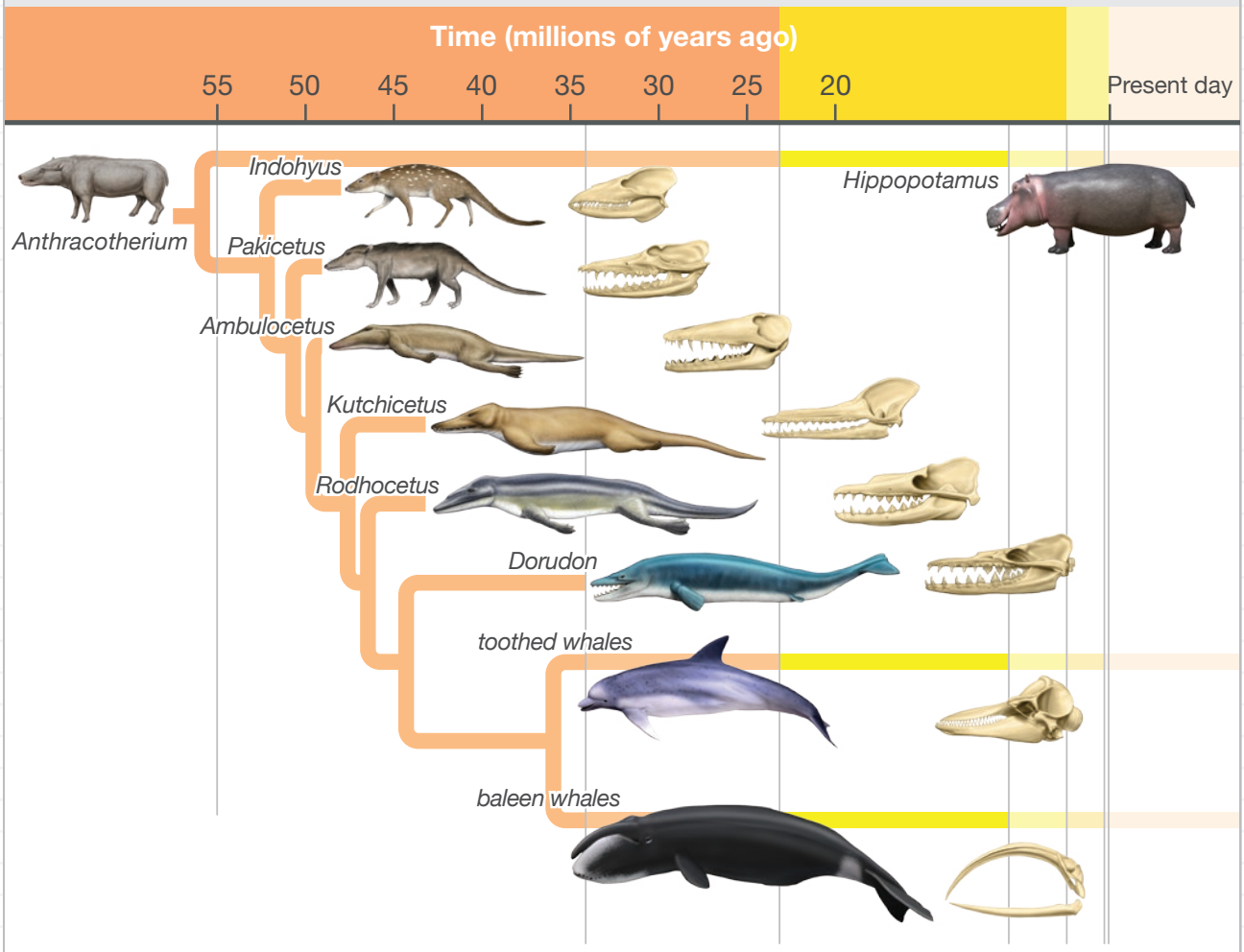
Anthracotheres lived around 50–60 million years ago. Over many millions of years, *Anthracotherium* populations evolved and developed into two main groups of organisms.

One group that is descended from Anthracotheres lived entirely in water. This group includes all species of whales and dolphins.

The other group lived mostly on land. Today, there are two species of hippos. They are the only remaining members of that group of land animals.

Evolution of Whales

The extinct species shown here are all ancient relatives of whales. The fossils of these extinct species have skeletal features that are similar to whales. Some features, such as the ear structure of the *Pakicetus*, are very similar to modern whales but unlike any other known mammal.



Credit: Adapted from The Tangled Bank by Carl Zimmer. Copyright © 2012 by Roberts and Company Publishers. Adapted and reprinted by permission of Macmillan Publishing Company.

4. Genetic information, in the form of DNA / fossils, gets passed from generation to generation. Because of this, offspring look similar to / very unlike their parents. Over time, genetic changes add up. Populations come to look more and more similar to / different from their ancestors. For whales, this explains why Pakicetus / Rodhocetus looks the most different from modern whales. It looks most different because it is a very ancient / recent relative of whales.

5. Which conclusion can be made from the diagram of whale evolution?

A. All known whale ancestors had four legs.

B. Whale ancestors transitioned from land to water habitats.

C. Only skulls show evidence of relationships among whale ancestors.

D. Whales always existed in their current form, along with many other relatives.

Engineer It

Apply the Use of 3D Printing to Model Fossils

Fossils can be both fragile and tiny, making them very difficult to study. One solution to this problem is using 3D printing technology. People can use 3D printers to make copies of fossils out of sturdy materials such as plastic. They can even make copies that are smaller or larger than the original fossil. Another advantage of 3D printing is that many copies of the fossil can be made.

A 3D printer allows this scientist to create a large model of a tiny 100 million-year-old fossilized ant.

6. Propose at least two ways that 3D printing could help students who are interested in studying fossils but cannot access actual fossils.

Evidence of Evolutionary Relationships

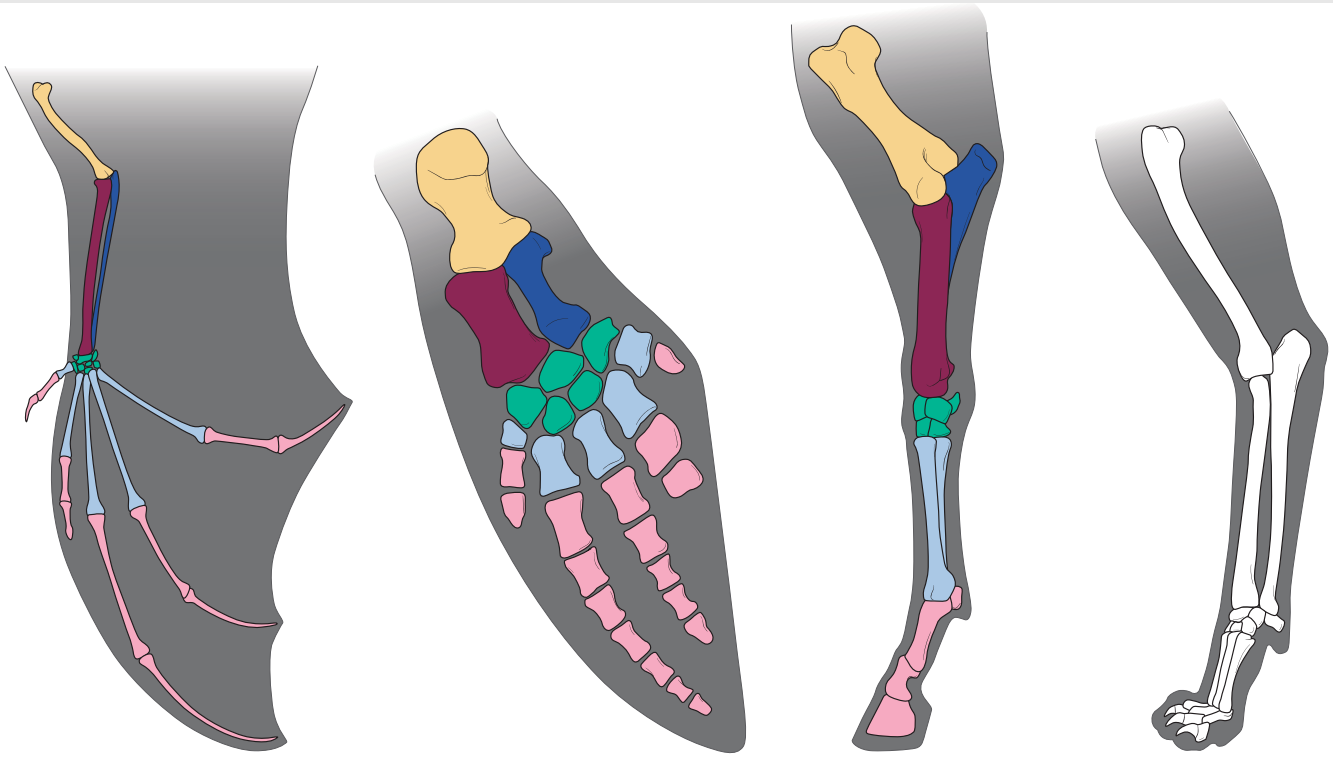
Evolutionary relationships are inferred based on evidence from the fossil record. They are also inferred from similarities in the bodies of living organisms, similarities between living and fossilized organisms, and similarities among the embryos of different types of organisms. Recently, evolutionary relationships have also been studied at the genetic and molecular level. Scientists infer that the more similar species are at any level, the more closely related they are to each other.

Similarities in Anatomy

The **anatomy** of an organism is its body structure and its structural traits. Related organisms have a similar anatomy. For example, the body structures of insects are more like those of other insects than those of birds. Consider a structural trait such as feathers. It was once accepted that only birds had feathers. Soft, fluffy feathers provide insulation. Longer, sleeker feathers enable flight. But recent fossil discoveries reveal short structures in certain dinosaur fossils that look similar to certain modern bird feathers. Scientists identified these structures as feathers. These feathers provide evidence that dinosaurs and birds are more closely related to each other than was once thought.

Similarities in the Anatomy of Front Limbs among the Bat, Dolphin, Horse, and Cat

7. The front limbs of the bat, dolphin, horse, and cat look different from each other and are used in different ways. But the skeletal structure of the limbs is similar. Use the colors of the leg bones of the bat, dolphin, and horse to color the similar bones of the cat.



bat dolphin horse cat

8. These limb bones have similar / different overall patterns of bones which can indicate a close / distant evolutionary relationship. However, the limb bones are different sizes and shapes. For example, the "finger" bones, shown in light blue and pink, are different in each animal. The form / color of the bones can help you identify the function / age of the limb.

Many four-legged organisms have similar leg structures that carry out similar functions. Similarities in anatomy can indicate evolutionary relationships. But they are not always the result of a close relationship. Some body structures evolved at different times. Some structures with similar functions also evolved in very different species. Think about the fins of whales and fish. The fins help both animals move in water. But they developed along very different evolutionary paths. So too did the wings in birds, bats, and insects. The presence and function of wings does not indicate a close evolutionary relationship between these groups of organisms because the anatomy of their wings differs so much.

EVIDENCE NOTEBOOK

9. What anatomical structures do the *Confuciusornis* fossil and the *Corvus* (crow) share? Record your evidence.

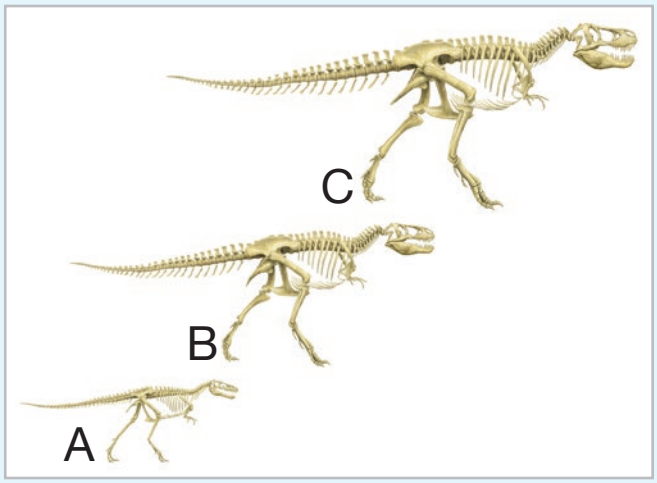
Inferring Evolutionary Relationships among Organisms

Data from fossils help scientists to make inferences about extinct organisms. For example, data from fossils can be used to infer the sizes of living things, their life spans, what they ate, and how they moved. As new fossils are found, new observations are used to support, modify, or correct earlier ideas. Understanding how living things have changed over time is an ongoing process. New information adds to what scientists understand about evolutionary processes.

Do the Math

Analyze Growth Curve Data

Scientists have found fossils of the various growth stages of many extinct species, including *Tyrannosaurus rex* (*T. rex*). Observations from these fossils are used to infer how the extinct species grew. When the different ages of *T. rex* fossils were first found, it was thought that they were different species because they looked so different. The data used to plot the graph was collected from the fossils of seven individual *T. rex*. These are the data points in the graph.



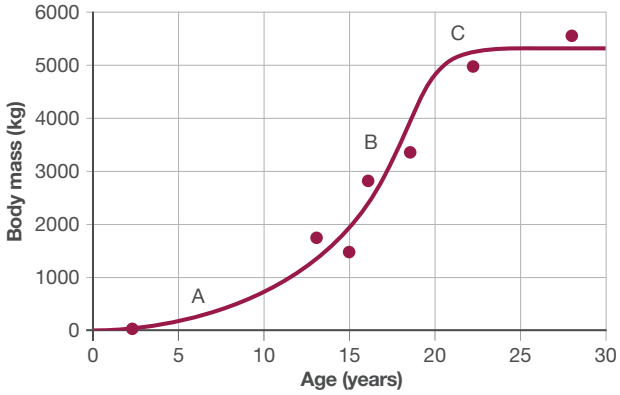
15. Imagine you are a scientist studying two different *T. rex* fossils.

- Observations from one fossil suggest it is from a *T. rex* with a body mass of about 2,000 kg.
- The other fossil is from a *T. rex* with a body mass of about 3,500 kg.

Based on the growth curve data, what is the age difference between these two fossilized dinosaurs? Why can you assume the larger *T. rex* is more mature, not just bigger? Defend your answer using evidence from the graph.

Growth Curve of *T. rex*

Points A, B, and C represent the sizes of the juvenile, adolescent, and adult *T. rex* shown in the illustration.



Credit: Adapted from "Gigantism and comparative life-history parameters of tyrannosaurid dinosaurs" by Gregory M. Erickson, et al, from *Nature*. Adapted by permission from Macmillan Publishers Ltd: *Nature* (430), 772-775. Copyright © 2004.

Hands-On Lab

Make Inferences from Evidence

You will make inferences based on visual observations. Then you will modify these inferences based on new information and data.

Scientists usually do not have all of the pieces of evidence for the topic they are studying. Instead, they work to understand the natural world by making connections, inferences, and predictions using the information they have.

MATERIALS

- picture, cut into strips

Procedure

STEP 1 Study the strips of paper provided by your teacher. Write down all observations and inferences that you can make about this picture.

STEP 2 Make a prediction about what is shown in the picture. Use your observations to support your prediction.

STEP 3 Record observations, inferences, and a prediction as you receive each remaining strip of "new information" from your teacher.

Analysis

STEP 4 Explain how you modified your prediction about what the picture shows as you gathered more information about the picture.

STEP 5 How is this process similar to how scientists make inferences from fossil evidence? How is it different?

Relationships among Fossil Organisms and Living Organisms

Body structures and other features of fossilized organisms may be similar to features present in modern organisms. In general, the more recently the fossilized organism lived, the more similar its body structures are to modern, living organisms.

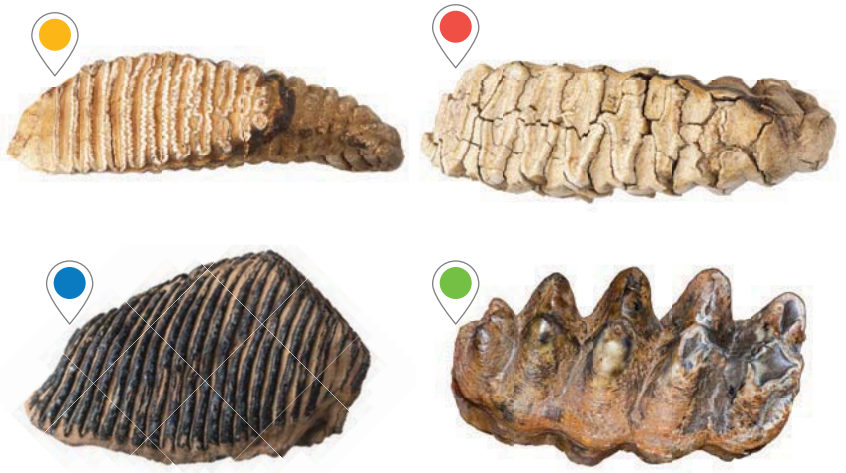
Similarities and differences in anatomy are used to make inferences about evolutionary relationships among living and extinct organisms. Scientists revise and refine their understanding of evolutionary relationships as new evidence is found.

Case Study: Evolution of Elephants

Modern elephants belong to a group of mammals that includes extinct animals such as the mammoth and the mastodon. Until recently, there were only two genuses of living elephants recognized: the African elephant and the Asian elephant. Scientists closely compared the anatomy and DNA of these elephants. This evidence suggests that there are actually two different species of African elephant: the savannah elephant and the forest elephant.

Scientists have used both anatomical data and DNA analyses to make inferences about how modern elephants are related to extinct relatives. For example, scientists use tooth shape to study relatedness among elephants and their ancestors. Modern elephants have flat, ridged teeth to grind up the tough plants they eat. Like elephants, mammoths and mastodons were herbivores. They had teeth that helped them chew their food well.

Teeth of Modern Elephants and Extinct Ancestors



Asian elephant tooth The flat surface helps to grind up grasses and shrubs.

African elephant tooth Diamond-shaped ridges help to grind up tree branches and bushes.

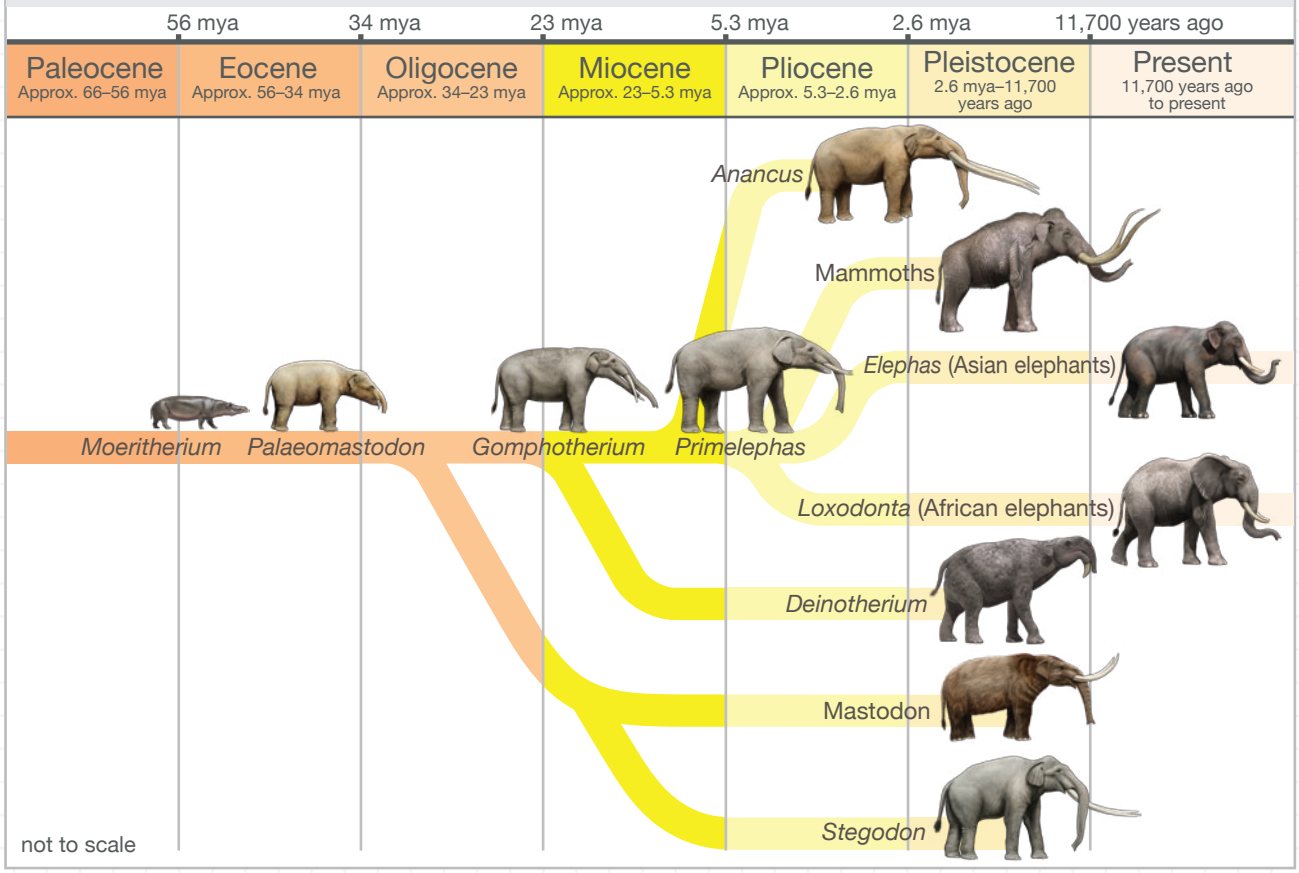
Mammoth tooth Food particles caught in a mammoth's teeth can help scientists tell what it ate.

Mastodon tooth The wavy ridges of the mastodon's tooth are very different from the mammoth tooth.

16. Look at the teeth of the four different animals. Based on the structure of the teeth, which extinct animal do you think is most closely related to the Asian elephant? Support your answer with evidence.

Elephant Lineage

The relationships in this diagram were determined by examining the anatomy of modern animals and extinct animal fossils, as well as embryological and genetic data.



17. Scientists work to understand the evolutionary history of elephants. They look at embryological / anatomical data, such as tooth structure. They infer that the Asian / African elephant is most closely related to the mammoth because both animals have very similar / different tooth structures as well as other similarities.

18. Based on the diagram, which animal—extinct or alive—would you expect to have the most anatomical similarities to the mastodon? How long ago did this animal live? Explain your answer.

EVIDENCE NOTEBOOK

19. What evidence from the extinct bird fossil supports an evolutionary relationship with living bird species? Record your evidence.

Language SmArts

Defend a Claim with Evidence

The Ashfall Fossil Beds in northeast Nebraska contain many well-preserved fossils of ancient animals. The most common fossilized animal found there is the barrel-bodied rhinoceros (*Teleoceras major*). Fossils of five different species of horses are also found at the beds. About 12 million years ago, these animals all died and were buried in volcanic ash.

The lines on this photo outline the bone structures of an extinct rhino and a horse that are found in the Ashfall Fossil Beds. It is possible to see some of the anatomical similarities between the fossilized rhino and the living rhino and between the fossilized horse and the living horse.


Black rhinoceros (*Diceros bicornis*)


Przewalski's horse (*Equus ferus*)

20. Make a claim about which fossil, A or B, is the rhino and which fossil is the horse. Use anatomical evidence from the photos to defend your claim.

Continue Your Exploration

Name: Date:

Check out the path below or go online to choose one of the other paths shown.

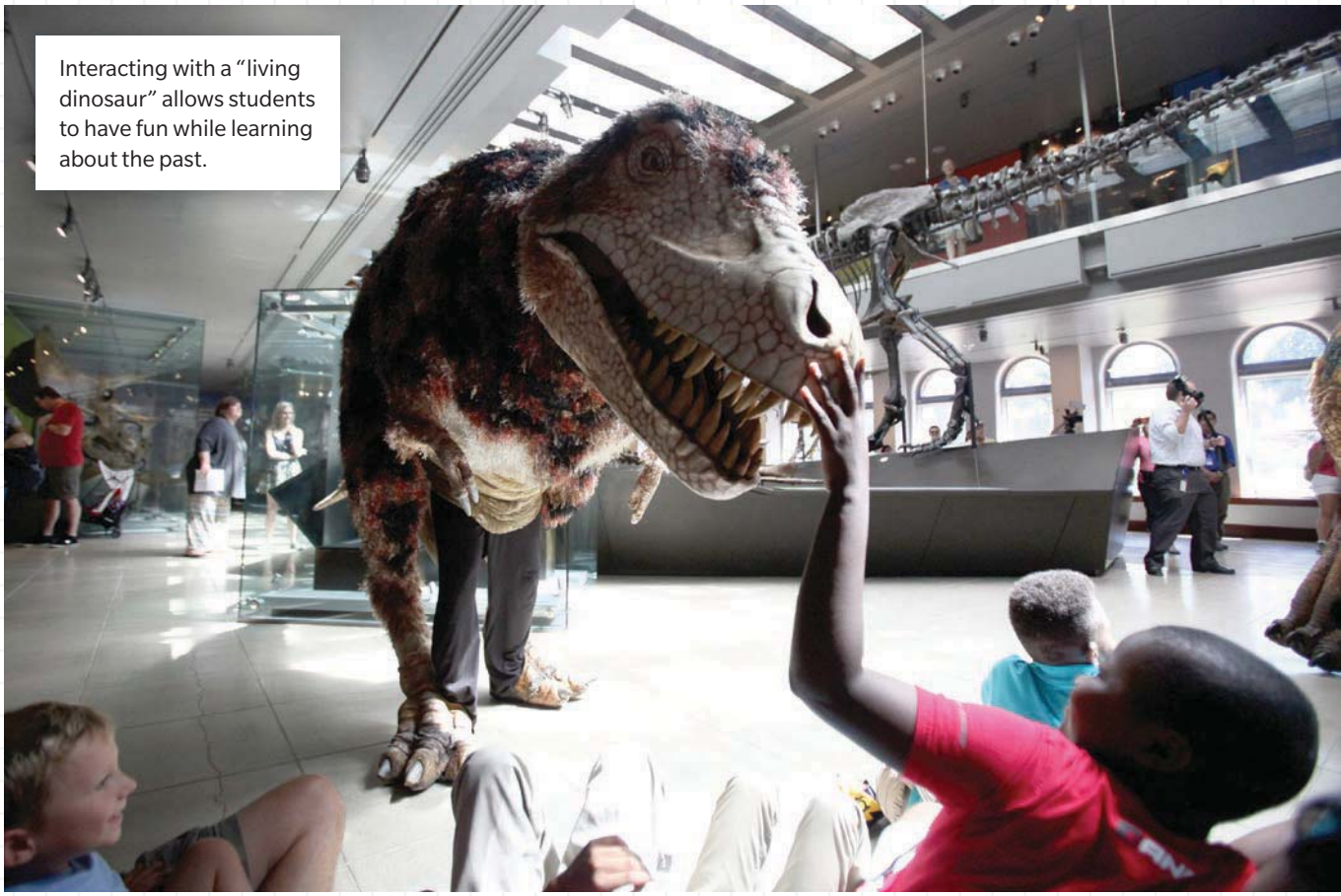
Careers in Science

- **Hands-On Labs**
- **Classification of Living Things**
- **Propose Your Own Path**

Go online to choose one of these other paths.

Museum Exhibit Designer

Museum exhibit designers and educators help communicate scientific ideas to the general public through fun exhibits. Exhibit designers use creativity and innovation to share complex ideas in understandable, engaging, and interactive ways. They need a deep understanding of scientific ideas. They also need an understanding of how people learn about science and interact with museum exhibits. A successful exhibit connects with the people who go to the museum. Designers, educators, and others often collaborate to come up with new and exciting ways to share scientific ideas with learners of all ages. Today's science museums often have many opportunities for visitors to actively participate in science.



Interacting with a "living dinosaur" allows students to have fun while learning about the past.

Continue Your Exploration

1. Think of a topic that you would enjoy learning about through a museum exhibit. Describe the topic and why you chose it.

2. Imagine you are an exhibit designer. Using words and drawings, describe how you would set up an exhibit about the topic you chose in order to share it with visitors.

3. What are some limitations you may need to consider while designing your exhibit?

4. **Collaborate** Work with classmates to design an exhibit about a topic from this lesson.
   - Identify the likely visitors to your exhibit (for example, third- to fifth-graders).
   - Propose one or two key messages that you want to communicate in the exhibit.
   - Describe or produce at least one interactive experience for your exhibit.
   - Share your exhibit design with others.

Can You Explain It?

Name: **Date:**

What evidence supports a relationship between extinct and modern birds?

EVIDENCE NOTEBOOK

Refer to the notes in your Evidence Notebook to help you construct an explanation of how evidence indicates that extinct and modern birds are related.

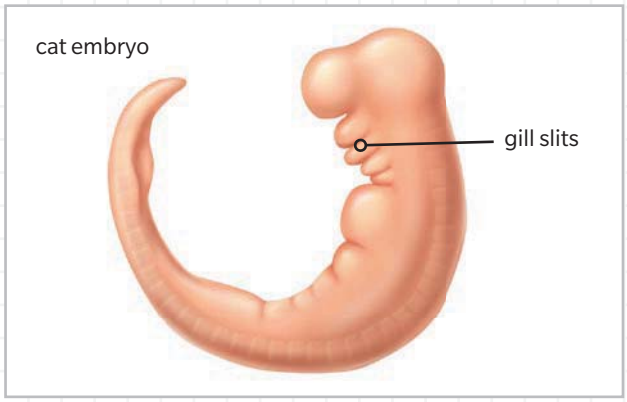
1. State your claim. Make sure your claim fully explains how the extinct and modern organisms might be related.

2. Summarize the evidence you have gathered to support your claim and explain your reasoning.

Checkpoints

Answer the following questions to check your understanding of the lesson.

Use the image to answer Question 3.



3. Gill slits are structural features in cat embryos that are / are not found in a fully developed cat. The presence of gill slits is evidence that cats share a common ancestor with chickens and other organisms that have gill slits as adults/ during embryo development.

---

4. Which of the following observations provide evidence of evolutionary relatedness among organisms? Select all that apply.

A. similarities in body structures

B. similarities in molecular structures

C. similarities in embryological development

D. similarities in the foods that organisms eat

Use the photos to answer Question 5.

5. Which statement is the most logical inference that can be made based on observations of the photos?

A. The two organisms shown are likely related because they have similarities in leaf structure.

B. The two organisms shown are likely related because the fossilized plant was green like the living plant.

C. The two organisms shown are NOT likely related because one is a fossil and the other is living.

D. The two organisms shown are NOT likely related because there is no evidence that they grow and develop in similar ways.

---

6. Which description best explains what scientists do if new evidence is found about evolutionary relationships that is different from evidence already gathered?

A. Scientists discard earlier ideas about the evolutionary relationships.

B. Scientists revise their understanding about evolutionary relationships.

C. Scientists rarely change their ideas even if new evidence is found.

D. Scientists change evidence to fit existing ideas of evolutionary relationships.

Interactive Review

Complete this section to review the main concepts of the lesson.

Offspring look similar to their parents because heritable traits are passed down from parent to offspring. Over time, genetic changes in populations build up.

A. How can anatomy be used to study relationships among different types of organisms?

Scientists use fossil, anatomical, embryological, and genetic evidence to make inferences about evolutionary relationships.

B. Explain how inferences about evolutionary relationships can change as new evidence is discovered.

Choose one of the activities to explore how this unit connects to other topics.

Social Science Connection

Uncovering the Past Archaeologists study material remains of past human civilizations to learn about human history. For example, Machu Picchu, shown here, was built around 1450 in Peru. It is made up of over 150 buildings believed to have been used by Inca leaders.

Research methods that archaeologists use to find material remains, such as remote sensing, field surveys, and excavation. Prepare a presentation that includes at least three images of artifacts found at an archaeological site. Describe how they were found and what was learned from them.

Art Connection

Paleoart Art that uses scientific evidence to depict prehistoric life is called *paleoart*. Some paleoart shows fossil remains, such as a complete skeleton, and other pieces show living creatures in their environment. Paleoart influences how people think about species that have been long extinct.

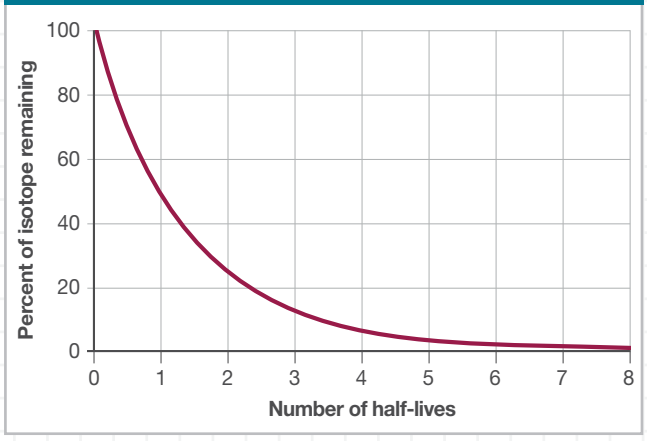
Research a paleoartist. Explore how the artist creates his/her work, including the kinds of scientific evidence used. Present a poster with your findings that includes three different images of the artist's work and descriptions explaining each piece.

Physical Science Connection

Rock Dating Radioactive isotopes are unstable particles that break down, or *decay*, into more stable particles at a precise rate. Different radioactive isotopes decay at different rates. Scientists compare the amount of a radioactive isotope to the amount of stable particles in a rock sample to find its age.

Research a radioactive isotope that scientists use to estimate the ages of rocks. Identify the *half-life* of this isotope and the stable particles that are formed. Present a graph that shows the decay rate of the isotope over time. Use the graph to help explain what a half-life is and how scientists use the decay rate to estimate the age of the rock sample in which the isotope is found.

Breakdown of a Radioactive Isotope over Time



Name: Date:

Complete this review to check your understanding of the unit.

Use the photo of the flowering plant fossil to answer Questions 1 and 2.

1. This fossil is about 50 million years old. What might this fossil provide evidence for? Select all that apply.

A. the existence of flowering plants 50 million years ago

B. the extinction of flowering plants 50 million years ago

C. similarities in structure between ancient and modern flowering plants

D. a common ancestor of certain types of modern flowering plants

2. Most fossil evidence of flowering plants is limited to grains of pollen. Why might it be rare for a complete plant fossil, such as this one, to form? Select all that apply.

A. There were not many plants 50 million years ago.

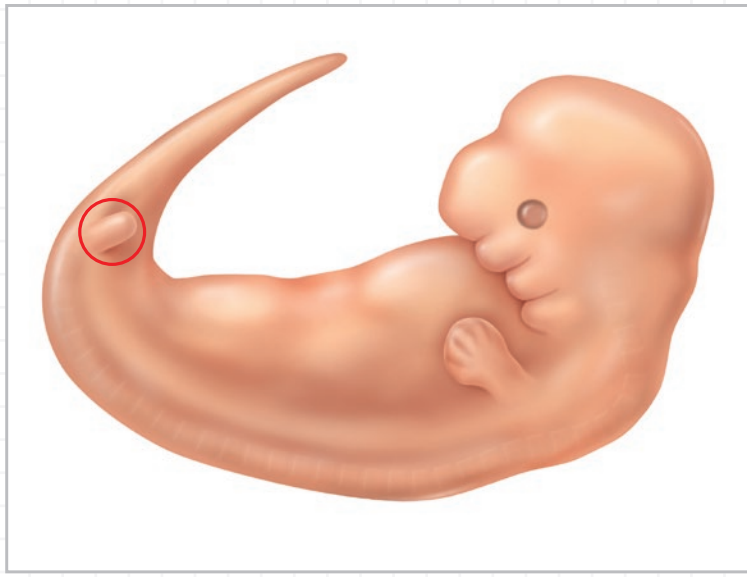
B. Wind or water can carry soft plant parts away before they fossilize.

C. Dry environments cause plants to decay too slowly to fossilize.

D. Flower parts are delicate and rarely experience the conditions needed to fossilize.

Use the illustration of the dolphin embryo to answer Questions 3 and 4.

3. The red circle on the dolphin embryo identifies the beginning of a hind leg structure. This embryo structure is / is not present in the fully formed dolphin anatomy. This structure is an example of a similarity between dolphins and other mammals that is evident / not evident in the fully formed organisms.



4. Which statement does this dolphin embryo structure provide evidence for?

A. Dolphins are more closely related to other mammals with hind legs than to fish.

B. Dolphins are more closely related to fish than to other mammals with hind legs.

C. Dolphins do not share an evolutionary relationship with other mammals.

D. Dolphins do not share an evolutionary relationship with fish.

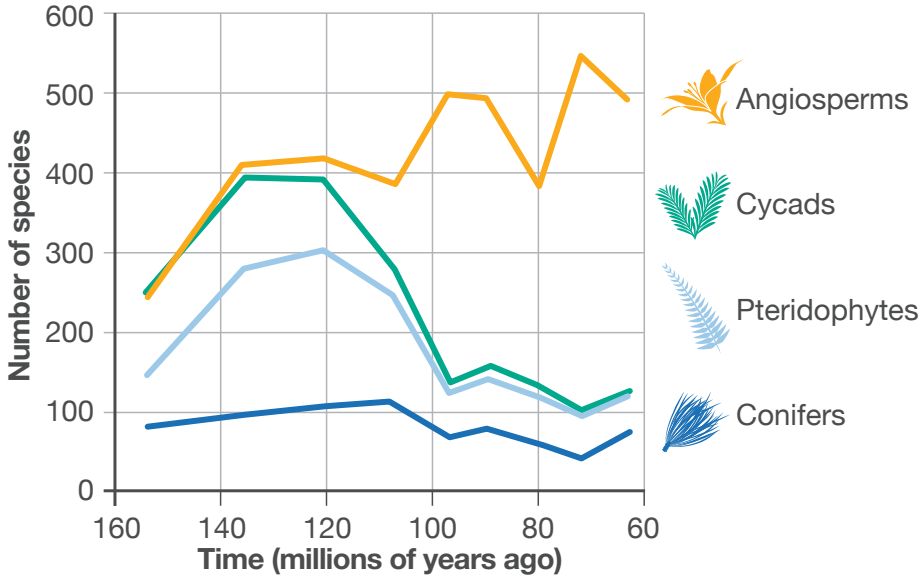
5. Complete the table by providing at least one example of how these methods of studying the history of life on Earth relate to each big concept.

Method of Study	Pattern Used to Identify Relationships	Methods of Analyzing Data	Evidence of Common Ancestry
Finding Relative Ages of Rock Layers	Deeper rock layers are older; layers closer to the surface are more recent.		
Finding Absolute Ages of Rock Layers			
Comparing Embryo Development			
Comparing Anatomical Structures			

Name: **Date:**

Use the graph to answer Questions 6–8.

Number of Species of Different Plant Types over Time



Credit: Adapted from "Quantitative analyses of the early angiosperm radiation" by Scott Lidgard and Peter R. Crane, from *Nature*. Adapted by permission from Macmillan Publishers Ltd: *Nature* (331), 344. Copyright © 1988.

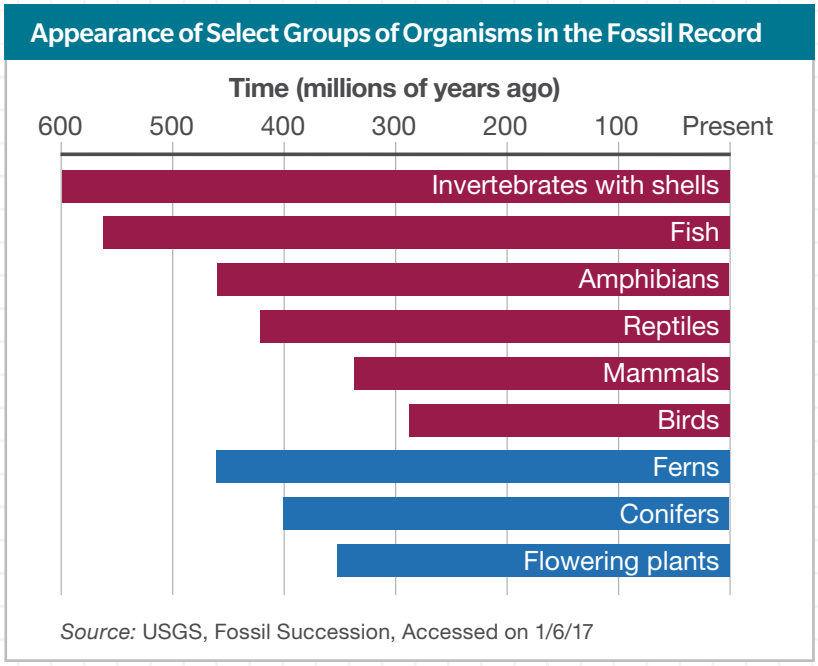
6. Scientists use fossil data to estimate the number of species for each plant type over time. Explain how they estimate the ages of plant fossils found in different rock layers.

7. Which group of plants has had the most extinctions during the time frame shown in the graph? When did most of these extinctions occur? Explain your answer.

8. Construct an explanation for the pattern in the number of flowering plant species during the time period when many other plant species were going extinct.

Use the chart to answer Questions 9–12.

9. Which group of organisms represented in this graphic appears earliest in the fossil record? Which group appears most recently?



10. Would you expect the earliest mammal fossils to be found in deeper or shallower layers of rock than the earliest fern fossils? Explain your reasoning.

11. Describe how this graphic provides evidence for the general pattern of increasing diversity of life over time.

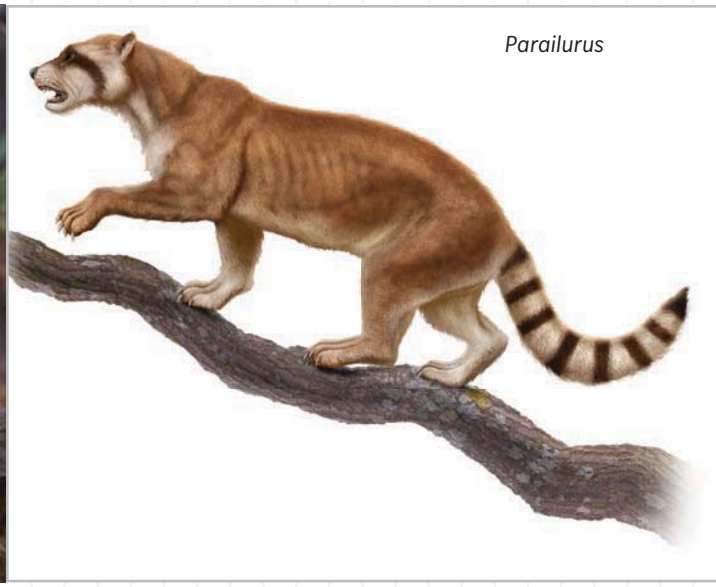
12. Only multicellular organisms are represented in this graphic. Given that most fossils older than 500 million years are single celled marine organisms, describe the changes in the level of complexity of organisms in the fossil record over time.

Name: Date:

Which species is more closely related to the red panda?

Examine the images of the red panda and the *Parailurus*. The *Parailurus* has been extinct for about three million years. Scientists have discovered fossil remains of the *Parailurus* in Japan, North America, and Europe. The *Parailurus* is the closest ancestor of the red panda, but what is the red panda's closest living relative? Some scientists have classified the red panda with the giant panda, others have classified it with the raccoon family. Use evidence to make a claim about which of these living species is likely more closely related to the red panda.


red panda


Parailurus

The steps below will help guide your research and develop your explanation.

1. **Ask Questions** How can an extinct species be an ancestor to a living species? Why would you expect organisms with similar anatomy to be more closely related? What questions do you have about the red panda that might help you determine its closest living relative?

2. **Conduct Research** Find information about the anatomy of the red panda, the giant panda, and the raccoon, including their sizes.

3. **Develop Diagrams** Create diagrams that illustrate the anatomical structures and relative sizes of the red panda, the giant panda, and the raccoon.

4. **Analyze Diagrams** Use the diagrams to identify anatomical similarities and differences among the three living species.

5. **Construct an Explanation** Write an explanation as to whether the giant panda or the raccoon is likely the closest living relative to the red panda. Use evidence from your analysis of anatomical structures and a description of the relationship between genetic makeup and anatomy to support your reasoning.

Self-Check

	I explained how an extinct species can be an ancestor to a living species.
	I conducted research on the red panda, giant panda, and raccoon.
	I developed diagrams to compare the anatomies of the red panda, the giant panda, and the raccoon.
	I analyzed my diagrams to identify anatomical similarities and differences.
	I constructed an explanation based on an analysis of anatomical structures.

Grades 6-8 Social Studies
January Continuous Learning Packet

OPENER:

Political Powers and Achievements (500-1500 CE)

Practice 1: Getting Familiar

➡ **Directions:** Examine the list of words and phrases below, then rate each one according to the following scale.

1	I have no idea what this word means.	**2**	I think I've heard of it!	**3**	I can tell you something about it!	**4**	I can define it!	**5**	I can use it in writing and speaking!

Example:

2	**conquer**	3	**conquest**	3	**consolidate**	5	**diverse**	1	**empire**

	centralized		**codify**		**decentralized**		**divergent**
	feudalism		**interdependence**		**manorialism**		**power vacuum**
	reform		**secular**		**social mobility**		**unify**

Practice 3: *Visualize*

➡ **Directions:** Using the definition provided, create an image to represent each word.

Word	Definition	Symbol/Image
centralized (v.)	controlled by a single government or person	
codify (v.)	to arrange into a system of rules or laws	
decentralized (v.)	loosely organized system in which many people have power in different areas, but they are not unified by any one government or person	
divergent	tending to develop differently, or in different directions	

feudalism (n.)	a decentralized system of power in which land owned by a powerful person is divided up and given to others in exchange for work and a promise to fight for the interests of the land owner	
interdependence (n.)	the state of needing another person or group of people	
manorialism	an economic system used in Western Europe in the Middle Ages in which a group of people lived on a lord's;s estate called a manor. The lord (sometimes a king or knight) allows peasants called serfs, or people bound to the land, farm the land. In exchange for farming and repairs, serfs were protected by their lord in the event of a war or raid. The manor was self-sufficient which meant that the peasants produced most of everything they needed including food, clothing, tools and furniture. They did not need to trade with others for their basic needs.	
power vacuum	a condition that exists when someone has lost control and no one has replaced them	
reform	(v) to change; (n) a change	

secular	non-religious	
social mobility	the ability to become part of a social class other than the one someone is born into	
unify	to bring together as a single unit	

Practice 4: *Correct, Incorrect, Explain*

➡ **Directions:** Read each statement and determine whether the bolded word is used correctly or incorrectly. If the bolded word is used correctly write a "C" in the second column and move on to the next statement. If the bolded word is used incorrectly, write "I" in the second column, then rewrite the sentence so it conveys the correct meaning of the word. You may need to change the word, or rewrite the whole sentence.

	C or I	**If "incorrect," *rewrite the sentence correctly***
1. An example of a **centralized** government is when many people hold power in different locations throughout a nation.		
2. When the Babylonians decided to **codify** the Code of Hammurabi, it was the first time in history that laws had been written down.		
3. A **decentralized** government usually has a single ruler who controls the entire nation.		
4. Even though Sparta and Athens were both Greek city-states, they developed **divergent** values.		
5. An example of **interdependence** is when people and regions do not depend on one another to meet their needs.		
6. When there is a **power vacuum,** someone has absolute control.		
7. An example of a **secular** law code is the 10 commandments.		

8. In a social structure with **social mobility,** I am required to stay in the social class I was born into.		
9. To **unify** a society is to divide everyone into smaller groups.		

Objective:

What and when was the post-classical era?

- **Identify** characteristics that post-classical civilizations had in common.

Introduction

Predict

➡ **Directions: Read the words and sentences and examine the images below, then respond to the prompts that follow.**

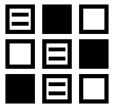
Word	Image	Sentence
postgame conference	 Citation 1	After the basketball finals, members of both teams and their coaches attended the **postgame** conference where they answered questions about the game.
post-production	 Citation 2	After a movie has been filmed, it is sent to **postproduction** where the video and audio are matched, and mistakes are re-recorded in a studio.
post-surgery	 Citation 3	To recover after she had her appendix removed, Sara was sent to the section of the hospital called **Post-Surgery** where she was taken care of by doctors and nurses and taught how to take care of herself in the coming months.

1. Based on the information above, what do you think the prefix "post" means? How do you know?	**2. The time period you are going to learn about in Units 4, 5, and 6 is called the post-classical era. Based on your response to question 1 and your understanding of Global History, what do you think "post-classical" means?**

What is periodization? How are periods determined and named?

➡ **Directions: Review the definition below and answer the questions that follow.**

Categorize



Identify Patterns

<u>Periodization</u>-the process or study of dividing the past into periods of time and naming them

Sometimes when historians engage in ***<u>periodization</u>***, the ways they divide up the time and the labels they give to time periods has an effect on the way people think about that era and what happened during it.

1. What was the name of the time period you studied in the last unit?	**2. What were the common characteristics of the civilizations you studied in the last unit?**

Predict

What and when was the post-classical era? What makes a civilization "post-classical"?

➡ **Directions: Examine the text, timeline, and images below having to do with the Post-Classical Era, then respond to the accompanying prompts.**

The time period you will study in Units 4, 5, and 6 is known the

"Post-Classical Age"
"Post-Ancient Era"
"Pre-Modern Era"
"The Middle Ages"

1. Based on the names given to this era, what do you think you might learn about it?

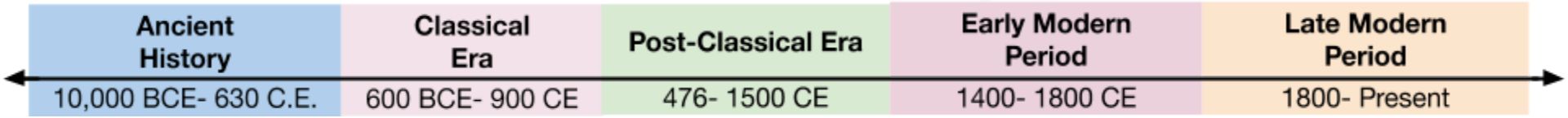
2. Circle the words or phrases in the definition to the right that you do not know or are confused by.

3. Based on the definition to the right, why do you think we study the Post-Classical Era?

Post-Classical Era/Period/Age (476-1500 CE)

Period of time when the first large empires that were established in the Classical Era lost their power to rising states which established ***land empires*** in a world that was more ***interconnected through trade*** than earlier civilizations. Increased interconnectedness led to greater **cultural diffusion** and **conflict**. These civilizations made great contributions to our collective learning as a result of ***golden ages*** marked by prosperity. During the post-classical era, ***major belief systems*** that still impact our world gained popularity and had a large influence on empires and those who lived in them.

Timeline of Human History



4. Based on the timeline above and your knowledge of Global History, during which time period were the first early river valley civilizations founded?

5. Based on the timeline above and your knowledge of Global History, during which time period was the Roman Empire at its height?

Before we proceed, a quick note about time periods...

The **Middle Ages** are the time period from 476 CE to around 1450 CE in Western Europe. Sometimes the whole post-classical era is referred to as the Middle Ages, but it is referred to the "Middle" Ages because historians viewed it as an less important time period between Rome and the Early Modern Period, and since Rome and the birth of the Early Modern Period happened in Europe, we will only consider the Middle Ages to be an era specific to Europe.

Medieval Europe

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Europe during the Middle Ages

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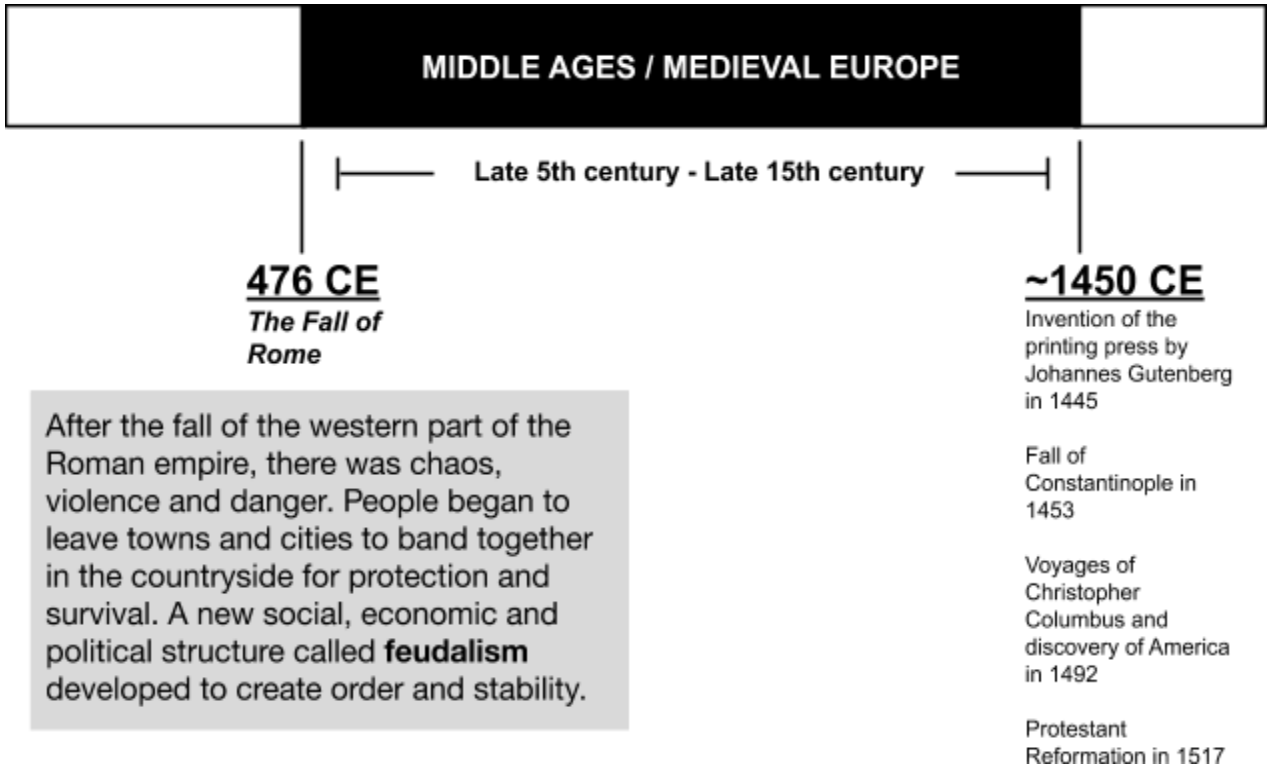
5th century (400s) CE - 15th century (1400s) CE



What happened during the post-classical era?

➡ **Directions: Watch this video entitled "The Middle Ages in 3 1/2 minutes" then respond the prompts below.**

See List three things you ***see*** in the video.	**Think** Based on your observations, what do you ***think*** you will learn about in the post-classical era?	**Wonder** Write two questions you have about what you saw in the video.

FA

SQ 1. What and when was the post-classical era?

➡ **Directions: Using evidence from the information above, respond to the task below in the space provided.**

Predict

Task:

- Predict three things you'll learn about in the upcoming unit.

Objective:

Where were post-classical civilizations located? How interconnected were they?

- **Identify** where post-classical civilization were located.
- **Describe** how interconnected Classical Civilizations were.

Introduction

➡**Directions:** Label the continents, regions, and bodies of water listed on the map below.

Continents			Regions		Bodies of Water	
North America	Asia	South America	Middle East	South Asia	Atlantic Ocean	Indian Ocean
Africa	Europe	Antarctica	East Asia	North Africa	Pacific Ocean	Southern Ocean
Australia					Mediterranean Sea	

Post-Classical Era/Period/Age (476-1500 CE)

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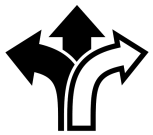
In this lesson, you will examine the geographic location of the post-classical civilizations and their expansion and contraction over time.

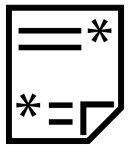
Mapping Post-Classical Civilizations

➡**Directions: As you read the maps below, complete the annotation steps for each map, and then answer the questions accompanying each map.**

Think Like a Geographer



Predict



Annotate

1. **Find** and **read** the **legend, and labels** on the map.

2. Put a **question mark** next to **information on the map that confuses you.**

3. **Write notes on the map or in the margins** with information that you think relates to the map or questions you have.

Remember, when analyzing a map:

1. Examine the **DOGSTAIL**
Date, **O**rientation, **G**rid, **S**cale, **T**itle, **A**uthor, **I**ndex, **L**egend/**K**ey, **S**ources

2.Determine what each **symbol** on the map represents.

3. **Contextualize:** Identify where the region on the map is in the world and what is around it.

Map #1: Classical Civilizations in 200 CE

Adapted by New Visions from TimeMap of World History (www.timemaps.com) page: https://www.timemaps.com/history/world-200ad/

1. Which two civilizations controlled the greatest amount of land in 200 CE?

2. Identify the *three* continents that the Roman Empire controlled land on.

3. Based on your knowledge of Global History, identify two reasons why the Roman Empire declined.

Map #2: Post- Classical Civilizations in 500 CE

Adapted by New Visions from TimeMap of World History (www.timemaps.com) page: https://www.timemaps.com/history/world-500ad/

4. Which civilization had control of most of South Asia in 500 CE?

5. To travel from the Byzantine Empire to the Persian Empire in which direction would a merchant have to go?

6. Looking at Map #1 and Map #2, what changed in Europe and East Asia between 200 CE and 500 CE?

Map #3: Post- Classical Civilizations in 750 CE

Adapted by New Visions from TimeMap of World History (www.timemaps.com) page:https://www.timemaps.com/history/world-750ad/

7. Identify three continents on which the Islamic Caliphate controlled land in 750 CE.

8. Based on Map 2 and Map 3, which empires lost power as a result of the expansion of the Islamic Caliphate?

9. Identify two empires that controlled land that the Silk Roads passed through.

Map #4: Post- Classical Civilizations in 979 CE

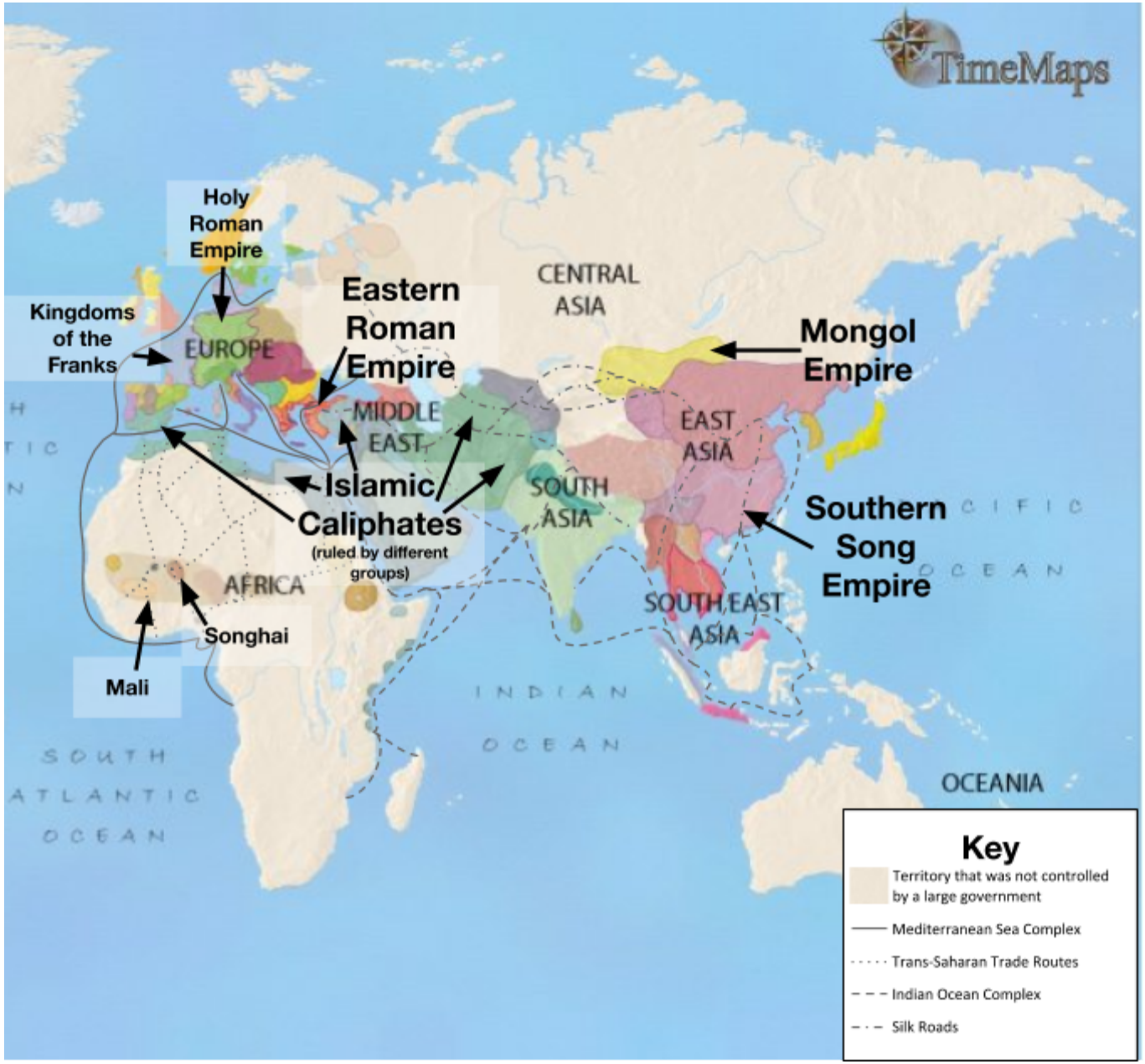
10. According to Map 3 and Map 4, what changed in east Asia between 750 and 979 CE?

11. How did the Islamic Caliphates change between 750 and 979 CE?

12. What trade routes connected West Africa with the Middle East? How might this have affected the people who lived in Ghana, Mali, and Songhai?

Adapted by New Visions from TimeMap of World History (www.timemaps.com) page:https://www.timemaps.com/history/world-979ad/

Map #5: Post- Classical Civilizations in 1215 CE



13. Based on Maps 2, 3, 4, and 5, how did the Byzantine Empire change between 500 CE an 1215 CE?

14. What new empire emerged in central Asia in 1215?

FA

SQ 2: Where were post-classical civilizations located? How interconnected were they?

➡ **Directions: Using evidence from the documents above, respond to the task below in the space provided.**

Think Like a Geographer

Relative location is a description of where a place is in relation to how a place is related to other places.

Task 1

Using the maps in the lesson above, write one sentence to describe the *relative location* of post-classical civilizations using the bank of cardinal directions below. For example, Canada is *north of* the state of New York.

North	East	West	South	West	South	Northeast	Northwest

1. Describe the location of the **Byzantine Empire** in **500 CE** relative to *at least two* geographic features, regions, or other civilizations.

2. Describe the location of the **Islamic Caliphate** in **750 CE** relative to *at least two* geographic features, regions, or other civilizations.

3. Describe the location of the **Tang Dynasty** in **750 CE** relative to *at least two* geographic features, regions, or other civilizations.

4. Describe the location of the **Mali Empire** in **1215 CE** relative to *at least two* geographic features, regions, or other civilizations.

Task 2

➡ **Directions: Based on what you have learned about trade routes and networks during the Post-Classical Era, complete the prompts below.**

Think Like a Geographer

Construct Arguments

Interconnectedness is the state of regions and societies being connected, or in contact with one another. For example, during the classical age, different regions were connected through the Silk Roads.

Description of good	**Could the good have been traded between the regions specified?**	**Explain how or why not** If it could have been traded between those regions, then explain how by identifying *which regions* the good could have travelled through, *which bodies of water* it could have crossed, and *which trade networks* it would have been traded through. If the item could NOT have been traded between the regions identified, then explain why.
Paper making technology from **East Asia** was traded in the **Middle East.**	**YES** **NO**	
Gold from **Mali** was traded in **East Asia**.	**YES** **NO**	
Pepper from **Southeast Asia** was traded in **the Byzantine Empire.**	**YES** **NO**	

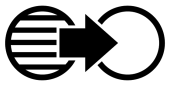
Objective:

How did the fall of Rome impact Western and Eastern Europe?

- **<u>Describe</u>** how the fall of Rome affected Western and Eastern Europe during the post-classical era.

Introduction

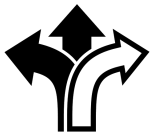
➡ **Directions: In the space provided below, recall reasons why the Roman Empire "fell" and predict the effects of this turning point.**



Recall:
Causes for the Fall of Rome

Predict:
Effects of the Fall of Rome

Connect Cause and Effect



Predict

_____

_____

_____

Turning Point: The Fall of Rome

_____

_____

_____

Before we proceed, a quick note about time periods...

The **Middle Ages** are the time period from 476 CE to around 1450 CE in Western Europe. Sometimes the whole post-classical era is referred to as the Middle Ages, but it is referred to the "Middle" Ages because historians viewed it as an less important time period between Rome and the Early Modern Period, and since Rome and the birth of the Early Modern Period happened in Europe, we will only consider the Middle Ages to be an era specific to Europe.

Medieval Europe

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Europe during the Middle Ages

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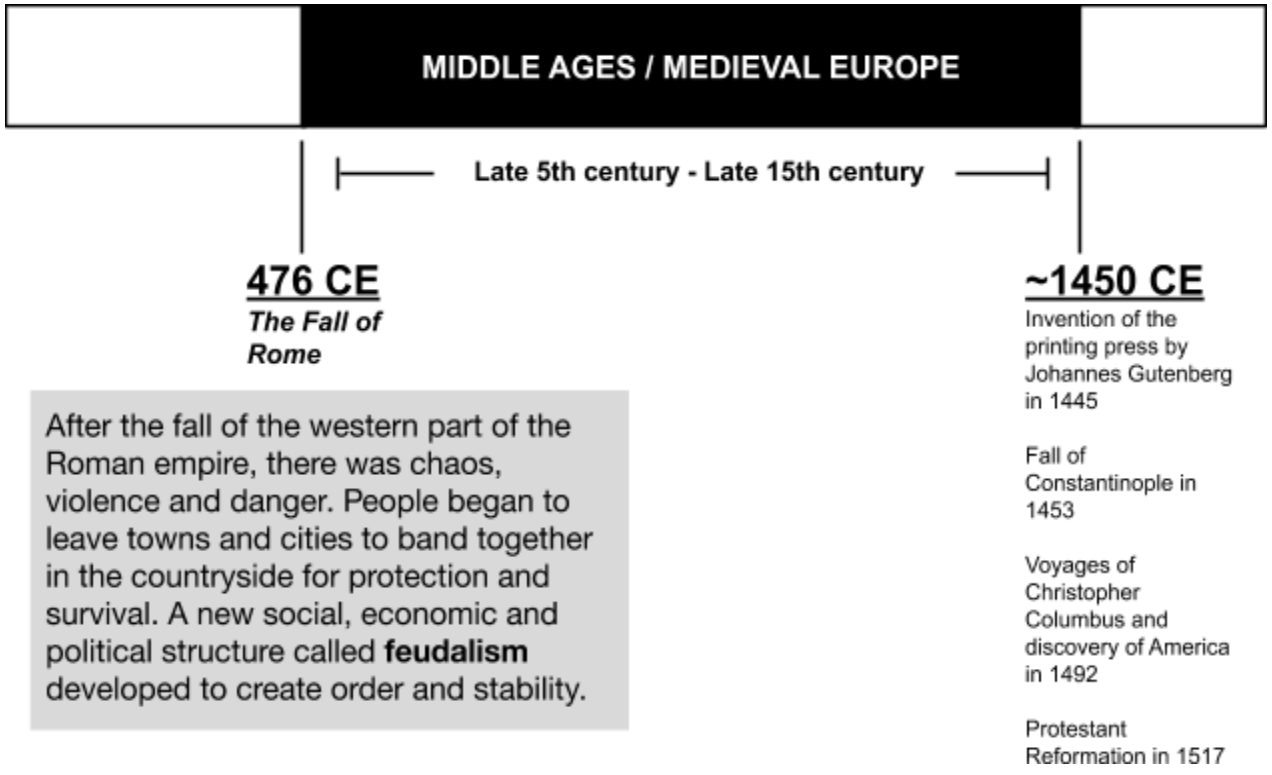
5th century (400s) CE - 15th century (1400s) CE



A Quick Review: Why did the Roman Empire fall? How did this lead to the development of Medieval Europe and the Byzantine Empire?

➡ **Directions: Complete the They Say/I Say activity below to review the causes of the fall of the Roman Empire.**

They Say	I Say
• There were several reasons for the decline including: invasions, increased taxes, political instability	**1. Identify two causes for the decline of the Roman Empire.**
• The Roman Empire did not just fall one day. Instead, it slowly declined over several hundred years.	**2. Given your knowledge of the Roman Empire, why did it take several hundred years for the Roman Empire to fall?**
• During the years of decline, emperors attempted to make **reforms** or changes to make things better to prevent the Roman Empire from completely falling apart. • In 284 CE, Emperor Diocletian decided that the empire was too large and should be split into an Eastern and Western province. Each province had its own emperor. Diocletian kept the wealthy Eastern province for himself and gave the weaker and poorer province to another emperor.	**3. Describe Diocletian's reform.** **4. Did this reform have a positive or negative effect on the Western province of the Roman Empire?**
• During the years of decline, emperors attempted to make **reforms** or changes to prevent the Roman Empire from completely falling apart. • In 330 CE, Emperor Constantine established the new capital of the Roman Empire called Constantinople in the Eastern province. The Eastern province of the empire became the center of power.	**5. Describe Constantine's reform.** **6. Did this reform have a positive or negative effect on the Western province of the Roman Empire?**
• Despite all these reforms, by 476 CE, the Western province of the Roman Empire fell.	**7. The Eastern province of the Roman Empire did not decline as drastically. Based on what you've read, why do you think the Western province fell?**

Western Europe vs. Eastern Europe During the Middle Ages

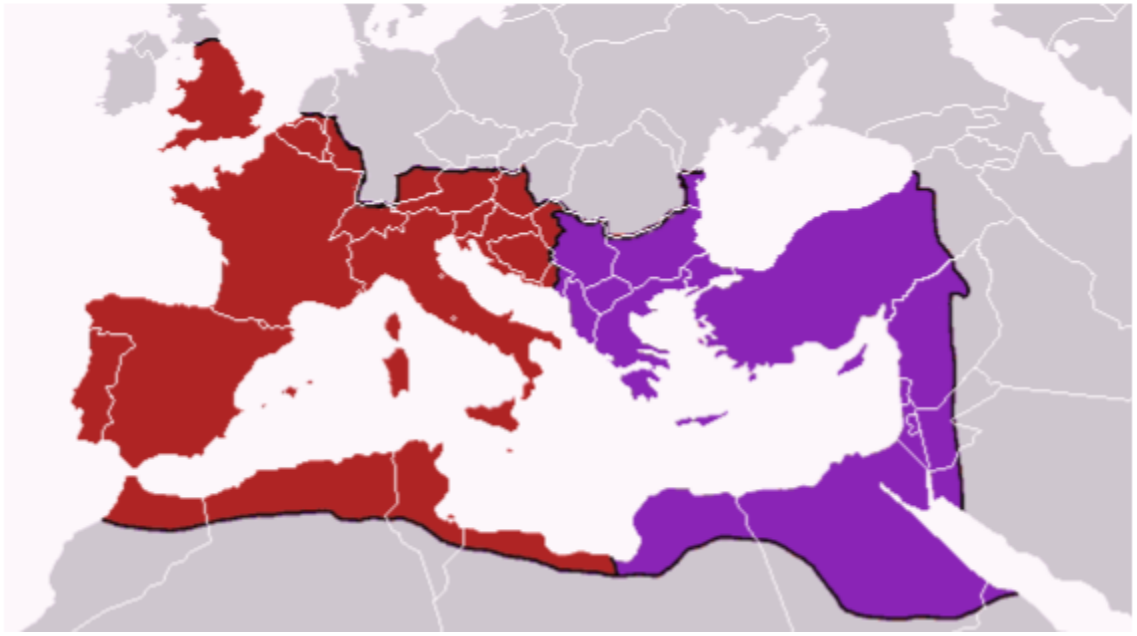
➡ **Directions: Examine the information below summarizing the differences between the Byzantine Empire in Eastern Europe and Western Europe during the Middle Ages, then answer the questions that follow.**

The **Middle Ages** are the time period from 476 CE to around 1450 CE in Western Europe. Sometimes the whole post-classical era is referred to as the Middle Ages, but it is referred to the "Middle" Ages because historians viewed it as a less important time period between Rome and the Early Modern Period, and since Rome and the birth of the Early Modern Period happened in Europe, we will only consider the Middle Ages to be an era specific to Europe.

Following the fall of the Western province of the Roman Empire, *divergent* societies emerged in Europe.

WESTERN EMPIRE
Medieval Europe

EASTERN EMPIRE
Byzantine Empire



Topic 1: Government

Europe and the Eastern Roman Empire, 533-600

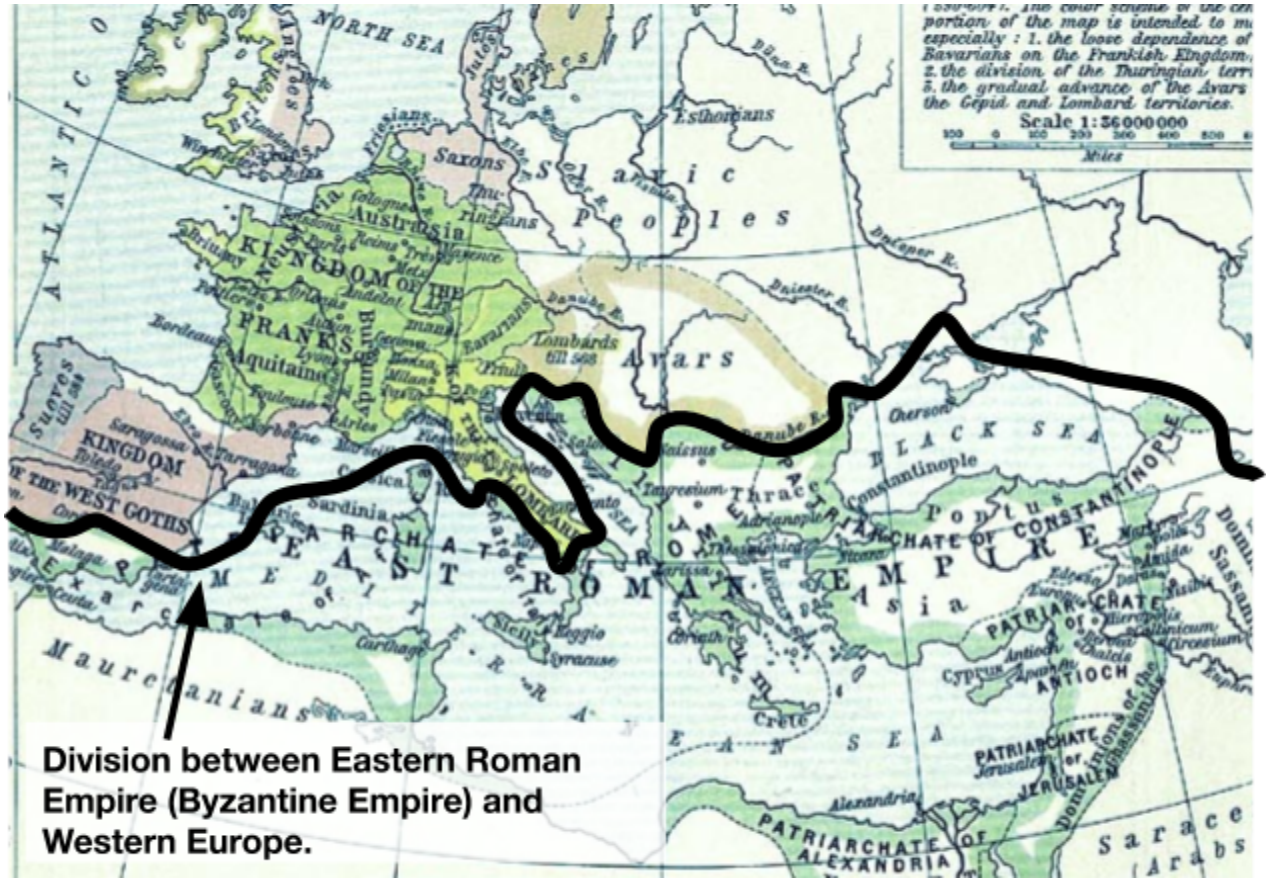


Image modified by New Visions. Original image is courtesy of Wikimedia and is in the public domain.

Question:

1. Based on the map and text provided, what was the difference between the political structures in Western and Eastern Europe after the fall of the Roman Empire? What evidence do you see from the map?

Western Europe- <u>Medieval Europe</u>

- Western Europe was divided up into small kingdoms ruled by kings who often fought against one another
- These kingdoms were often based on common cultures (ie- those who spoke French lived in the Kingdom of the Franks)
- There was no government that controlled all of western Europe as there was when the Roman Empire was in control

Eastern Europe- <u>Byzantine Empire</u>

- Ruled by the Eastern Roman Empire, later referred to as the Byzantine Empire, who had a ruling structure similar to the Roman Empire
- The Byzantine Empire brought stability to the region

Topic 2: Religion

Modern day leaders of the Roman Catholic Church (the Pope) and the Eastern Orthodox Church (the Ecumenical Patriarch of Constantinople) standing outside of the Church of the Holy Sepulchre in Jerusalem.

Western Europe- <u>Medieval Europe</u>

- The **Roman Catholic Church** was the sect of Christianity that most Christians in Western Europe followed during the Middle Ages. It started during the Roman Empire and grew in strength after the Fall of Rome.
- The Roman Catholic Church was and still is led by the Pope who lives in Vatican City in **Rome, Italy.**
- **Latin** was and is the official language of the Roman Catholic Church.
- The Roman Catholic Church was the only unifying organization in Western Europe during the Middle Ages and it had a great deal of power. For example, the Pope crowned all of the new kings and queens of kingdoms in the Middle Ages.

Eastern Europe- <u>Byzantine Empire</u>

- In 1054 CE, the **Eastern Orthodox Church** split from the Roman Catholic Church to become its own sect of Christianity.
- The Eastern Orthodox Church was and still is led by a person named the **Ecumenical Patriarch of Constantinople** who lived in the city of **Constantinople** which has been renamed Istanbul which is in modern-day Turkey.
- **Greek** is the official language of the Eastern Orthodox Church.
- During the Byzantine Empire, the emperor selected the Ecumenical Patriarch of Constantinople, giving the emperor power over the Eastern Orthodox Church.

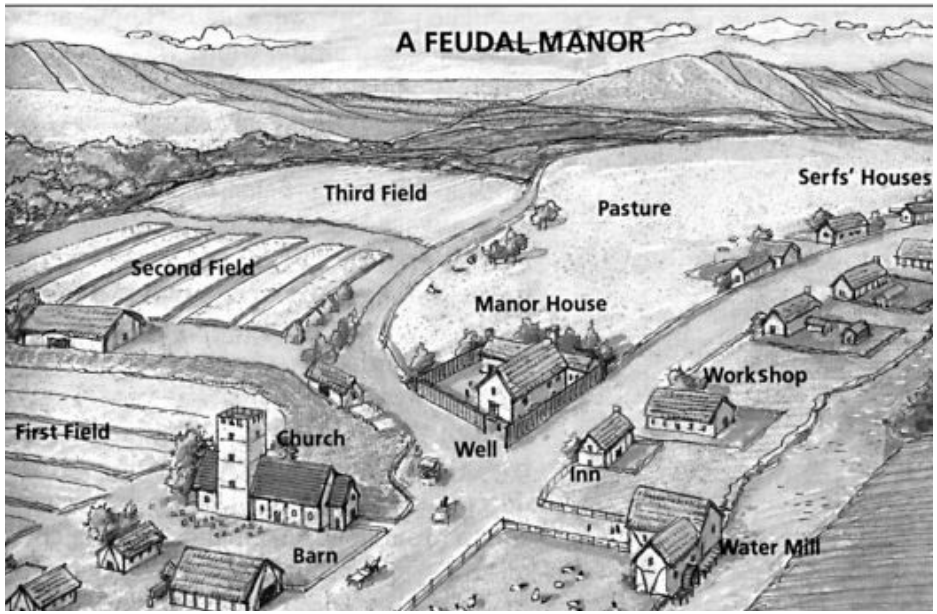
Questions:

2. Based on the image and text provided, identify *<u>three</u>*** differences between the religions in Western Europe and Eastern Europe During the Middle Ages.**

3. Based on the image and text provided, identify *<u>one</u>*** similarity between the religions in Western Europe and Eastern Europe During the Middle Ages.**

Topic 3: Economics

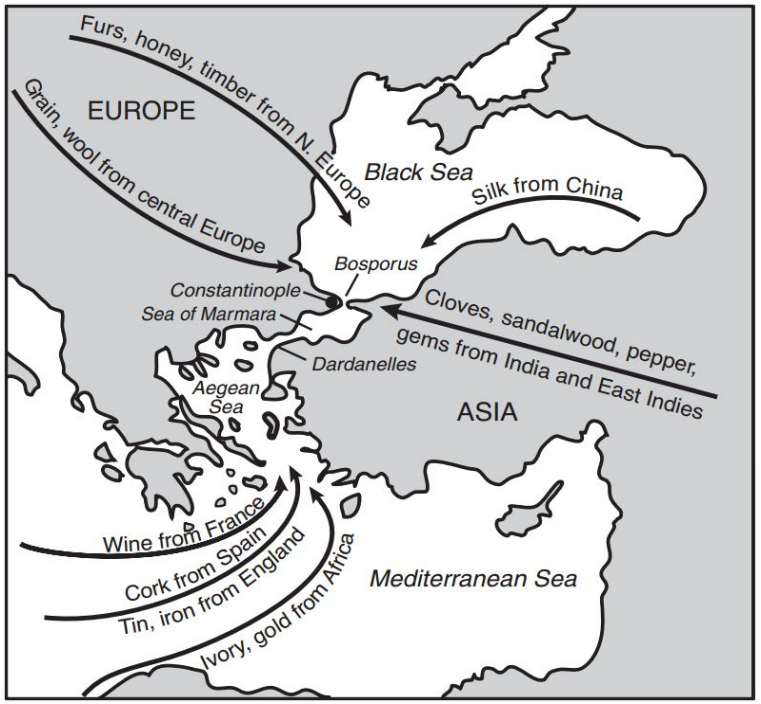
Western Europe- <u>Medieval Europe</u>



Source: Michael B. Petrovich et al., People in Time and Place: World Cultures, Silver, Burdett & Ginn, 1991 from the NYS Global History and Geography Regents Exam, January 2006.

- During the Middle Ages in Western Europe, the economic system in most places was called **manorialism**. A **manor** is a small area of land owned by a noble that included homes, farmland, artisans, water, and **serfs** (peasants that could not leave the land and who performed farm labor for the noble).
- Since each manor was mostly **self-sufficient** (provided for its own needs), trade decreased during the Middle Ages.

Eastern Europe- <u>Byzantine Empire</u>



Source: Farah and Karls, World History, The Human Experience, Glencoe/McGraw-Hill (adapted)

- The Byzantine Empire was located between Europe, Asia, and Africa. As a result, it was a crossroads of trade. Trade from the Silk Roads, North Africa, the Indian Ocean, and the Mediterranean Sea came through the Byzantine Empire.
- Constantinople, the capital of the Byzantine Empire was especially busy with trade.
- Trade made the Byzantine Empire wealthy and prosperous.

Question:

4. Based on the images and text provided, how were Western and Eastern Europe different economically during the Middle Ages?

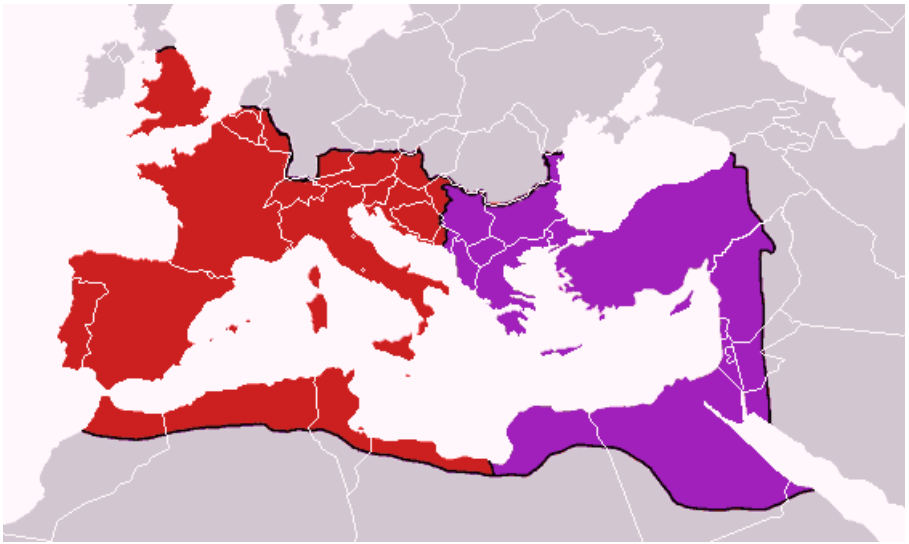
FA

SQ 3: How did the fall of Rome impact Western and Eastern Europe?

Predict

Compare

➡ **Directions:** Using evidence from the documents above, respond to the task below in the space provided.



Using the conjunctions <u>but</u>, <u>because</u>, or <u>so</u>, describe a difference between the political, religious, or economic structures in the Western Europe and Eastern Europe during the Middle Ages.

Objective:

What were feudalism and manorialism? Why did they develop in Western Europe? What effects did they have on people living in Medieval Europe?

- **Define** what feudalism and manorialism were and **describe** what effects they had on people living in Western Europe.

Introduction

➡ **Directions: Read the vocabulary word and examine the image below, then complete the See-Think-Wonder task to the right.**

Social Hierarchy

Drawing criticizing the American class structure in 1911. Source.

See

List two things you ***see*** in the image to the left.

Think

Based on your observations, what do you ***think*** about the image to the left?

Wonder

Write two ***questions*** you have about the image to the left.

Vocabulary

Social Class: A group of people with similar levels of wealth, influence, and status.

Social Hierarchy: A system in society where people are ranked by their social class.

Social Mobility: The movement of people between different social classes.

Rigid Class Structure: A social class system where there is no mobility. A person remains in the same class their entire life.

Does the image above best represent a society with social mobility or a rigid class structure? Explain.

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Medieval Europe

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Europe during the Middle Ages

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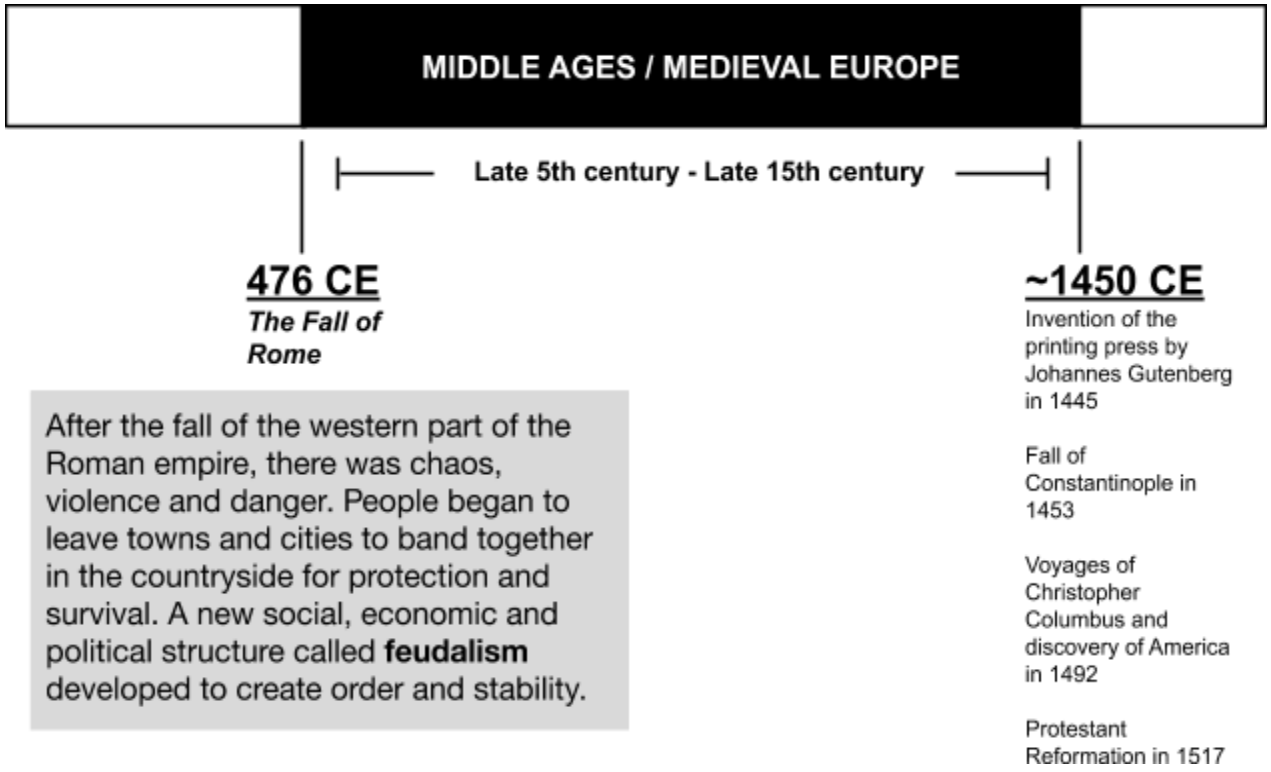
5th century (400s) CE - 15th century (1400s) CE



Contextualize

Connect Cause and Effect

Contextualize Medieval Europe, Feudalism, and Manorialism

➡ **Directions: Read the text and examine the images below, then answer the accompanying questions.**

The Fall of Rome

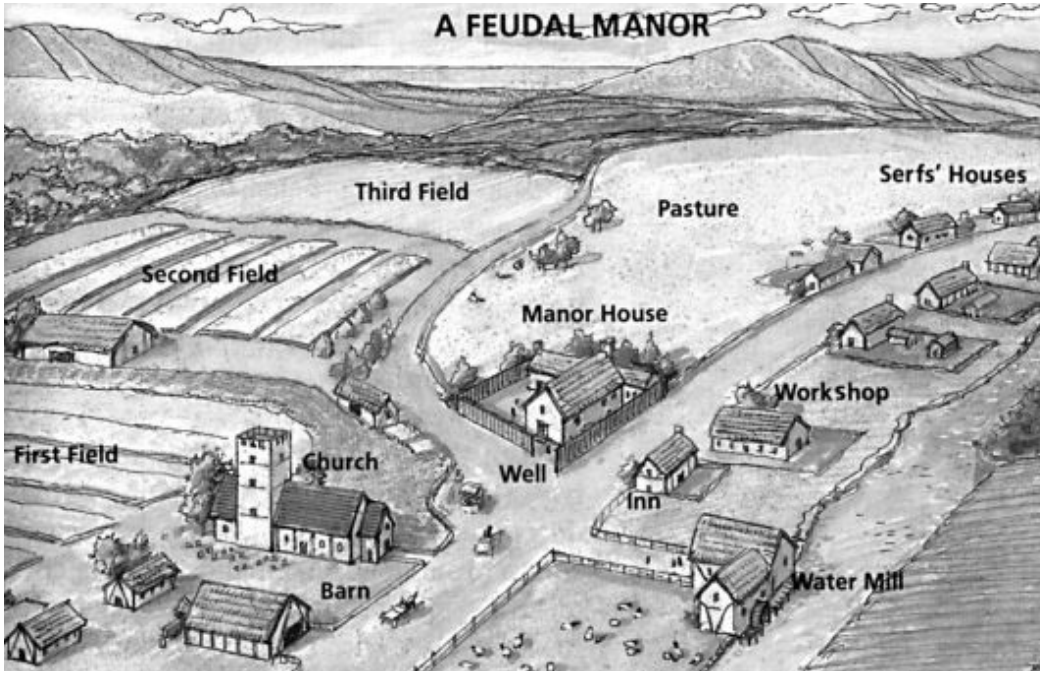
When the Western Roman empire fell in 476 CE, kings and emperors were too weak to maintain order. There was a **power vacuum**. A power vacuum is a condition that exists when someone has lost control and no one has replaced them. With the power vacuum in the western Roman empire, Europeans began fighting for **domination**. In addition to the fighting between Europeans, there were constant **invasions** by the Vikings, Muslims, and other groups. This was a time period of danger, violence, and instability.

Feudalism Brings Protection

To create a safer environment, a system of **feudalism** developed. Feudalism was a **decentralized**, or loosely organized system of rule based on land ownership. In Feudalism, kings divided up their land into **fiefs** and gave them to **lords**. Fiefs could range from a few acres to a hundred square miles. These **lords** gave fiefs to **vassals**. In exchange for the fief, the vassals pledged allegiance to their lord. This allegiance meant that they would raise armies to protect their own lands and fight for their lords. This exchange of pledges is called a **feudal contract**. This was an **interdependent** relationship with **mutual feudal obligations**.

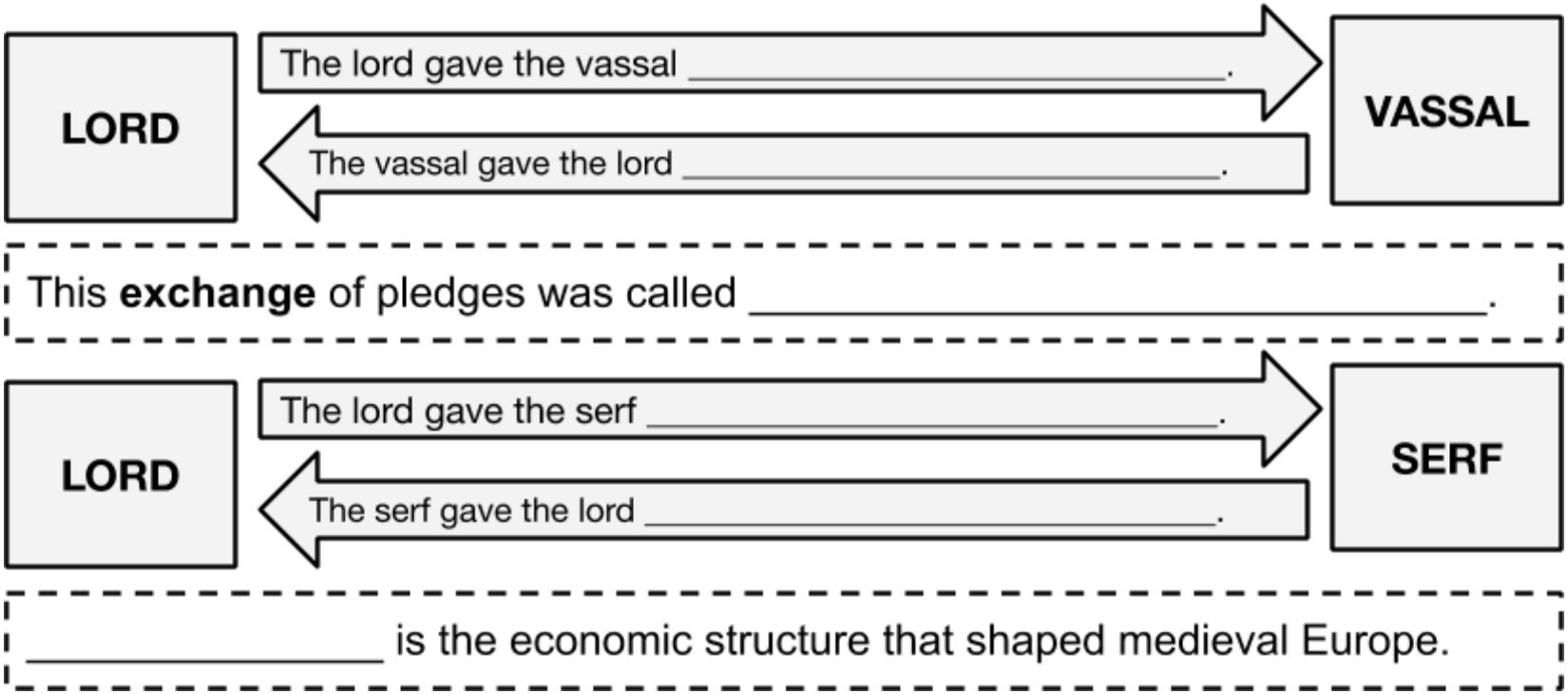
Feudalism Brings Stability

Feudalism created stability through the **manor system** which established a clear social and economic structure called **manorialism**. Manorialism was an economic system structured around the **feudal manor**, or the lord's estate. This estate included the lord's landholding, farming lands, and peasant villages. Most peasants were **serfs,** or people bound to the land. Serfs were not allowed to leave the manor without permission. Serfs made repairs and farmed the land. In exchange for farming and repairs, serfs were protected by their lord in the event of a war or raid. The manor was **self-sufficient** which meant that the peasants produced most of everything they needed including food, clothing, tools and furniture. They did not need to trade with others for their basic needs.



Source: Michael B. Petrovich et al., People in Time and Place: World Cultures, Silver, Burdett & Ginn, 1991 from the NYS Global History and Geography Regents Exam, January 2006.

1. Using the text above, complete the graphic organizer.



2. Using the diagrams and text above, respond to the following question: *Why did feudalism develop in Western Europe in the 500s after the decline of the Roman Empire?* **Use at least one of the following conjunctions in your response: but, because, so, therefore.**

The Effects of Feudalism

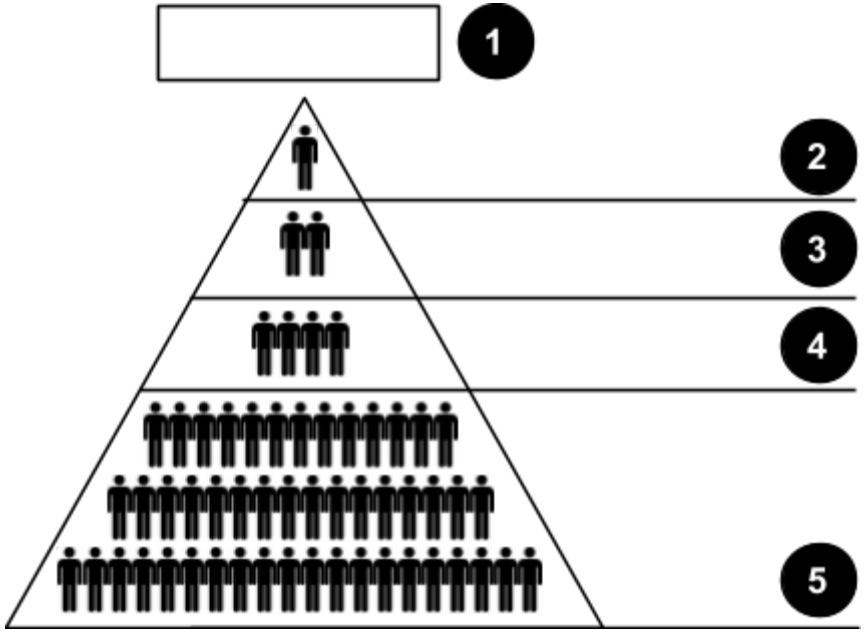
Everyone had a well-defined place in medieval society. People were born into their social positions, and there was little chance of moving beyond them.

Therefore, this was a society built around _____ (social mobility OR a rigid social structure).

➡ **Directions: Using the text to your right, place the following social classes in the correct ranking on the social pyramid.**

Social Classes:

- Serfs and Peasants
- Kings (Monarchs)
- Roman Catholic Church/Pope
- Knights and Vassals
- Lords



Serfs and Peasants: Most peasants on a manor were serfs, bound to the land. Serfs were not slaves who could be bought and sold. Still, they were not free. They could not leave the manor without the lord's permission. If the manor was granted to a new lord, the serfs went along with it.

Kings (Monarchs):
The king owned all the land and allowed the trusted nobles to govern a part of the land in return for other services.

Roman Catholic Church/Pope: In the centuries after the fall of the Roman Empire, the Roman Catholic Church carved out a unique position in Western Europe. It not only controlled the spiritual life of Christians but gradually became the most powerful **secular**, or non-religious, force in medieval Europe.

During the Middle Ages, the pope was the spiritual leader of the Western Christian Church, based in Rome. Declaring themselves representatives of God on Earth, medieval popes eventually claimed **papal supremacy**, or authority over all secular rulers, including kings and emperors.

The Church developed their own body of laws, known as **canon law**, as well as its own courts. [...] Anyone who disobeyed Church law faced a range of penalties. The most severe and terrifying was **excommunication**. Those who were excommunicated could not receive the sacraments or a Christian burial, which condemned them to hell for eternity.

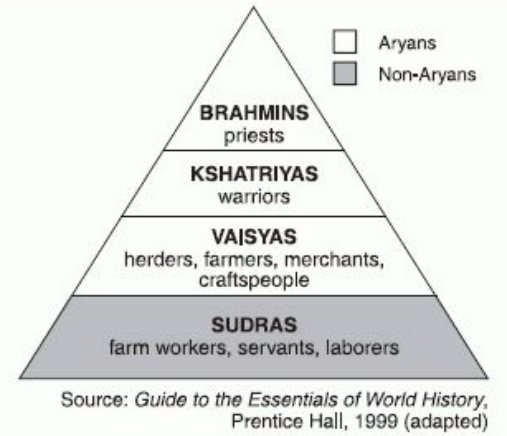
Knights and Vassals:
For medieval nobles, warfare was a way of life. Rival lords battled constantly for power. Many nobles began training in boyhood for a future occupation as a **knight**, or mounted warrior. In the later Middle Ages, knights adopted a code of conduct called **chivalry**.

Nobility (Lords): Below the monarchs were powerful lords such as dukes and counts who held the largest fiefs. Each of these lords had vassals.

Thinking Critically about Social Hierarchy

➡ **Directions: Based on what you learned in this lesson and previous units, respond to the questions below.**

Questions	Responses
1a. Which social class had the greatest amount of power in feudal Europe?	**1a.**
1b. What specific powers did this class have?	**1b.**
2a. Which class of people made up the bulk of the medieval population?	**2a.**
2b. If you were a serf, what would be your opinion of the feudal system? Why?	**2b.**



Source: *Guide to the Essentials of World History*, Prentice Hall, 1999 (adapted)

3a. What are the similarities between the feudal social structure and the Hindu caste system?

3a.

3b. What are the differences between the feudal social structure and the Hindu caste system?

3b.

FA

SQ 4. What were feudalism and manorialism? Why did they develop in Western Europe? What effects did they have on people living in Medieval Europe?

Connect Cause and Effect

➡ **Directions:** Using evidence from the documents above, respond to the task below in the space provided.

1. Define what feudalism was.

2. Define what manorialism was.

3. Write two sentences to describe the advantages and disadvantages of feudalism and the manorialism using one of the clauses below:

Even though	While	Despite that	However

Objective:

Was the Catholic Church powerful in Medieval Europe?

- **Argue** whether the Catholic Church was or was not powerful in Medieval Europe.

Introduction

➡ **Directions: Read the text below and complete the See-Think-Wonder activity that follows.**

The statements below come from a document called Dictatus Papae (1075), which stated the powers of the Pope in the Middle Ages. The Pope is the leader of the Catholic Church.

9. That of the pope alone all princes shall kiss the feet.

12. That it may be permitted to him [pope] to depose [remove from power] emperors.

14. That he has power to ordain [make someone a priest] a clerk of any church he may wish.

17. That no chapter and no book shall be considered canonical [included in a list of sacred books] without his authority.

18. That a sentence passed by him may be retracted by no one; and that he himself, alone of all, may retract it.

19. That he himself may be judged by no one.

Excerpt is from Select Historical Documents of the Middle Ages which is published on the Internet Medieval Sourcebook.

See List two things you ***see*** in the text above that interest you.	**Think** Based on your observations, what do you think about the power the pope had in the Middle Ages?	**Wonder** Write two questions you have about the text from Dictatus Papae.

Before we proceed, a quick note about time periods...

The **Middle Ages** are the time period from 476 CE to around 1450 CE in Western Europe. Sometimes the whole post-classical era is referred to as the Middle Ages, but it is referred to the "Middle" Ages because historians viewed it as an less important time period between Rome and the Early Modern Period, and since Rome and the birth of the Early Modern Period happened in Europe, we will only consider the Middle Ages to be an era specific to Europe.

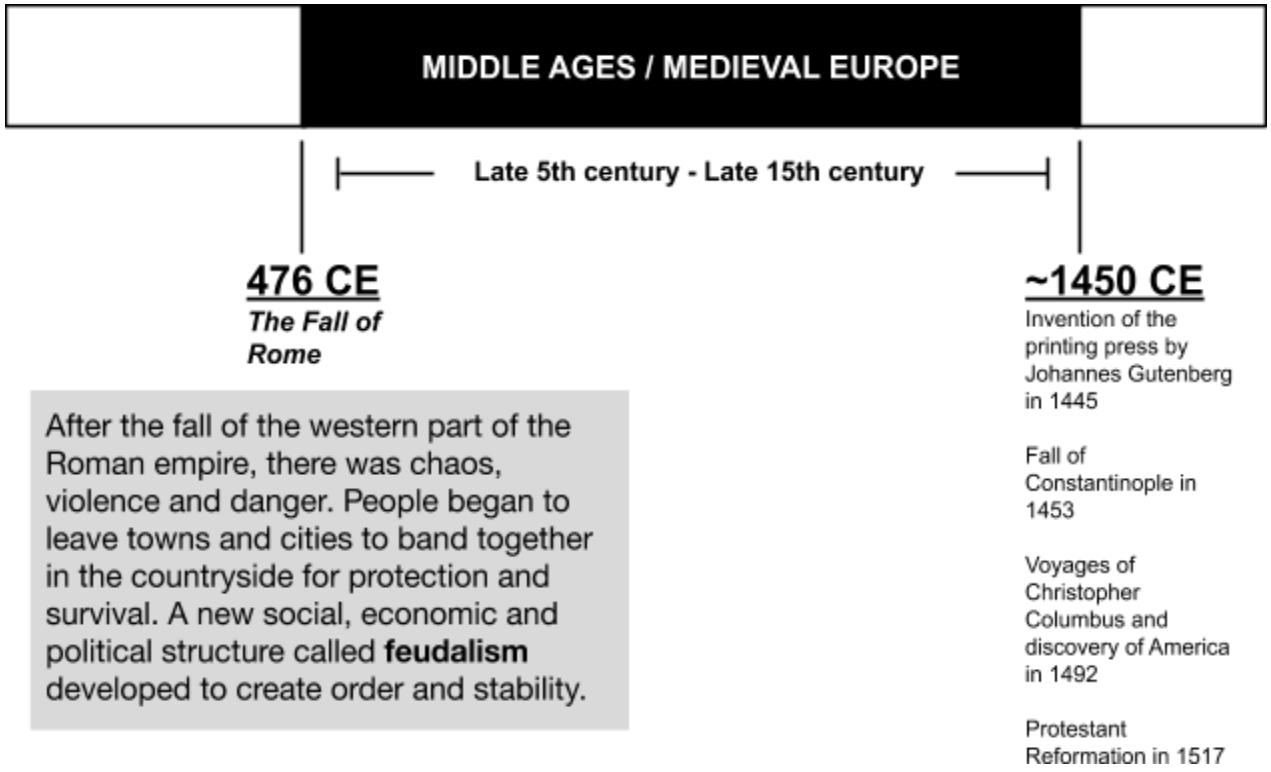
Medieval Europe

=

Europe during the Middle Ages

=

5th century (400s) CE - 15th century (1400s) CE



Contextualize the Catholic Church in Medieval Europe

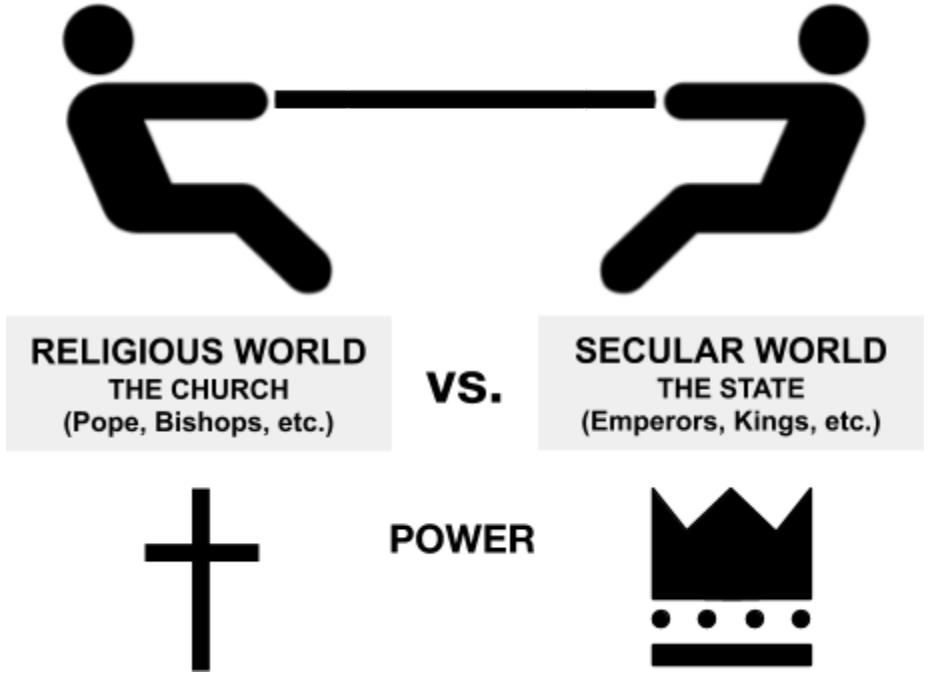
➡ **Directions: Read text below and answer the accompanying question.**

Contextualize

After the fall of the Roman Empire in 476 CE, western Europe broke into small warring kingdoms. Since it was the official church of the Roman Empire, most people in Western Europe were Christians, and it owned a great deal of wealth and land, the Catholic Church became the most important unifying and stabilizing force in western Europe during the Middle Ages. The power vacuum left by the Roman Empire was filled by the Catholic Church.

Over the course of the early Middle Ages, the Catholic Church became more influential and powerful, to the point where the Church and the beliefs of its clergy [people who had high positions in the Church like priests and bishops] controlled secular [non-religious] life and secular government.

By the 11th century (1000s), the Pope, the leader of the Catholic Church, had the power to decide who would be king in some regions and was able to raise an army to go to war. For centuries afterwards, secular leaders and the Church competed for power in western Europe.



Citations 1

1. Why did the Catholic Church become powerful in Western Europe?

2. What powers did the Catholic Church gain during the early Middle Ages?

Document Analysis Activity: Was the Catholic Church powerful in Medieval Europe?

Corroborate

➡ **Directions: Examine each of the following documents, then respond to the accompanying prompts to determine if the evidence supports that the Catholic Church was or was not powerful in Medieval Europe.**

Document 1

A painting depicting the three "estates" or classes in Medieval France.

Image is courtesy of Wikimedia and is in the public domain.

1a. Circle which claim this document supports.

Claim A: The Catholic Church was very powerful in Medieval Europe.

Claim B: The Catholic Church was not very powerful in Medieval Europe.

1b. Identify a piece of textual or visual evidence from this document that supports the claim this document makes.

Document 2

Watch this excerpt of the Crash Course World History Video "Luther and the Protestant Reformation" (01:28-02:35)

Transcript:

During the European Middle Ages, the Catholic Church really dominated European civilization. It's almost impossible to imagine the scope of the Church's power in the Middle Ages, but let's try.

First off, the Catholic Church was the caretaker of the most important thing that Christians had, their souls, which, unlike our temporal [secular] bodies, were eternal. And then there was the parish priest, who played a pivotal role throughout every person's life, baptizing them, marrying them, hearing their confessions, [and] providing last rites.

The church also provided all of the social services: It distributed alms [money or food given as a donation] to the poor, and ran orphanages, and provided what education was available. Most Europeans would in their lives meet exactly one person who could read the Bible, which was only available in Latin - their parish priest.

And, the church owned over 1/3 of all the land in Europe, which helped make it the most powerful economic and political force on the continent.

And the Pope claimed authority over all the kings of Europe, as the successor to the Roman Emperor. So this was a very powerful institution...

2a. Circle which claim this document supports.

Claim A: The Catholic Church was very powerful in Medieval Europe.

Claim B: The Catholic Church was not very powerful in Medieval Europe.

2b. Identify a piece of textual or visual evidence from this document that supports the claim this document makes.

Document 3: *Dictatus papae*

Pope Gregory was elected pope in 1073 CE. He believed that as pope, he was God's "vicar [representative] on earth" and that his authority extended over religious life and secular political life. In 1075, he issued a decree forbidding a practice called lay investiture. Lay investiture was a practice whereby secular rulers like emperors or kings could select leaders of the church. Pope Gregory felt that this practice reduced his power so he ended it. This angered many kings and emperors. *Dictatus papae* is a compilation of 27 statements about the powers of the pope. It was included in Pope Gregory VII's register under the year 1075. *Dictatus papae* reflects the views of Pope Gregory about the power of popes.

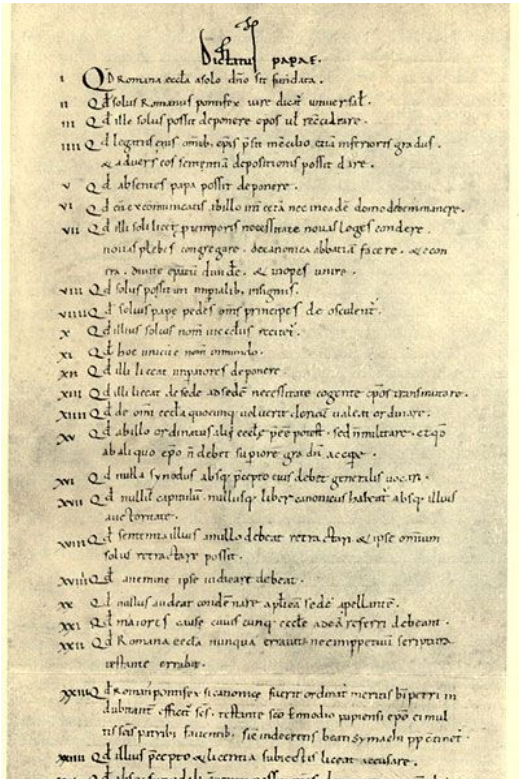


Image is courtesy of Wikimedia and is in the public domain.

Excerpts from Dictatus Papae:

9. That of the pope alone all princes shall kiss the feet.

12. That it may be permitted to him [pope] to depose [remove from power] emperors.

14. That he has power to ordain [make someone a priest] a clerk of any church he may wish.

17. That no chapter and no book shall be considered canonical [included in a list of sacred books] without his authority.

18. That a sentence passed by him may be retracted by no one; and that he himself, alone of all, may retract it.

19. That he himself may be judged by no one.

Excerpt is from Select Historical Documents of the Middle Ages which is published on the Internet Medieval Sourcebook.

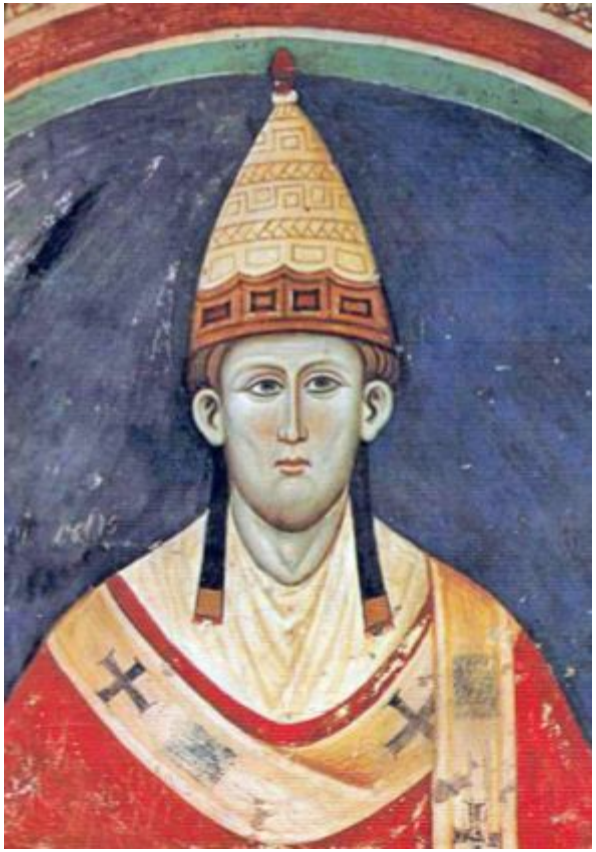
3a. Circle which claim this document supports.

Claim A: The Catholic Church was very powerful in Medieval Europe.

Claim B: The Catholic Church was not very powerful in Medieval Europe.

3b. Identify a piece of textual or visual evidence from this document that supports the claim this document makes.

Document 4: *Canon Law, Excommunication, and Interdict*



Painting of Pope Innocent III, 1219.

During the Middle Ages, the Catholic Church developed its own set of laws called **canon law.** Medieval canon law was based on the Bible and decision made by the clergy as well as local laws and Roman law also influenced canon law.

Canon law set out the rules that Catholics needed to follow and included topics like religious teachings accepted by the church, crimes, the role of the clergy, and marriage.

Depending on the situation, breaking canon law could result in **excommunication**, the limiting or ending of a person's membership in the Catholic Church. Those who were excommunicated could not receive the sacraments [sacred ceremonies of the church] or a Christian burial, which many believed could condemned them to hell for eternity.

Popes and other clergy members in the Church used excommunication to punish those who opposed them. If the Church wanted to send a message to a noble or king who disagreed with them or spoke out against them he could impose an interdict, an order that excluded a whole region from receiving holy sacraments in the Catholic Church. In some cases, this led to revolts from the people who feared their souls were in danger which might lead to the Church getting what they wanted. A powerful noble who opposed the Church might face an interdict, but even the strongest ruler usually gave in rather than have to deal with revolts by the common people.

4a. Circle which claim this document supports.

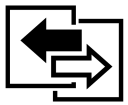
Claim A: The Catholic Church was very powerful in Medieval Europe.

Claim B: The Catholic Church was not very powerful in Medieval Europe.

4b. Identify a piece of textual or visual evidence from this document that supports the claim this document makes.

FA

SQ 5. Was the Catholic Church powerful in Medieval Europe?



Corroborate

Construct Arguments

➡ **Directions:** Using evidence from the documents above, respond to the task below in the space provided.

Based on the evidence from these documents, write a thesis statement in response to the questions, "Was the Catholic Church powerful in Medieval Europe?"

Remember, CLAIM + REASONS = THESIS

CLAIM
The Catholic Church **was/was not** very powerful in Medieval Europe …

REASONS
List your reasons that support the claim.

Final Thesis:

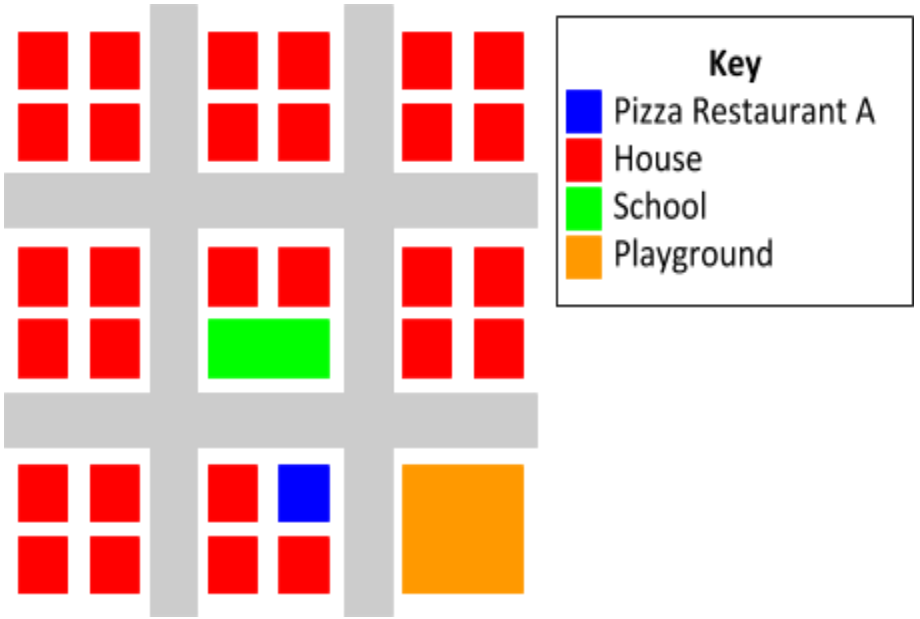
Objective:

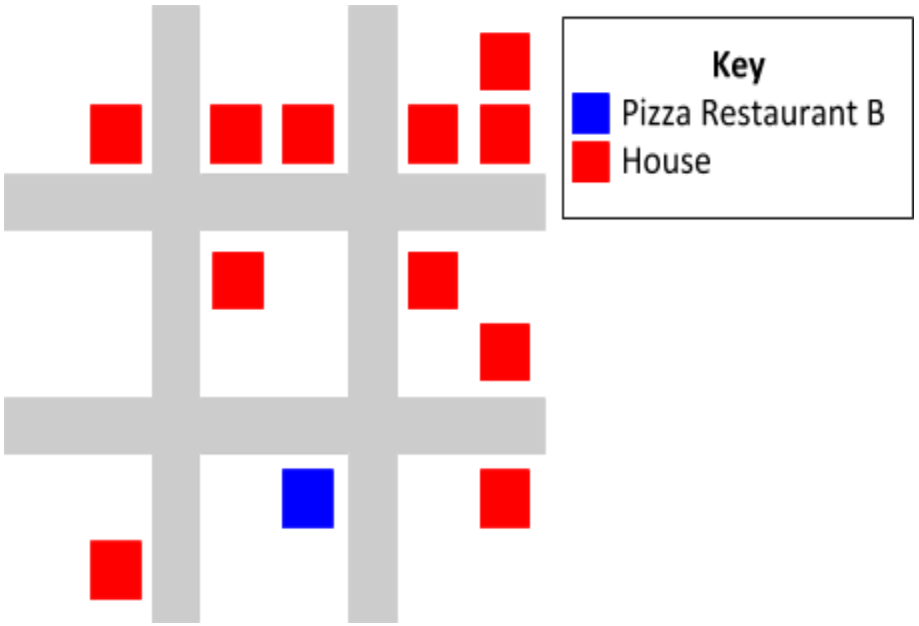
Where was the Byzantine Empire? How did geography and its location affect the development of the Byzantine Empire?

- **Describe** the location of the Byzantine Empire and its capital, Constantinople.
- **Explain** how its geography and location impacted the development of the Byzantine Empire

Introduction

➡ **Directions:** Examine the maps below, then answer the question that follows.





Which of the pizza restaurants pictured above will make more money? Why?

Where was the Byzantine Empire (330-1453)?

➡ **Directions:** Examine the map of the Byzantine Empire below, then answer the questions that follow.

Think Like a Geographer

Source: Justinian555AD.png created by Tataryn published under Creative Commons Attribution-Share Alike 3.0 Unported license and modified by New Visions for Public Schools.

Relative location is a description of where a place is in relation to how a place is related to other places. For example, Canada is *north of* the state of New York.

North	East	West	South	West	South	Northeast	Northwest

Using the map and directional words above, complete the tasks below.

1. Identify ***three continents*** on which the Byzantine Empire controlled land.

2. Describe the location of the Byzantine Empire relative to ***two regions***.

3. Describe the location of the Byzantine Empire relative to ***two bodies of water***.

4. In 1-3 sentences, describe the location of the **Byzantine Empire** relative to **four** different locations or geographic features.

How interconnected was the Byzantine Empire in the post-classical era?

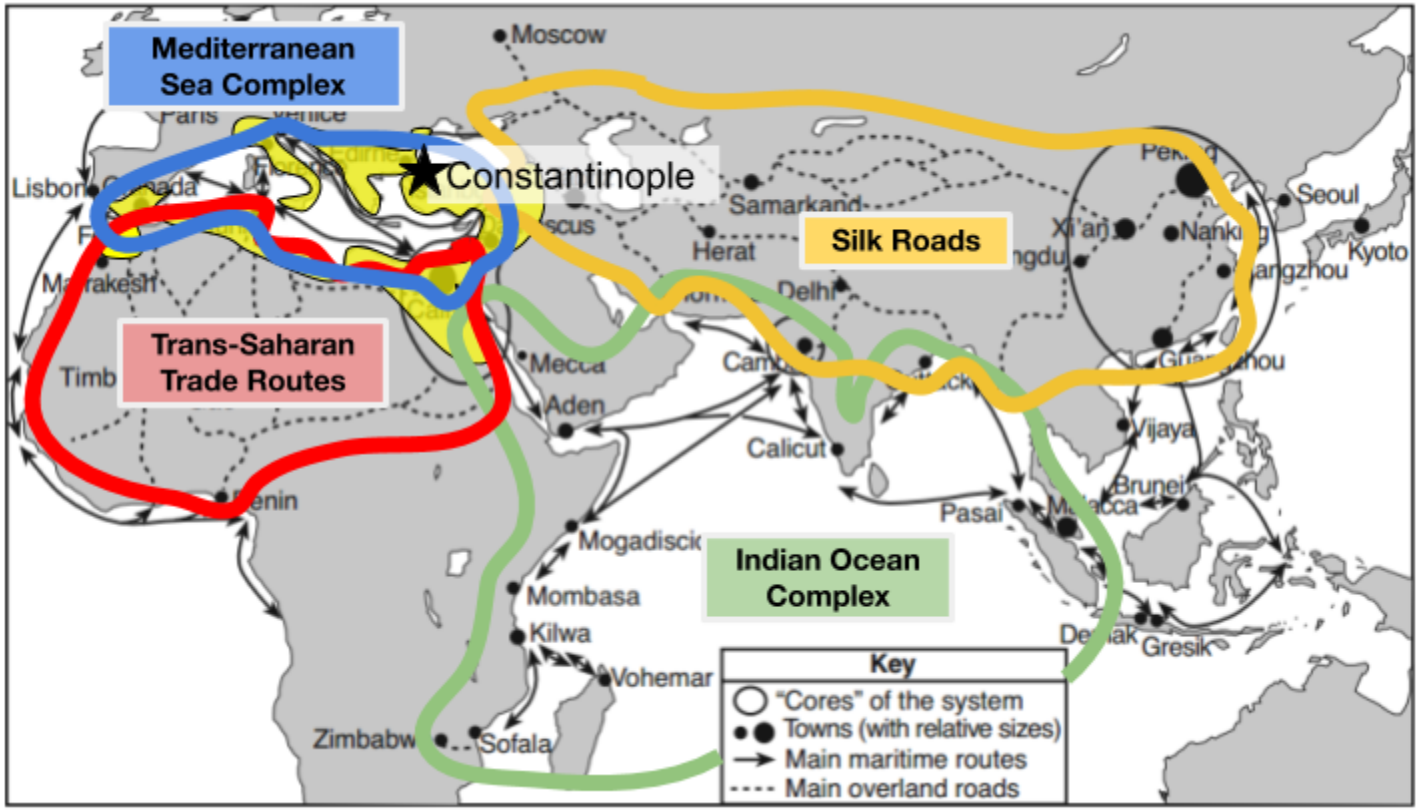
Think Like a Geographer

Contextualize

Predict

➡ **Directions: Examine the map below and answer the questions that follow.**

The map below shows trade routes in existence before the 16th Century, most of which existed during the post-classical era. The Byzantine Empire, at its height, is highlighted in yellow.



Source: Adapted from Philippe Beaujard in "The Indian Ocean in Eurasian and African World-Systems before the Sixteenth Century," Journal of World History (adapted) from the NYS Global History and Geography Regents Examination, August 2012.

1. Which trade networks connected to the Byzantine Empire?	2. Identify four cities that the people living in Constantinople could have traded with.

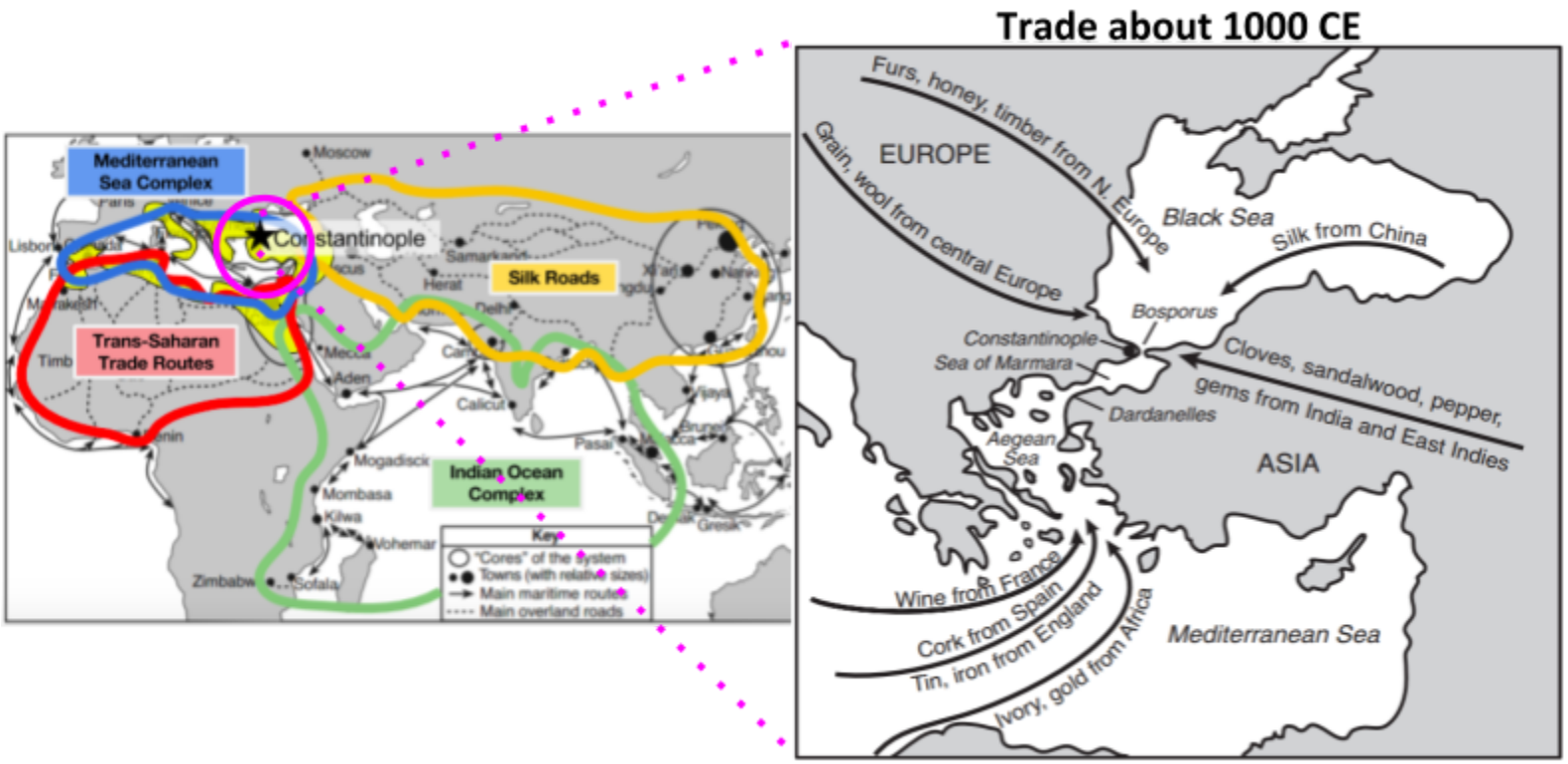
3. How might living at the intersection of several trade networks have affected the lives of people in the Byzantine Empire during the post-classical era?

How did the location of Constantinople affect its development and that of the Byzantine Empire?

Think Like a Geographer

Contextualize

➡ **Directions: Examine the map and text below, then complete the tasks that follow.**



Source: Adapted from Philippe Beaujard in "The Indian Ocean in Eurasian and African World-Systems before the Sixteenth Century," Journal of World History (adapted) from the NYS Global History and Geography Regents Examination, August 2012.
Source: Farah and Karls, World History, The Human Experience, Glencoe/McGraw-Hill (adapted) from the NYS Global History and Geography Regents Exam.

1. Describe the location of Constantinople, the capital of the Byzantine Empire, relative to ***two continents***.

2. Describe the location of Constantinople, the capital of the Byzantine Empire, relative to ***two bodies of water***.

3. Based on the map above, describe how geography and its location affected the development of Constantinople.

Benjamin of Tudela's Description of Constantinople

➡ **Directions: Read the information about Benjamin of Tudela, examine the map of his travels, and read his account, then complete the tasks that follow.**

Think Like a Geographer | **Contextualize** | **Source** | **Corroborate** | **Connect Cause and Effect**

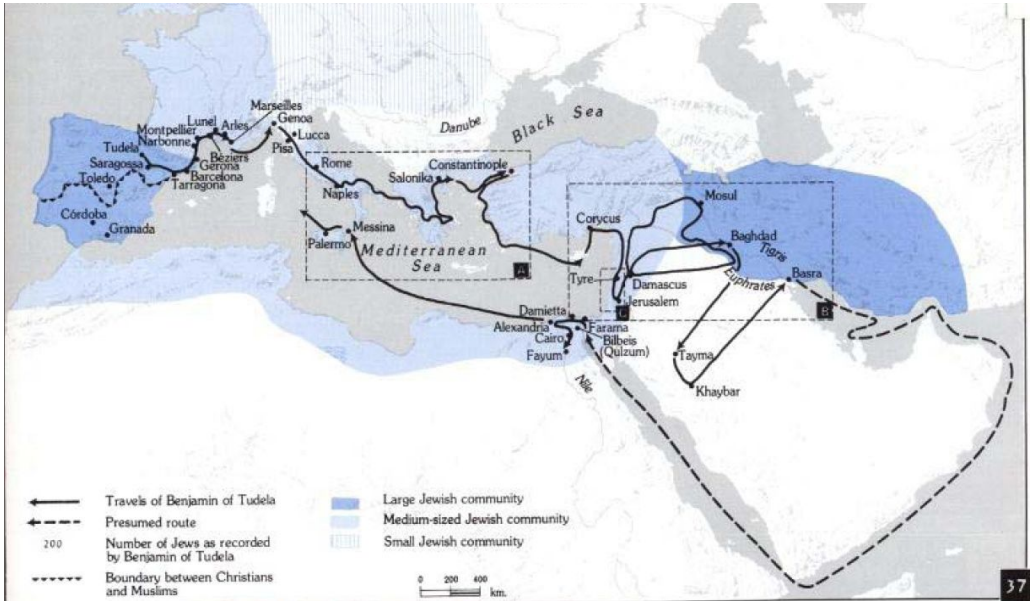
Benjamin of Tudela was a Jewish traveler from the Kingdom of Castille, in modern-day Spain in the 12th century. He traveled throughout Europe, the Middle East and North Africa visiting Jewish communities and writing about his travels. His book, *The Tales of Benjamin* provide historians with descriptions of the Mediterranean world during the post-classical era.

Benjamin of Tudela's Description of Constantinople

. . . The circumference of the city of Constantinople is eighteen miles; one-half of the city being bounded by the continent, the other by the sea, two arms of which meet here; the one a branch or outlet of the Russian [Black Sea], the other of the Spanish sea [Mediterranean Sea]. Great stir and bustle prevails [dominates] at Constantinople in consequence of the conflux [meeting] of many merchants, who resort thither [come there], both by land and by sea, from all parts of the world for purposes of trade, including merchants from Babylon and from Mesopotamia, from Media and Persia, from Egypt and Palestine, as well as from Russia, Hungary, Patzinakia, Budia, Lombardy and Spain. In this respect the city is equalled only by Bagdad, the metropolis of the Mahometans [Muslims]. . .

— Rabbi Benjamin of Tudela, Manuel Komroff, ed., Contemporaries of Marco Polo, Boni & Liveright from the NYS Global History and Geography Regents Exam.

Map of the Travels of Benjamin Tudela



Benjamin of Tudela route - ru.svg, created by Bogdan is in the public domain.

4. Who was Benjamin of Tudela?

5. When did Benjamin of Tudela write his description of Constantinople?

6. Based on Benjamin of Tudela's account, identify three locations merchants came to Constantinople from.

7. According to Benjamin of Tudela's account, why did "*Great stir and bustle"* prevail [dominate] in Constantinople?

8. Explain the extent to which Benjamin of Tudela's account is a reliable source of evidence about ***Constantinople in the 1100s.***

Questions to consider when describing a source's reliability.	**Your response to task #8**
Does the source include evidence about the given topic? (Constantinople in the 1100s)	
Is the source primary or secondary?	
Is the author biased?	
What are the limitations of the source to give evidence about the topic?	

9. Identify and explain a cause and effect relationship between what is depicted in the map of Constantinople entitled "Trade about AD 1000" and Benjamin of Tudela's description of Constantinople.

FA

SQ 6. Where was the Byzantine Empire? How did geography and its location affect the development of the Byzantine Empire?

Think Like a Geographer

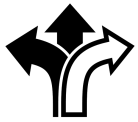
Task 1:
Relative location is a description of where a place is in relation to how a place is related to other places.

Using the maps above, write one sentence to describe the *relative location* of the Byzantine Empire and Constantinople using the bank of cardinal directions below. For example, Canada is *north of* the state of New York.

North	South	East	West
Northeast	Southeast	Northwest	Southwest

Contextualize

Byzantine Empire	Constantinople



Predict

Task 2
Explain how the location of Constantinople and the Byzantine Empire affected their development

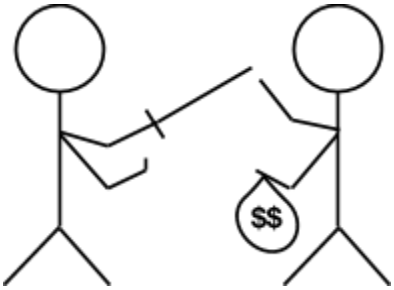
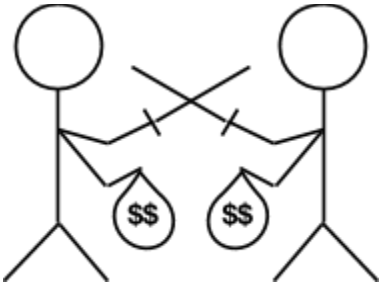
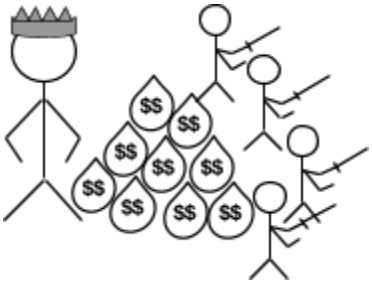
Objective:

How did Justinian and Theodora gain, consolidate, and maintain power in the Byzantine Empire?

- **<u>Describe</u>** how Justinian and Theodora gained, consolidated, and maintained power.

Introduction

➡ **Directions: In the spaces below, write out at least *<u>two</u>* methods that empires you have already learned about used to gain, consolidate, and maintain their power.**

GAIN	CONSOLIDATE	MAINTAIN
		
Gaining power is the process of getting it and expanding it.	**Consolidating power** is the process of taking control from other people who also have power.	**Maintaining power** is the process of keeping one's power.

Contextualize

What was the Byzantine Empire? Who were Justinian and Theodora?

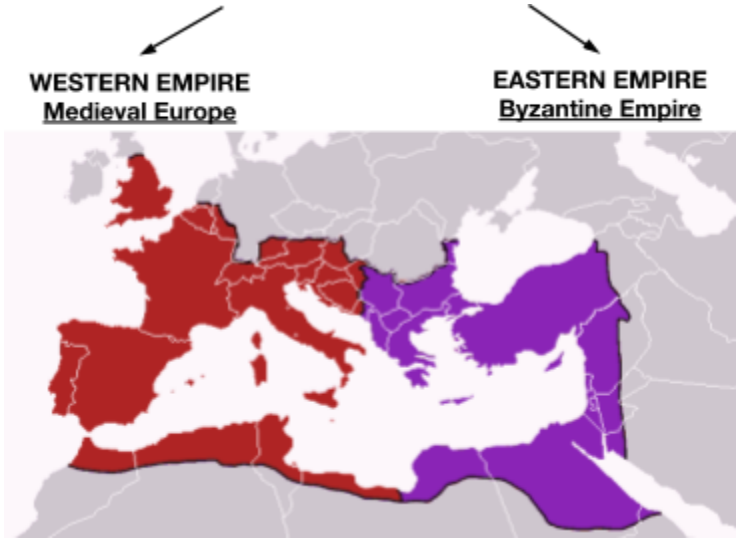
Watch this excerpt of the History Channel's *Engineering an Empire* (21:32- 23:42), read the text and examine the images below, then complete the tasks that follow.

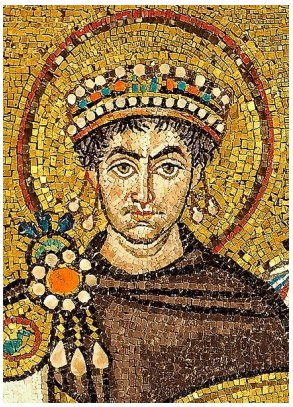
The western and eastern provinces of the Roman Empire drifted apart in the fourth century when Diocletian and Constantine began making **reforms**. As invasions increased, the western Roman Empire finally fell to Germanic invaders in 476 CE. Even though the western province collapsed, the eastern province survived and grew into the great Byzantine Empire.

There were many leaders of the Byzantine Empire, but the empire reached its height under **Emperor Justinian and his co-ruler and wife Theodora** in the sixth century. Unlike the fallen Western province of the Roman empire, Justinian and Theodora developed a **centralized government** where all power and decision-making was concentrated in one unit instead of having power in the hands of many different people in different locations. Justinian and Theodora were **autocrats**, sole leaders with complete authority. They had political and religious power. Justinian appointed leaders of the **Eastern Orthodox Church**. Also, as emperor, he was considered Jesus' co-ruler on earth.

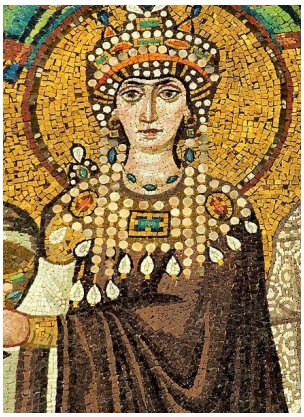
The goal that drove Justinian and Theodora's actions was to reconquer Rome and restore its glory under their rule.

Following the fall of the Western province of the Roman Empire, *divergent* societies emerged in Europe.





A mosaic of Justinian I in the Basilica of San Vitale in Italy.



A mosaic of Theodora in the Basilica of San Vitale in Italy.

1. How was Justinian and Theodora's Byzantine Empire different from Western Europe during the same time period?

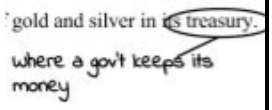
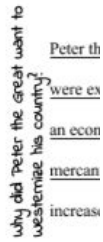
2. What title did Justinian give Theodora when he became the ruler of the Byzantine Empire? Based on this, what can you infer about their relationship and her power?

How did Justinian and Theodora gain, consolidate, and maintain power in the Byzantine Empire?

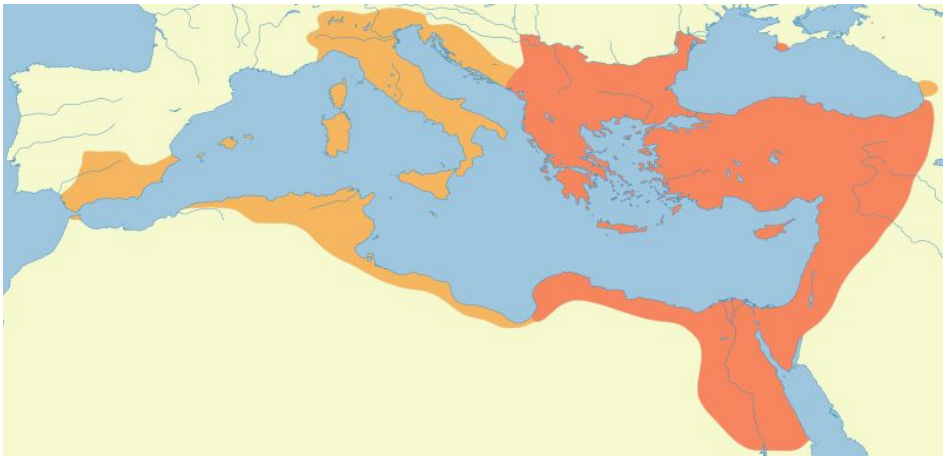
Annotate

➡ **Directions: Use the annotation key below while reading the documents that follow to gather evidence to answer the questions: How did Justinian and Theodora gain, consolidate, and maintain power in the Byzantine Empire?**

Annotation Key

G	C	M		
Place a "**G**" next to evidence of how Justinian and Theodora **GAINED** power	Place a "**C**" next to evidence of how Justinian and Theodora **CONSOLIDATED** power	Place an "**M**" next to evidence of how Justinian and Theodora **MAINTAINED** power	Circle words that are unclear and identify possible meanings.	Write questions in the margins to clarify misunderstandings.

Document 1: Map of the Expansion of the Byzantine Empire During the Reign of Justinian and Theodora

Timeline of Military Campaigns		Map of Byzantine Territory at the end of Justinian and Theodora's Reign (527-565)
527-532	War with the Sassanid	
533-534	Conquest of North Africa	The red represents the land controlled by the Byzantine Empire in 527 when Justinian and Theodora started their rule. The orange represents land they conquered.
535-540	War in Italy, first phase	
540-562	War with Sassanid Empire	
541-554	War in Italy, second phase	

Document 2: Nika Riots

Watch this excerpt of the History Channel's *Engineering an Empire* (23:42- 25:23, 26:00-29:40) about the Nika Riots and read the text below.

As a result of increased taxes and harsh laws, the people of Constantinople came together against Justinian and Theodora in 532 CE in an event known as the Nika Riots. The riots started in a stadium called the Hippodrome, where up to 100,000 people gathered regularly to see chariot races and to root on their favorite chariot teams like the Blues, Greens, Reds, and Yellows.

Often where people lived, their political beliefs, and their favorite chariot teams were similar. For example, Emperor Justinian supported the Blues and most of his political supporters and trusted friends rooted for the Blues too. People in Constantinople were usually divided among these lines, but came together in opposition to Justinian and Theodora in 532 CE. They violently protested, burned the city, and tried to crown someone else emperor.

The excerpt below was written by *Procopius*, a Byzantine historian who traveled with Justinian's general Belisarius as his legal adviser and was present during the Nika Riots. In the excerpt below, Procopius describes what happened after Theodora convinced Justinian to stay and fight rather than flee the city. Justinian sent his general Belisarius to the Hippodrome to stop the rioting.

> . . . . Belisarius, with difficulty and not without danger and great exertion, made his way over ground covered by ruins and half-burned buildings, and ascended to the stadium. . . . Concluding that he must go against the populace who had taken their stand in the hippodrome-a vast multitude crowding each other in great disorder-he drew his sword from its sheath and, commanding the others to do likewise, with a shout he advanced upon them at a run. But the populace, who were standing in a mass and not in order, at the sight of armored soldiers who had a great reputation for bravery and experience in war, and seeing that they struck out with their swords unsparingly, beat a hasty retreat. . . . [Mundus, another of Justinian's generals] straightway made a sally [sudden charge] into the Hippodrome through the entrance which they call the Gate of Death. Then indeed from both sides the partisans of Hypatius were assailed with might and main and destroyed. . . . There perished among the populace on that day more than thirty thousand. . . . The soldiers killed both [of the leaders of the riots] on the following day and threw bodies into the sea. . . . This was the end of the insurrection in Byzantium.
>
> Source: Procopius, History of the Wars, I, xxiv, translated by H.B. Dewing (New York: Macmillan, 1914), pp. 219-230, slightly abbridged and reprinted in Leon Barnard and Theodore B. Hodges, Readings in European History, (New York: Macmillan, 1958), 52-55. This text is part of the Internet Medieval Source Book. https://sourcebooks.fordham.edu/Halsall/source/711Tarik1.asp

Document 3a: Justinian's Code, excerpt 1

At the core of Justinian and Theodora's goals as leaders was reestablishing the greatness of the Roman Empire. One of their methods was to draft a new law code called *Corpus Juris Civilis, or* **Justinian's Code**. Justinian set up a commission to collect and revise all of the Roman laws. In 529 CE, Justinian published his first set of laws known as the "Body of Civil Law." The work of compiling and editing Justinian's Code was directed by Tribonian, an official in Justinian's court. The code included laws on marriage, slavery, property ownership, women's rights, and criminal justice. Justinian used the law to unify his empire under his control and provide a sense of stability for his people. Justinian's Code did not only have an effect of the Byzantine Empire. Over the centuries, it became the basis of legal systems in Europe.

Justinian's Code: *Book I, Of Persons*

Book I, Of Persons

I. Justice and Law

> 3. The **maxims** of law are these: to live honestly, to hurt no one, to give everyone his due.
>
> 4. The study of law is divided into two branches; that of public and that of private law. **Public law** regards the government of the Roman Empire [the Byzantines and most other groups of people at the time referred to themselves as "Romans." Historians started using the term Byzantines to separate this empire from the western Roman Empire]; **private law**, the interest of the individuals.

VIII. Slaves

We now come to another division relative to the rights of persons; for some persons are independent, some are subject to the power of others. Of those, again, who are subject to others, some are in the power of parents, others in that of masters. Let us first treat of those who are subject to others; for, when we have ascertained who these are, we shall at the same time discover who are independent. And first let us consider those who are in the power of masters.

> 1. Slaves are in the power of masters, a power derived from the law of nations: for among all nations it may be remarked that masters have the power of life and death over their slaves, and that everything acquired by the slave is acquired for the master.

Source: Excerpt is from The Institutes, 535 CE which is published on the Internet Medieval Sourcebook.

Document 3b: Justinian's Code, excerpt 2

At the core of Justinian and Theodora's goals as leaders was reestablishing the greatness of the Roman Empire. One of their methods was to draft a new law code called *Corpus Juris Civilis, or* **Justinian's Code**. Justinian set up a commission to collect and revise all of the Roman laws. In 529 CE, Justinian published his first set of laws known as the "Body of Civil Law." The work of compiling and editing Justinian's Code was directed by Tribonian, an official in Justinian's court. The code included laws on marriage, slavery, property ownership, women's rights, and criminal justice. Justinian used the law to unify his empire under his control and provide a sense of stability for his people. Justinian's Code did not only have an effect of the Byzantine Empire. Over the centuries, it became the basis of legal systems in Europe.

IX. The Power of Parents

Our children, **begotten** in lawful marriage, are in our power.

1. Marriage, or matrimony, is a binding together of a man and woman to live in an indivisible union.

2. The power which we have over our children is peculiar to the citizens of Rome; for no other people have a power over their children, such as we have over ours.

3. The child born to you and your wife is in your power. And so is the child born to your son of his wife, that is, your grandson or granddaughter; so are your great-grandchildren, and all her descendants. But a child born of your daughter is not in your power, but in the power of its own father.

Book II, Of Things

X. The Making of Wills

6. [...] But women, persons under the age of puberty, slaves, madmen, dumb persons, deaf persons, prodigals [people who waste their money] restrained from having their property in their power, and persons declared by law to be worthless and incompetent to witness, cannot be witnesses.

14. Thus much may suffice [enough] concerning written testaments [wills]. But if anyone wishes to make a testament, valid by the civil law, without writing, he may do so, in the presence of seven witnesses, verbally declaring his wishes, and this will be a testament perfectly valid according to the civil law, and confirmed by imperial constitutiones [laws of the empire].

Source: Excerpt is from The Institutes, 535 CE which is published on the Internet Medieval Sourcebook.

Document 4: Religious Order and Persecution

Justinian, as the emperor of the Byzantine Empire, appointed leaders of the Eastern Orthodox Church and he was considered Jesus' co-ruler on Earth. He persecuted and oppressed other Christian sects and other religions. Paganism was outlawed in Justinian's Code and his government took actions to destroy it. He closed a school that taught Plato's philosophy in Greece, abolished the worship of the god Amun at an oasis in the Libyan desert and the worship of Isis in Egypt.

In addition, the civil rights of Jewish people were restricted in Justinian's Code.

As a result, people from many different religious and ethnic groups converted to Eastern Orthodox Christianity to avoid persecution.

Justinian was one of the first emperors pictured holding the cross, a symbol of Christianity, as he is in the coin pictured above.

FA

SQ 7. How did Justinian and Theodora gain, consolidate, and maintain power in the Byzantine Empire?

➡ **Directions: Use the information you learned in the documents above to then write a claim that addresses the prompt below and supply three pieces of evidence that supports it.**

Construct Arguments

Task: Read through the Enduring Issues Essay introduction below, then write a topic sentence for the first body paragraph and identify the evidence from the documents you read about the Byzantine Empire that you would use to support that topic sentence.

Introduction

One enduring issue throughout history is that people and governments have tried to gain, consolidate, and maintain power. This desire to get and keep power is a significant enduring issue because individuals and states since the beginning of human history to today have sought power and people all over the world have been impacted by the short and long term effects of the methods used to gain, consolidate, and maintain power. Evidence of the people's thirst for power and the strategies they have used to keep it can be seen in ***the Byzantine Empire under the reign of Justinian and Theodora***, the British Empire, and the Russian Revolution.

Body Paragraph 1:

Topic Sentence:	
Evidence 1:	
Evidence 2:	
Evidence 3:	

Objective:

Where were the Tang and Song Dynasties? How interconnected were they with other regions?

- **Describe** the location of the Tang and Song Dynasties and their interconnectedness to other regions.

Introduction

➡**Directions:** Label the continents, regions, and bodies of water listed on the map below.

Continents		Regions		Bodies of Water	
Asia	Africa	Middle East	India (modern-day)	Pacific Ocean	Indian Ocean
Europe	Antarctica	China (modern-day)	East Africa	Mediterranean Sea	

Original image is in the public domain

Where were the Tang (618-907) and Song (960-1279) Dynasties? How interconnected were the Tang and Song Dynasties?

➡ **Directions:** Examine the maps of the Tang and Song Dynasties below, then answer the questions that follow.

Think Like a Geographer

Contextualize

Tang Dynasty, ca. 750

Adapted by New Visions from TimeMap of World History (www.timemaps.com) pages:https://www.timemaps.com/history/world-750ad/, https://www.timemaps.com/history/east-asia-750ad/

Song Dynasty, ca. 979

Relative location is a description of where a place is in relation to how a place is related to other places. For example, Canada is *north of* the state of New York.

North	East	West	South	West	South	Northeast	Northwest

Using the map and directional words above, complete the tasks below.

1. Identify the continent on which the Tang and Song Dynasties existed.

2. Describe the location of the Tang and Song Dynasties relative to ***two regions***.

3. Describe the location of the Tang and Song Dynasties relative to ***two oceans***.

4. Describe the location of the Tang and Song Dynasties relative to ***two other bodies of water***.

4. Describe the location of the Tang and Song Dynasties relative to ***two land-based geographic features***.

5. Describe the **difference** between the extent of the Tang Dynasty and the Song Dynasty by identifying how far north, east, south, and west the two empires reached.

6. If a Chinese merchant during the Tang or Song Dynasties wanted to trade with people in the Byzantine Empire, which direction would they go? What trade routes could they take?

7. What ***two*** trade routes could the information follow for someone in China to learn about the religion called Islam that started in the Middle East?

FA

SQ 8. Where were the Tang and Song Dynasties? How interconnected were they with other regions?

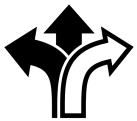
Think Like a Geographer

Task 1:
Relative location is a description of where a place is in relation to how a place is related to other places.

Using the maps above, write one sentence to describe the *relative location* of the Tang and Song Dynasties using the bank of cardinal directions below. For example, Canada is *north of* the state of New York.

North	South	East	West
Northeast	Southeast	Northwest	Southwest

Contextualize



Predict

Tang Dynasty	Song Dynasty

Task 2

➡ **Directions: Based on what you have learned about trade routes and networks during the Post-Classical Era, complete the prompts below.**

Think Like a Geographer

Construct Arguments

Interconnectedness is the state of regions and societies being connected, or in contact with one another. For example, during the classical age, different regions were connected through the Silk Roads.

Description of good	**Could the good have been traded between the regions specified?**	**Explain how or why not** If it <u>could have been traded</u> between those regions, then explain how by identifying *which regions* the good could have travelled through, *which bodies of water* it could have crossed, and *which trade networks* it would have been traded through. If the item <u>could NOT have been traded</u> between the regions identified, then explain why.
The secret of Silk making from **the Tang Dynasty** was passed to the Byzantine Empire.	**YES** **NO**	
Gunpowder, first used for fireworks, was created in China and traded with merchants in the **Islamic Caliphate.**	**YES** **NO**	

Objective:

What led to the Tang and Song Golden Ages? How did the Tang and Song Dynasties impact China, other regions, and later periods in history?

- **Contextualize** the Tang and Song Dynasty Golden Ages.
- **Explain** the impact of the Tang and Song Dynasties in China, other regions, and later periods in history.

Introduction: What is a golden age?

➡ **Directions:** Examine the maps below, then complete the questions that follow.

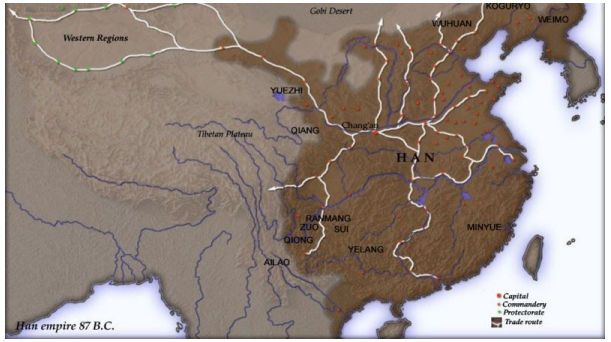
Ancient Greece

What were the major achievements and innovations of this golden age?

Rome

What were the major achievements and innovations of this golden age?

Han Dynasty of China



What were the major achievements and innovations of this golden age?

Identify *two* similarities between these golden ages?

Four-Column Notes on Golden Ages Vocabulary

The words used below are review from Unit 9.3 when you studied the golden ages listed in the last activity. Here, you will need to recall the meanings of those words to answer questions about them and provide examples and non-examples. Use the example with the word "innovation" as a guide

Question	Answer	Two Examples	Two Non-Examples
What is an **innovation?**	An innovation is something new that solves a problem.	• smart phones • a faster way to get to school	• doing something the way it has always been done • riding a horse instead of driving a car
What is an **achievement?**			
What is **prosperity?**			
What is **stability?**			
What are **visual arts?**			

What is **architecture?**			
What is **literature?**			
What is **philosophy?**			
What is **technology?**			
What is **science?**			

Contextualize

What led to the Tang (618–906) and Song (960–1279) Dynasty Golden Ages?

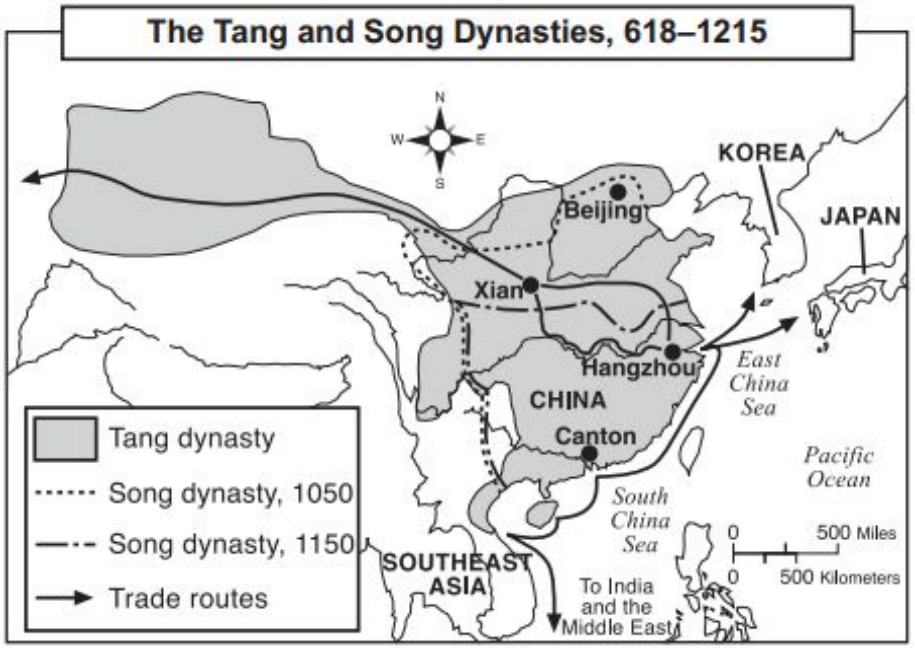
➡ **Directions:** Examine the text and map below, then respond to the questions.

During the Tang (618–906) and Song (960–1279) Dynasties, China was one of the most technologically advanced civilizations in the world. Innovation in art, science, philosophy, and technology gave the people in these societies an understanding of the world around them that other civilizations and even later dynasties in China would not accomplish for hundreds of years.

Like other golden ages in history, the Tang and Song Dynasties unified the region, created a strong central government, and ruled over a time of peace that was reinforced by the government's actions. The Tang expanded China's territories and influence to include Korea and Vietnam, as well as portions of northeast, central, and southeast Asia.

The peace that the Tang and Song governments created encouraged trade throughout the empire and abroad through the Silk Roads. Chinese cities during the Tang and Song dynasties became prosperous cultural centers of an international age where religious, academic, and artistic life and cultural exchange flourished. Scholars and merchants from as far as Persia and India came to Tang China to participate in its golden age.

While the government was strong, it was not oppressive. Some became very rich, but the Tang rulers redistributed land to give the less fortunate an opportunity to grow in wealth. In addition this was a time when education and achievement were rewarded and women attained a higher status in the government and more freedom than they had in previous dynasties.



Source: Goldberg and DuPré, Brief Review in Global History and Geography, Prentice Hall (adapted) from the NYS Global History and Geography Regents Exam, June 2005.

1. Based on the reading passage, why were Tang and Song cities considered "cultural centers of an international age?"

2. Based on the passage and your knowledge of golden ages, why was China during the Tang and Song dynasties a likely place for golden age to occur?

How did the Tang and Song Dynasties affect China, other regions, and later periods in history?

Connect Cause and Effect

NTD on China, *Discovering China: The Song Dynasty*

Directions:

- **Preview the questions listed in the right-hand column.**
- **Watch the video one time through, without stopping and try to answer the questions.**
- **Read the excerpts from the transcript of the video below and answer those questions that you could not by watching the film.**

Time	Excerpts from *Discovering China: The Song Dynasty*	Questions
1:17	...the Southern Song period was one of prosperity with flourishing art and culture as well as technological advancements. During the Song, the government started to grant farmers ownership of land which led to a huge increase in rice production. The economy started to change from a purely agricultural economy to a commercial one with peasants selling their surpluses to buy a wide range of goods such as tea, coal, oil, and wine. With the growth in the economy, so grew the population, hitting 100 million by the year 1100.	1. What evidence from this section suggests that the Song dynasty was prosperous?
1:50	Three of China's four great inventions originate from the Song Dynasty namely, printing, the magnetic compass, and gunpowder. The Song government used its printing techniques for currency production and in the 12th century, became the first government in the world to print paper money. The Song was also the first Chinese dynasty to establish a permanent standing navy to safeguard foreign trade and guard against invasions from the north. The ships used the newly invented compass to navigate and used gunpowder in their weaponry. Gunpowder was first employed in bombs delivered from ships via catapult. The Song used these tactics to successfully defend their territory against a Jurchen invasion on the Yangtze River in the year 1161 AD. A Song force of only three thousand men on 120 ships defeated a Jurchen force of seventy thousand on over six hundred ships.	2. Describe how each of the following innovations affected the Song Dynasty. 2a. Printing 2b. gunpowder 2c. the compass

3:25 Southern Song scholars gave a lot of attention to how Confucian principles could be applied to society rather than to politics. They proposed ways to build a better society focusing on families communities. The most famous of the Song Dynasty scholars was a man named Zhu Xi who would go on to leave a legacy lasting seven hundred years.

3. What philosophy was important to Song society?

3:57 ...Song painters also mimicked the mood of the time their artworks. Northern Song painters like Fan Quan painted huge grand landscape scenes. Whereas after the loss of the North, paintings became more intimate, focusing on family or village scenes within the natural environment. Scenes would often be in one corner with a large empty expanse occupying much of the painting.

4. Based on this excerpt from the video, describe Song Dynasty painting.

Example of a Song Dynasty landscape painting by Ma Lin.

Image is courtesy of Wikimedia and is in the public domain.

Bamboo and Rocks a painting by Li Kan, late Song Dynasty artist.

Image is courtesy of Wikimedia and is in the public domain.

Image is courtesy of Wikimedia and is in the public domain.

Poetry in the Tang (618-906) and Song (960-1279) Dynasties

During the Tang (618-906) and Song (960-1279) Dynasties, literature, and especially poetry flourished. One of the reasons that literature from this period is celebrated is because it was one of the subjects emphasized in the **civil service exams**. Civil service exams were used to identify people who were qualified for government positions and were an important way for people to move up the social ladder and to positions of power in the government. For example, if a child from a low class or poor family did well on the civil service exam, they could get a job with good pay and prestige that would help their families move up socially and economically.

During the Tang Dynasty, poetry was viewed as one of the most sophisticated forms of expression and was important to success in government positions because a good poet showed strength in communication, philosophy, and reasoning. On the civil service exams during the Tang Dynasty, students had to compose poems, which meant that if he wanted a good job, he needed to study poetry and be able to write it. During the Song Dynasty the poetry section of the exam was replaced by essays which also required high level literacy skills.

As a result of the emphasis on literature on the civil service exams, students studied poetry and writing and worked to become accomplished writers themselves. In addition, the invention of printing technology during these golden ages made it easier for poetry and literature to be published, purchased, and circulated which made it easier for students to study and for poets and writers to make a living at their art.

Source: Asian Art Museum's Education and Public Programs, "The Flourishing of Poetry in the Tang (618-906) and Song (960-1279) Dynasties." http://education.asianart.org/explore-resources/background-information/flourishing-poetry-tang-618-906-and-song-960-1279-dynasties

1. Based on the passage above, what were "civil service exams?" What were they used for?

2. Based on the passage, what tasks did students need to complete on the civil service exams during the Tang and Song Dynasties?

3. Why was there a flourishing of literature during the Tang and Song Dynasties?

Technological Beginnings

The westward flow of Chinese technology occurred throughout the existence of the Silk Road. Historian Joseph Needham created a list of new inventions that reached Europe between the first and eighteenth centuries, often after a time lapse of several hundred years. There are many other examples not listed in the chart below, such as the use of paper money, the abacus, and the use of coal for fuel, but the table gives a good illustration of how technologically advanced the Chinese were from the Europeans.

Excerpt from Journeys Along the Silk Road - Unit 1- Middle School which is published by Indiana University Bloomington

Summary of the Transmission of Mechanical and Other Techniques From China To the West

Type of Device	Approximate Time-lag in Centuries	Type of Device	Approximate Time-lag in Centuries
Silk-Manufacturing Machinery	3-13	Deep Drilling for Natural Gas	11
Wheelbarrow	9-10	Gunpowder	5-6 4 (for military use)
Efficient Harness For Draught-Animals: Breast Strap (Postilion)	8	Magnetic Compass	11 4 (with needle) 2 (for navigation)
Crossbow (as an individual arm)	13	Paper	10
Printing (Block)	6 4 (Movable Type) 1 (Metal Movable Type)	Shipbuilding Methods (including watertight compartments, efficient sails, and the rudder)	10

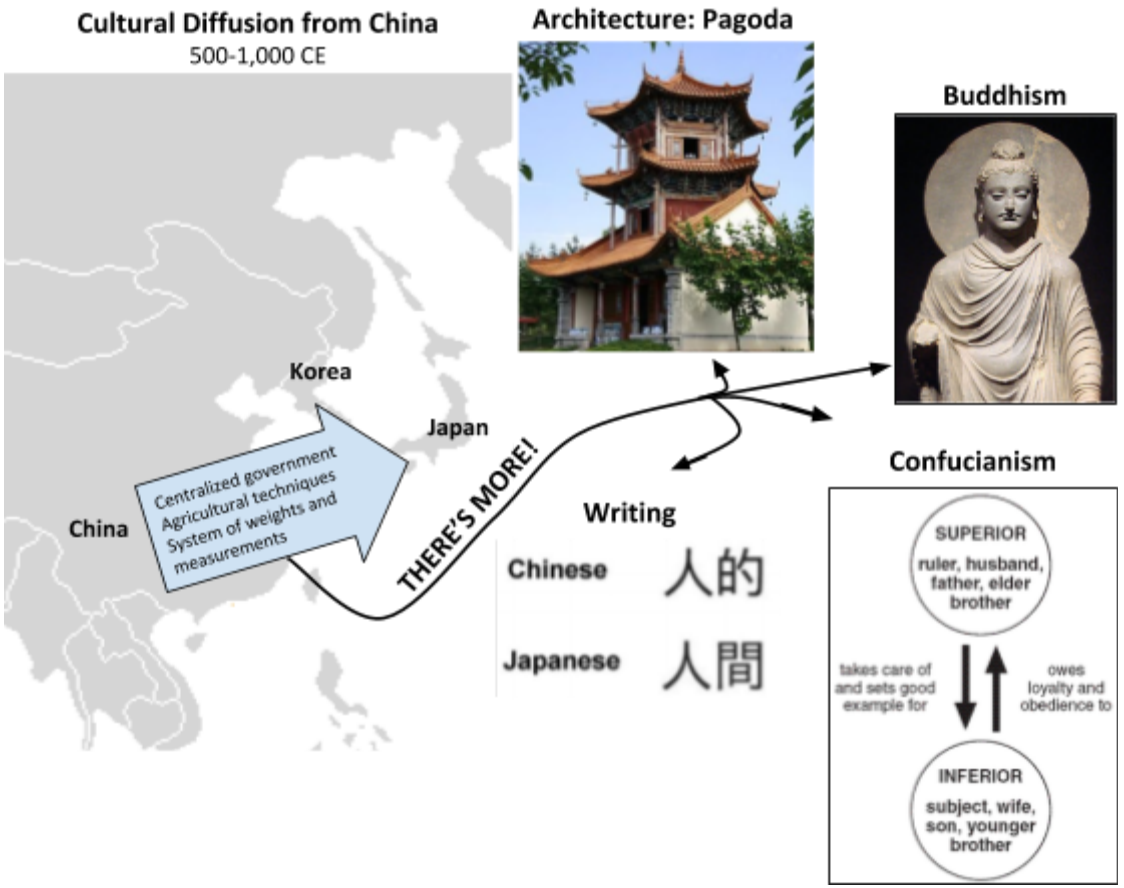
Excerpt from Journeys Along the Silk Road - Unit 1- Middle School which is published by Indiana University Bloomington..

See When you read this chart, what do you see? Trends?	**Think** What do you think about the information in this chart? What does it mean?	**Wonder** What do you wonder about this chart? What questions do you have?

Chinese Innovation and Culture Spreads East to Korea and Japan

Korean and Japanese cultures have been greatly influenced by Chinese culture because of their geographic location close to China. Korea acted as a "cultural bridge" between China and Japan. The Japanese and Koreans were in contact with one another early on in the history of their civilizations. They traded and warred against one another. In the process, Koreans introduced Chinese writing and culture, and Buddhism to the Japanese. This exchange sparked Japanese interest in China.

In the 600s, a Japanese ruler named Prince Shotoku of the Yamato clan sent nobles to China to study with government officials, scholars, and monks during the Tang Dynasty. Over the next 200 years, more Japanese students, monks, traders, and officials visited the Tang court. The Japanese absorbed Chinese technological innovations, agricultural techniques, philosophies, arts, and architecture, but they did not become Chinese. Instead, the Japanese practiced **selective borrowing**, by accepting some Chinese practices into their culture and modifying them to meet their needs, but choosing not to adopt other practices like the Chinese civil service system.



Question:

1. Based on the reading above and graphic to the left, what was the impact of Japan's location near Korea and China on its history?

FA

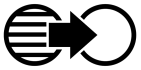
SQ 9. What led to the Tang and Song Golden Ages? How did the Tang and Song Dynasties impact China, other regions, and later periods in history?

➡ Directions: Based on what you have learned about the Tang and Song Dynasty Golden Ages, fill out the Tang and Song Dynasties section of this chart, then complete the prompts below.

Contextualize

FA 1. Contextualize the Tang and Song Dynasty Golden Ages by completing the following tasks:

- **Identify when and where the golden age took place**
- **Describe the factors that led to the golden age**



Connect Cause and Effect

FA 2. Explain the impact of the Tang and Song Dynasty Golden Ages on other regions, and later periods in history by completing the following tasks:

- **Identify two innovations developed during the golden age**
- **Describe the effects of those innovations on China, other regions and/or later periods in history**

Golden Ages Compare and Contrast

➡ **Directions: As you learn about each of the golden ages listed below, fill in the graphic organizer with notes about their achievements.**

Golden Age	ACHIEVEMENTS and INNOVATIONS			
	Prosperity and Stability	**Visual Arts and Architecture**	**Literature and Philosophy**	**Science and Technology**
Tang Dynasty (618–906) **Song Dynasty** (960–1279)				
Abbasid Dynasty (750-1258)				

Synthesis Task: Using the information from chart above and your knowledge of global history, compare and contrast the achievements and innovations of the Tang and Song dynasties with the Abbasid Caliphate.

Objective:

Where is the Middle East? How did geography affect the development of post-classical civilizations in the Middle East?

- **Describe** the location and geography of the Middle East.
- **Explain** how geography affected the development of post-classical civilizations in the Middle East.

Introduction

➡ **Directions**: In the chart below, write down everything you think you know about the Middle East right now and questions about the Middle East that you would like to know the answers to.

the Middle East

Ark of Desert - Camel created by Ahmed Rabea is published under the CC BY-SA 2.0 license.

Beyt-i_Haram.jpg created Nacizane is published under the CC BY-SA 2.0 license.

Image is in the public domain.

What do you already know about the Middle East?	What do you want to know about the Middle East? Write questions you would like to know the answers to.

What is the Middle East?

Contextualize

Source: Middle East (orthographic projection).svg created by Heraldry published under Creative Commons Attribution-Share Alike 3.0 Unported license.

The **Middle East** is a region of the world that includes parts of southwestern Asia and Egypt, in North Africa.

This is generally a hot and arid (desert-like) climate, but there are fertile river valleys like those of the **Nile** in Egypt and the **Tigris** and **Euphrates Rivers** in modern-day Iraq.

Throughout history, the Middle East has played an important role. It was the home of two ancient civilizations, **Ancient Egypt** and **Mesopotamia**, and three of the world's largest religions: **Judaism, Christianity**, and **Islam**. In addition, the region's location between Europe, Africa, and Asia made it a center of **trade** and **cultural diffusion**.

This area is was once known as the "Near East" but is most often referred to as the "Middle East." Both names demonstrate the power that European countries have had in writing world history since "the east" is a term that assumes the "center" of the world is Western Europe.

Today, the Middle East includes the countries Egypt, Saudia Arabia, Israel, Iraq, Iran, Turkey, Syria, Lebanon, Bahrain, Cyprus, Jordan, Kuwait, Oman, Palestine, Qatar, United Arab Emirates, and Yemen.

Though there are many different religions practiced in the region, most of the people who live in the Middle East are **Muslim**, meaning that they practice the religion called **Islam**, which was founded during the post-classical era.

Questions

1. What is the climate like in the Middle East?

2. Why is the Middle East historically significant?

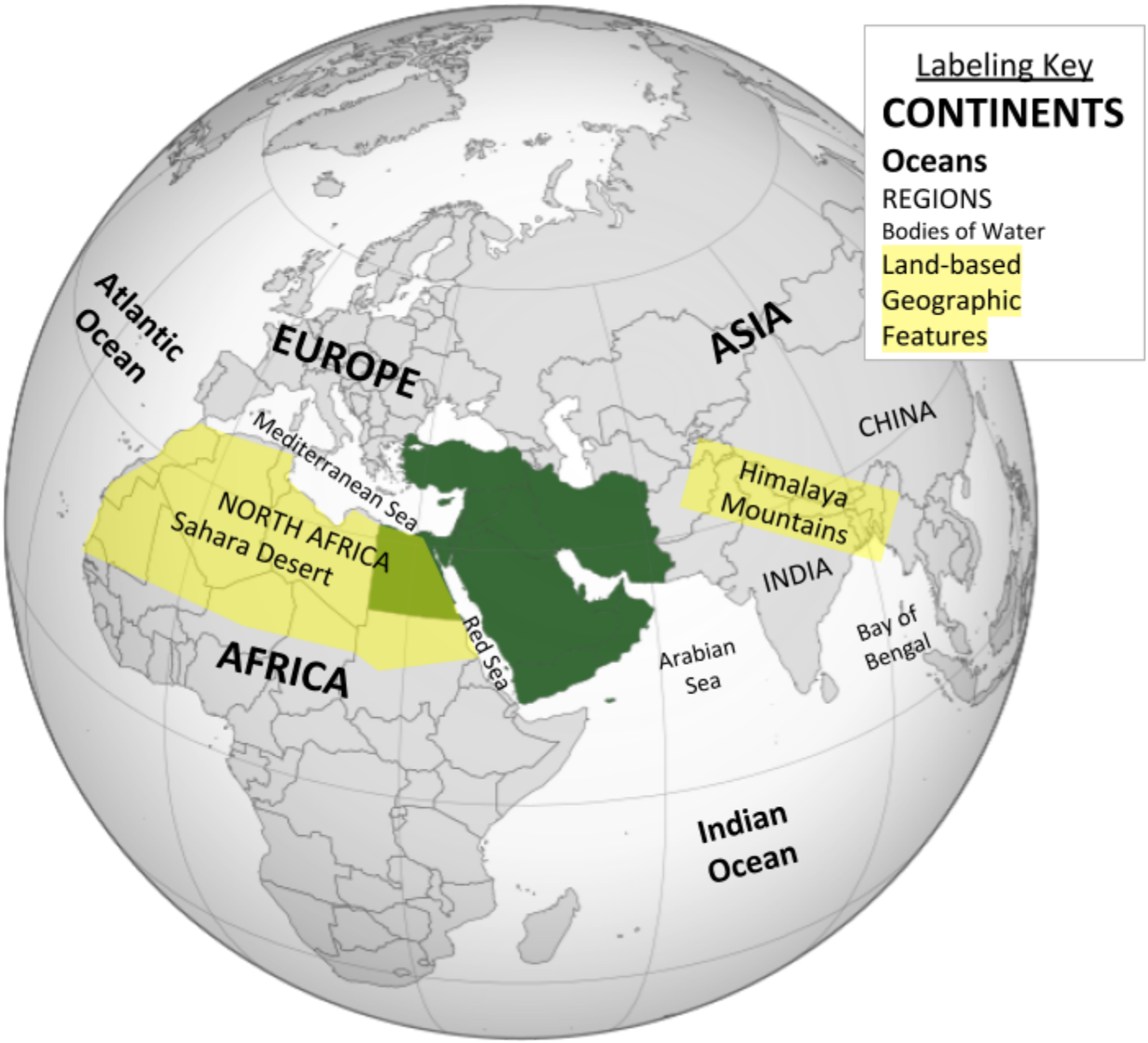
3. What religion do most people practice in the Middle East?

Think Like a Geographer

Where is the Middle East?

➡ **Directions: Examine the map below and use it to complete the tasks that follow.**

Note: The map below shows the boundaries of the Middle East in green.



Source: Middle East (orthographic projection).svg created by Heraldry published under Creative Commons Attribution-Share Alike 3.0 Unported license and modified by New Visions for Public Schools.

Relative location is a description of where a place is in relation to how a place is related to other places.
For example, Canada is *north of* the state of New York.

North	East	West	South	West	South	Northeast	Northwest

Using the map and directional words above, complete the tasks below.

1. Describe the location of the Middle East relative to ***two regions***.

2. Describe the location of the Middle East relative to ***two oceans***.

3. Describe the location of the Middle East relative to ***two other bodies of water***.

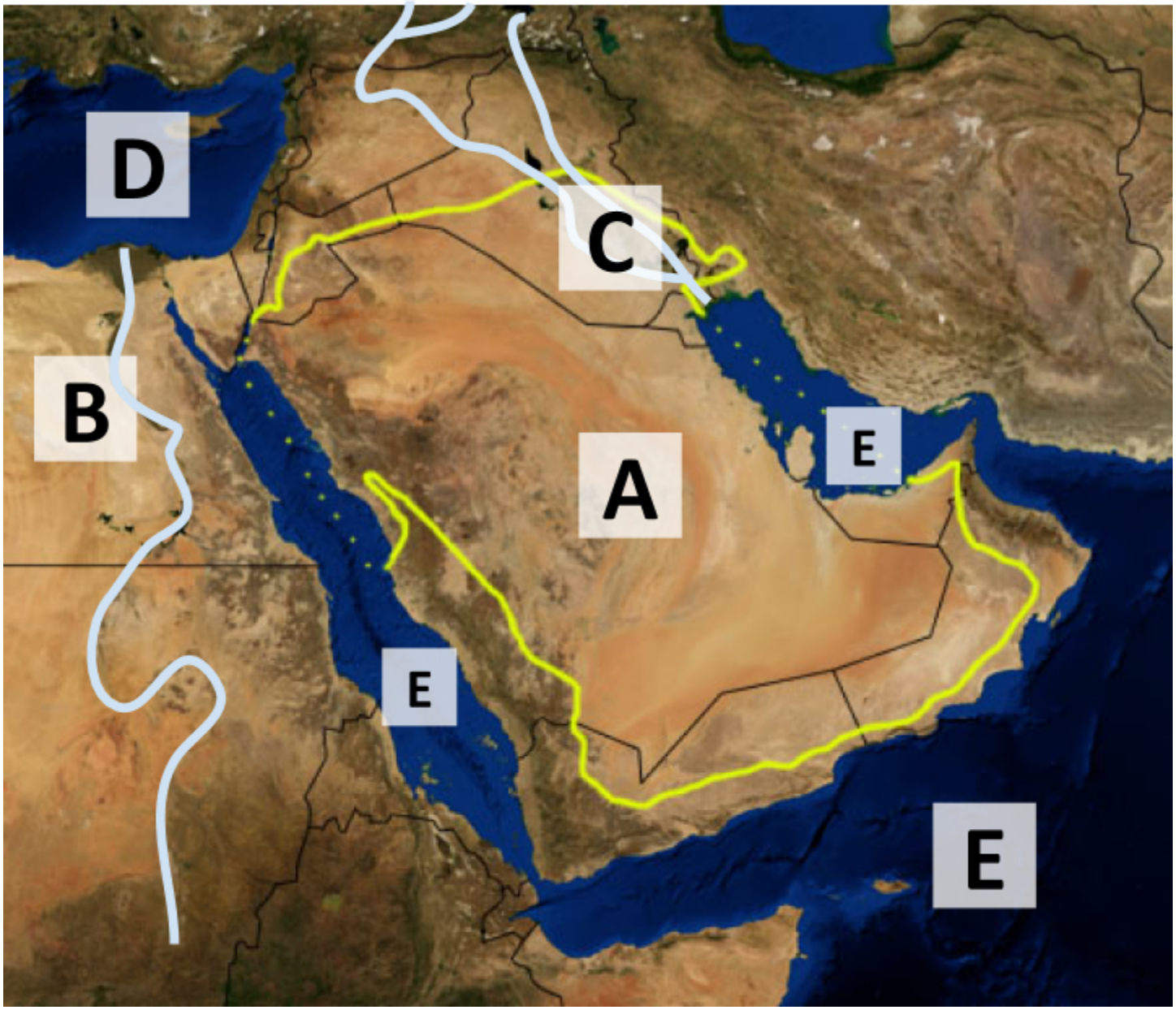
4. Describe the location of the Middle East relative to ***two land-based geographic features***.

5. In 1-3 sentences, describe the location of the Middle East relative to four different locations or geographic features.

Think Like a Geographer

What geographic features exist in the Middle East? How might those features have affected the development of post-classical civilizations in the Middle East?

➡ **Directions: Examine the map below, then read the descriptions of the corresponding geographic features and answer the accompanying questions.**



Source: Arabian_Desert.jpg created by NASA is in the public domain and modified by Pfly and by New Visions for Public Schools.

A. Arabian Desert on the Arabian Peninsula

Sand dunes in a section of the Arabian Desert known as the "empty quarter."

The largest land mass in the Middle East is the Arabian Peninsula and most of the Arabian Peninsula is covered by the Arabian Desert. The Arabian desert is the fourth largest desert in the world. Though it is a harsh climate, Arab traders traveled across the desert on camels to cities that formed near oases like Mecca and Medina. An oasis is a source of water in a desert.

1. What effect might this geographic feature have had on trade within the Middle East?

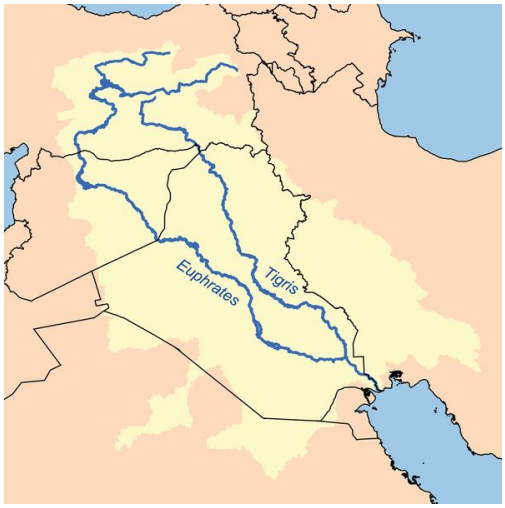
B. Nile River Valley

The Nile River as it flows through Cairo, Egypt.

The Nile River, which runs from south to north through modern-day Sudan and Egypt, is one of the longest rivers in the world. The fertile land on its banks gave birth to Ancient Egypt and was a center of trade and learning throughout the ancient, classical, and postclassical periods. During the classical era, the Greeks conquered Egypt and then the Romans did the same. The Nile River Valley was also an important economic and cultural region during the postclassical era. In addition, the Nile River served as a valuable route for traveling and transportation into the African continent.

2. Why might a post classical civilization want to conquer Egypt and the Nile River Valley?

C. Mesopotamia



Mesopotamia, the land between the Tigris and Euphrates Rivers in modern-day Iraq, Syria, and Turkey.

Tigris River in southeast Turkey.

Mesopotamia, ancient Greek for "land between two rivers," was a valuable region since the Neolithic Revolution. It's fertile land provided the foundation for the first human civilizations and its access to the Persian Gulf and location between Europe, Asia, and Africa made it a center of trade. The Persians, Greeks, and later the Romans conquered it during the Classical Era and later civilizations hoped to control it during the post-classical period.

3. Why might a post classical civilization want to conquer Mesopotamia?

D. Mediterranean Sea

The Mediterranean Sea near the ancient port of Jaffa with present-day Tel-Aviv, Israel in the background.

The Mediterranean Sea is a large body of saltwater that is connected to the Atlantic Ocean. It is almost completely surrounded by Europe to the north, Africa to the south, and the Middle East to the east.

The Mediterranean Sea has been an important body of water for trade and cultural diffusion since the establishment of the first human civilizations in the area. The Ancient Greeks controlled the eastern half of the sea at their height, and the Romans controlled most of the body of water during the Classical Era. During the post-classical period, the sea was the fastest way to travel between the three continents it joins.

4. How did the Mediterranean Sea affect Middle Eastern trade?

E. Red Sea, Persian Gulf, Arabian Sea, and Indian Ocean

Some of the major bodies of water in the Middle East.

The Red Sea, Persian Gulf, and Arabian Sea surround three sides of the Arabian Peninsula and connect the people living in that area with the Indian Ocean Trade Complex that was active during the post-classical era. Through traveling and trading on these bodies of water, people in the Middle East gained access to the knowledge and goods from East Africa, India, southeast Asia, and China.

5. How did the Red Sea, Persian Gulf, Arabian Sea, and Indian Ocean affect Middle Eastern trade?

FA

SQ 10. Where is the Middle East? How did geography affect the development of post-classical civilizations in the Middle East?

➡ **Directions:** Using evidence from the documents above, respond to the task below in the space provided.

Task 1:
Relative location is a description of where a place is in relation to how a place is related to other places.

Using the map above, **write one sentence to describe the *relative location* of the Middle East using the bank of cardinal directions below.** For example, Canada is *north of* the state of New York.

North	South	East	West
Northeast	Southeast	Northwest	Southwest

Task 2:
Complete the graphic organizer below.

Geographic Feature 1	**Geographic Feature 2**
Impact on Civilization • •	**Impact on Civilization** • •

Objective:

How interconnected was the Middle East in the post-classical era? How did trade routes in the Middle East affect the civilizations connected by them?

- **Describe** the location of trade routes in the Middle East during the post-classical period
- **Describe** how trade routes in the Middle East may have affected the civilizations connected by them.

Introduction:

➡ **Directions: Read the information below and examine the images, then answer the questions that follow.**

Frankincense is a product used in incense and perfumes that comes from trees that grow in the southern region of the Arabian Peninsula in modern-day Oman and Yemen and northeastern Africa in modern day Somalia. Since ancient times, frankincense has been a valuable good that people in the Arabian Peninsula have traded.

A frankincense farmer standing in front of one of his trees.
Image created by Francesco Bandarin is licensed under the Creative Commons Attribution-ShareAlike 3.0 IGO license.

Dried frankincense from Yemen.
Image was created by snotch and is in the public domain.

A child stares into smoke produced by frankincense incense.
The Mystic Swirls of the Frankincense Burner - Colour created by Ramkumar Rajendran, licensed under the Attribution-NonCommercial-ShareAlike 2.0 Generic (CC BY-NC-SA 2.0) license.

1. Why might someone want frankincense?

2. What effects would a demand for frankincense have on someone who farms it?

How interconnected was the Middle East in the post-classical era?

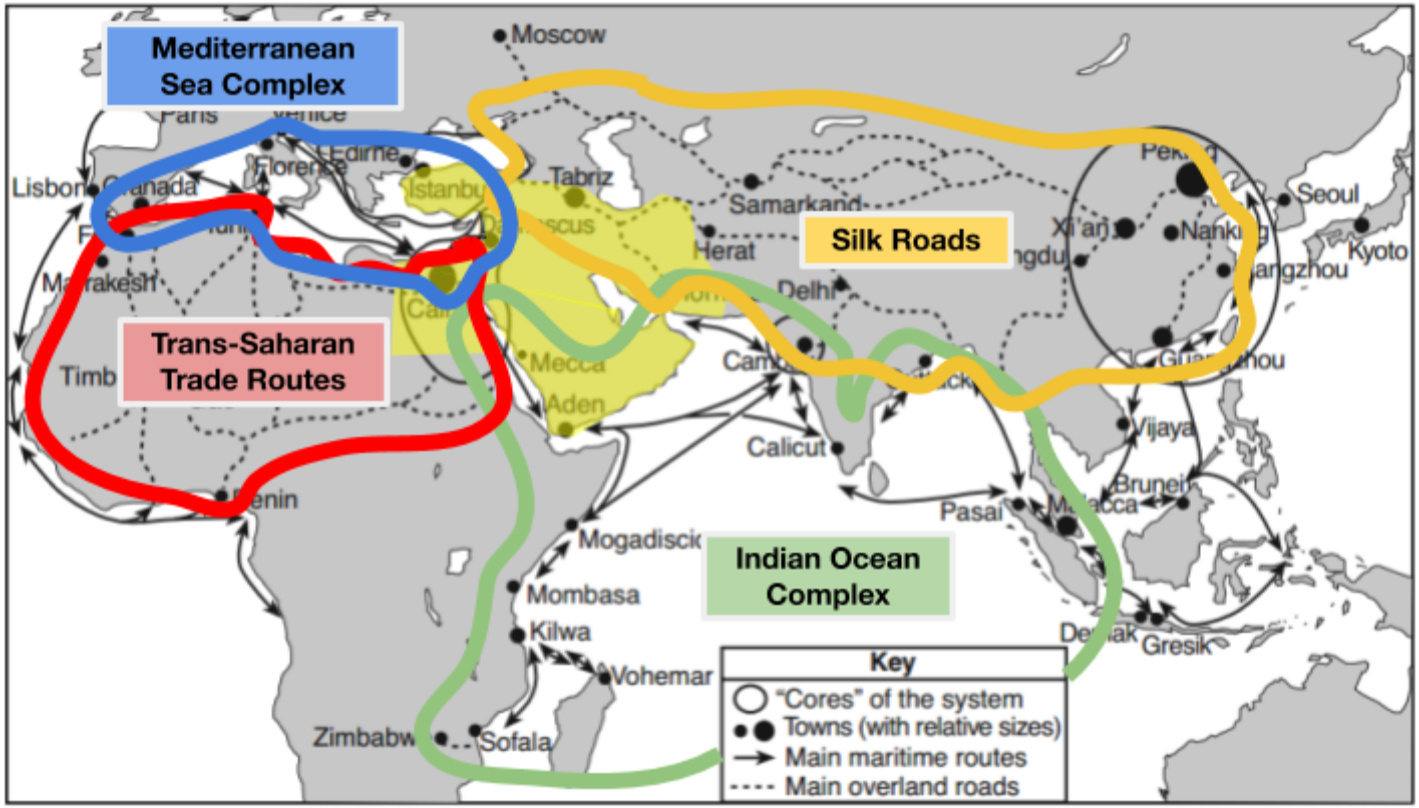
Think Like a Geographer

Contextualize

Predict

➡ **Directions: Examine the map below and answer the questions that follow.**

The map below shows trade routes in existence before the 16th Century, most of which existed during the post-classical era. The Middle East is highlighted in yellow.



Source: Adapted from Philippe Beaujard in "The Indian Ocean in Eurasian and African World-Systems before the Sixteenth Century," Journal of World History (adapted) from the NYS Global History and Geography Regents Examination, August 2012.

1. Which trade networks connected to the Middle East?	2. Identify four cities that the people living in Aden could have traded with.

3. How might living at the intersection of several trade networks have affected the lives of people in the Middle East during the post-classical era?

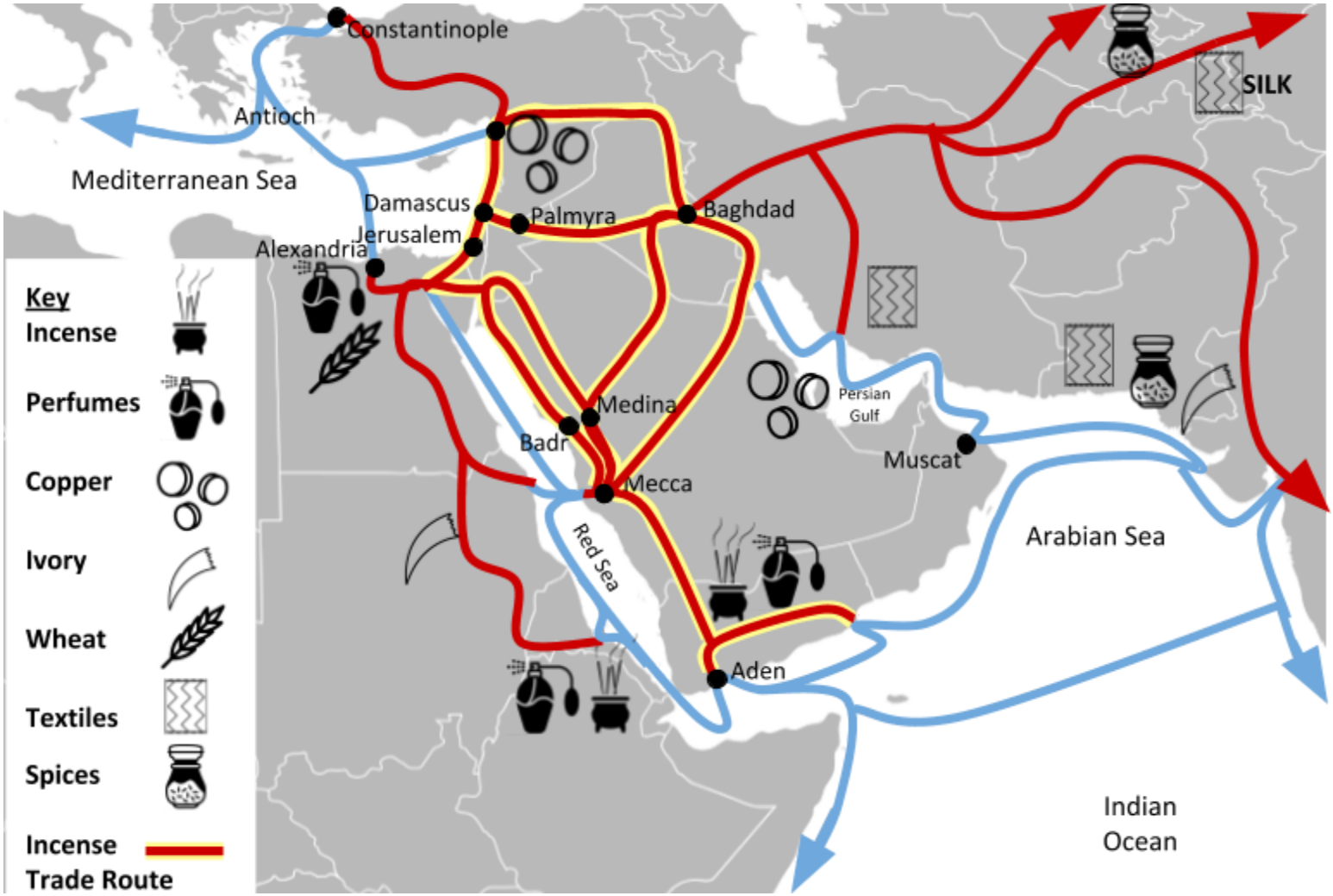
How did trade routes in the Middle East affect the civilizations connected by them?

Think Like a Geographer

Contextualize

➡ **Directions: Watch this video on Ancient Civilizations Arabian Peninsula to the Syrian Desert (start-2:52, 4:58-7:42, 12:53-17:10) and examine the map below, then answer questions that follow.**

Middle Eastern Trade Routes in the Post-classical Era



BlankMap-Middle East.svg created by NuclearVacuum is in the public domain and has been modified by New Visions. Icons provided by Noun Project.

1. What goods were traded between the Middle East and other regions during the Classical Era?	**4. What challenges did traveling in the Incense Trade Route in the desert pose to traders? How did they overcome those challenges? (video)**
2. What goods originated on the Arabian peninsula?	**5. Why was Palmyra a prosperous city? (video)**
3. Identify three cities on the Arabian peninsula that you think would have the most trade. Why did you choose those three cities?	**6. How do archaeologists know that Palmyra was a prosperous city? Cite three pieces of evidence. (video)**

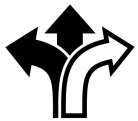
FA

SQ 11: How interconnected was the Middle East in the post-classical era? How did trade routes in the Middle East affect the civilizations connected by them?

Think Like a Geographer

➡ **Directions:** Based on the maps on the previous pages, choose *THREE* goods and/or religions that were traded on the Silk Roads during the classical era, identify where they were exported from (originated), three locations they could have been traded to, and predict what effects that good and/or religion could have had on the civilizations it was traded to.

Contextualize



Predict

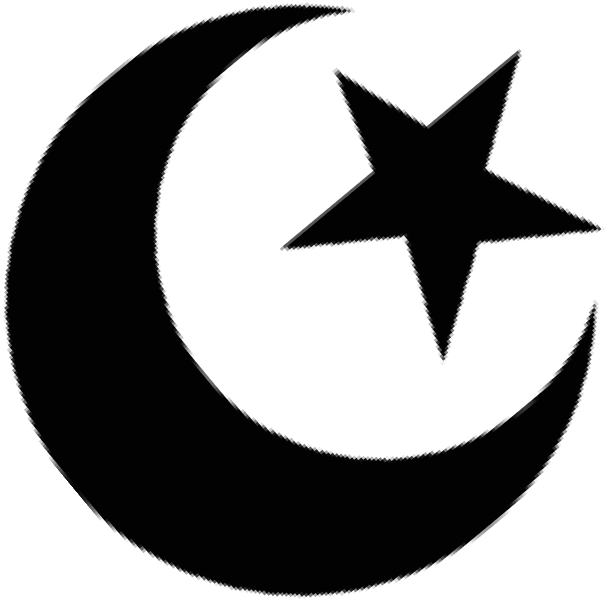
Good/Religion	Identify where the good/religion was exported from (where it originated)	Identify three locations it could have been traded to	Describe the effects the good/religion could have had on the civilizations it was traded to using the transitions below

but	because	so
led to	result in	due to

What are the major beliefs and practices of Islam?

Objective:

- **<u>Identify</u>** and **<u>describe</u>** the major beliefs and practices of Islam.



➡ **Directions:** Below, write down two things you know about Islamic beliefs.

What is Islam?

Contextualize

➡ **Directions: Watch this Introduction to Islam from the Oprah Winfrey Network, read the text, and examine the images below, and respond to the questions.**

Name of Followers	Muslims
Name of God	Allah
Place of Origin	Abrahamic religions are the monotheistic religions of the Middle East that trace their common origin to a person named Abraham. The three largest Abrahamic religions are Judaism (1000s B.C.E.), Christianity (30s C.E.) and Islam (600s C.E.) In the Qur'an, the holy book of Islam, Christians and Jews are referred to "People of the Book" because they are followers of monotheistic Abrahamic religions. All the Abrahamic religions were established in current-day Middle East and are connected by a common belief in the same god and recognition of many of the same prophets.

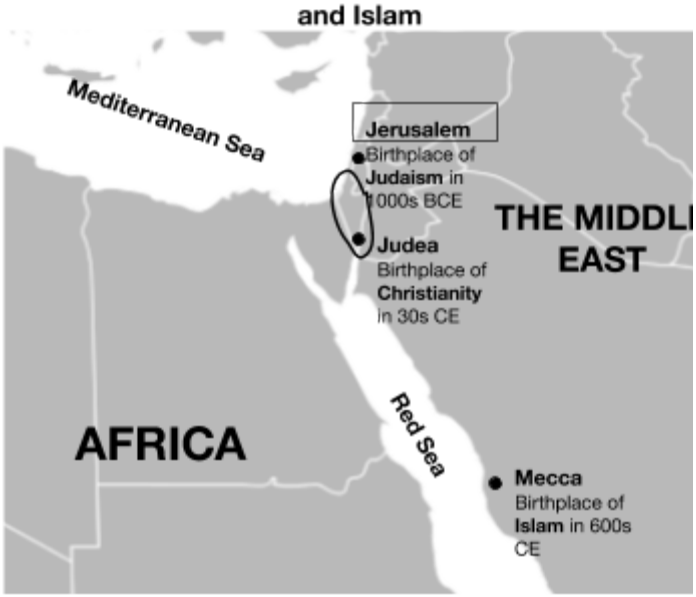
1. Why are Muslims, Christians and Jews considered Abrahamic religions?

2. What do Muslims call Christians and Jews? Why?

3. In what order were the Abrahamic religions established?

4. What are the three main commonalities between all Abrahamic religions?

The Middle East: Birthplace of Judaism, Christianity and Islam



Founder and/or Major Figures	**Muhammad,** was a merchant born in the Arabian city of Mecca. Muslims consider Muhammad to be the final prophet sent by God to mankind. Muslims revere other prophets including Abraham, Jesus, and Moses.	**5. In addition to Prophet Muhammad, who are the other important prophets in Islam?**
Holy Texts	**The Qur'an** is the holy book for Muslims. Muslims believe it was revealed in stages to the Prophet Muhammad over 23 years and written down into book form after Prophet Muhammad's death. Muslims believe the Qur'an is the sacred word of God. Muslims also believe that the Qur'an corrects any errors in previous holy books such as the Old and New Testaments. There are 114 chapters and the Qur'an is written in Arabic. **Hadith** is another holy text in Islam. Hadith are reports of what the prophet Muhammad said or approved. These sayings were overheard and written by people other than Muhammad.	**6. According to Muslim belief, how long did it take for the entire Qur'an to be revealed to Muhammad?** **7. Other than the Qur'an, what is another holy text in Islam?**
Symbols	 The star and crescent symbol only became associated with Islam in the mid-20th century.	

Beliefs and Practices

- Muslims are **monotheistic** and believe that there is only one God, Allah, which is the Arabic name for the same god worshipped by Jewish people and Christians.
- **Main Beliefs:** (1) Allah is the one and only God (2) Angels exist (3) The Qur'an and Hadith are holy books (4) Belief in the prophets mentioned in the Torah and Holy Bible including Abraham, Moses, David, Jesus, and others and that Muhammad is the final prophet (5) Belief in the Day of Judgment when Allah will determine if you go to heaven or hell (6) Belief that Allah has the knowledge of all that will happen, but that it does not prevent humans from having free will.
- **Beliefs About Jesus:** Unlike Christians, Muslims do not believe that Jesus is God or the son of God. Jesus is heavily discussed in the Qur'an as an important prophet but not as the son of God.
- **Sharia Law:** Sharia Law, or Islamic Law, is a set of rules that come from the Qur'an (the Muslim holy book), the Hadith (sayings attributed to the prophet Muhammad) and fatwas (the rulings of Islamic scholars)

8. How do Muslims view Jesus differently than Christians?

Places of Worship

Muslims worship in **mosques**, houses of worships that point towards Mecca. They look different depending on where they are and who built them.

Badshahi Mosque in Lahore, Pakistan.

Sheikh Lotfallah Mosque, Isfahan, Iran.

Great Mosque of Xi'an — Xi'an, China.

Names of Leaders

Spiritual leaders in Islam are called **imams** and **shaykhs.**

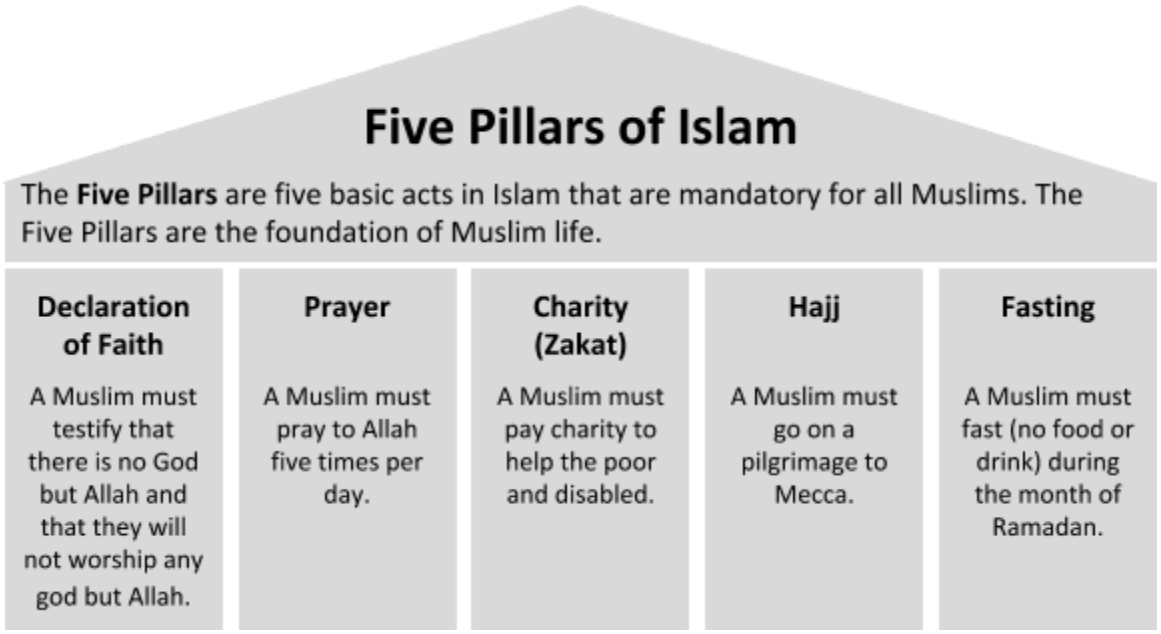
Holidays

There are two Eids (festivals)

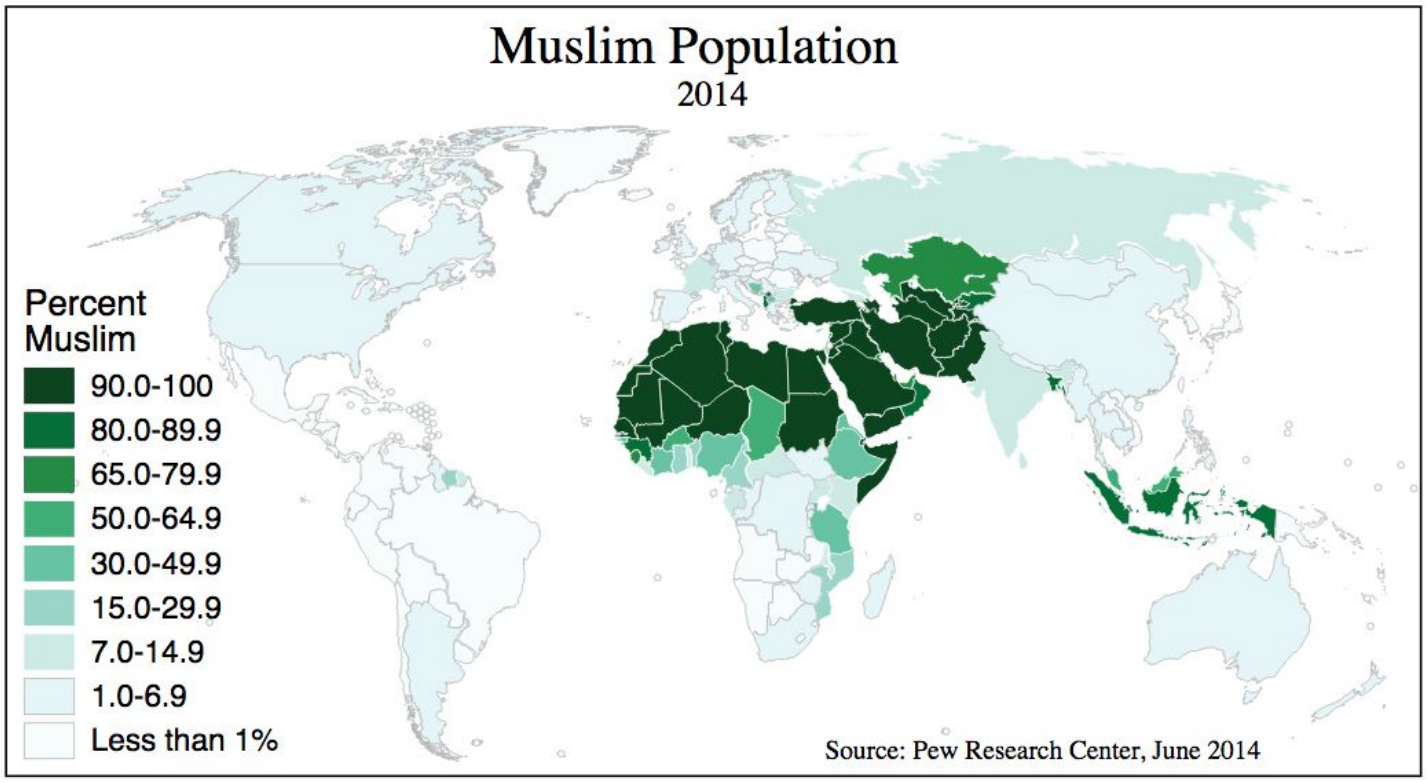
- **Eid ul Fitr:** Celebrates the end of the month of fasting called Ramadan
- **Eid ul Adha:** Celebrates Abraham's willingness to sacrifice his son when God ordered him to

Moral/Ethical Code of Conduct

Five Pillars



Percentage of Muslims Living in Each Country in the World (June 2014)



How do we know what we know about Muhammad?

Objective:

- **<u>Evaluate</u>** the primary sources that historians use to learn about early Muslims.

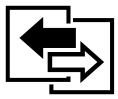
Introduction

➡ **Directions:** Below, write down two things you know about Muhammad and how you know those things.

What do you know about Muhammad?	How do you know this? Where did this information come from?

Looking at the Historical Documents about Muhammad

➡ **Directions:** Read the excerpts below and respond to the questions.



Corroborate

Where do we find most of the information about Muhammad and early Muslims?

Much of what we know about Muhammad and the early days of Islam comes from three sources:

- **Qur'an:** word of God as revealed to Muhammad
- **Hadith:** the recorded sayings and actions of Muhammad
- **Sira:** biographies of the prophet

Historians examine these sources. They investigate how they were created, who wrote them, when they wrote them, and any bias the writers might have had.

Qur'an

11th-century North African Qur'an in the British Museum

The Qur'ān literally means "the recitation" and it is the central religious text or scripture of Islam. Muslims believe it to be the word of Allah, revealed to Muhammad by an angel named Gabriel over a period of 23 years between 610 and 632 C.E. Tradition says that Muhammad recited the content to his companions, some of whom later recorded it. This exercise was often repeated to ensure that the recordings were accurate. However, no single copy existed during Muhammad's lifetime.

Muslims view the Qur'an as God's final revelation and complete message to humanity. The Qur'an influences Muslim conduct, law, faith and practice across the whole spectrum of religious and daily life.

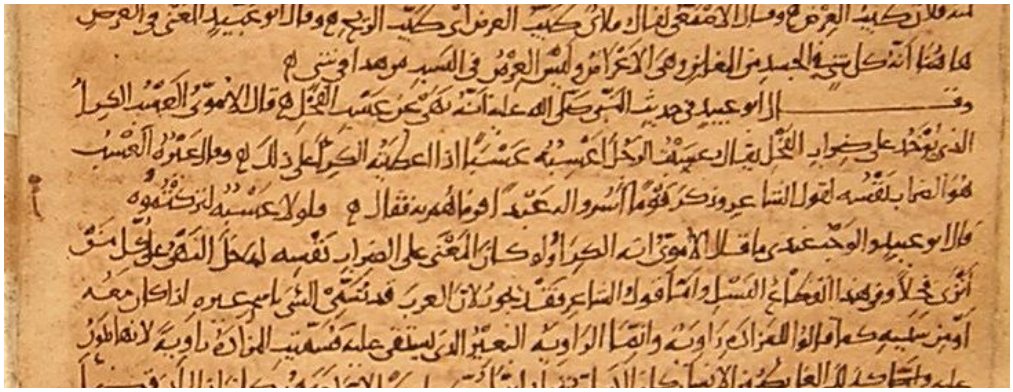
1. According to the excerpt above, to whom was the Quran revealed?

2. According to the excerpt above, during what years was the Quran revealed?

3. Who wrote down the Qur'an? When?

Hadith

Hadith are the recorded sayings and actions of Muhammad. Each hadith is based on two parts: a chain of narrators listed so that the reader knows who is telling the story and the text describing Muhammad's actions or words. Individual hadith are classified by Muslim clerics and jurists as authentic or weak because there was concern over people making up stories about Muhammad. The Hadith were evaluated and gathered into large collections during the 8th and 9th centuries.



Gharib al-Hadith, by Abu `Ubayd al-Qasim b. Sallam al-Harawi (d. 223/837). The oldest known dated Arabic manuscript on paper in Turkey libraries (dated 319 (931 AD)

Hadith from Imam Al-Nawawi, an Islamic scholar who died in 1277, 645 years after the death of Muhammad.

On the authority of Abdullah ibn Umar ibn Al-Khattab (may Allah be pleased with him) who said: I heard the Messenger of Allah (peace be upon him) say:
"Islam has been built on five [pillars]: testifying that there is no god but Allah and that Muhammad is the Messenger of Allah, performing the prayers, paying the Zakat, making the pilgrimage to the House, and fasting in Ramadan."

4. What is Hadith?

5. Based on the hadith from Imam Al-Nawawi, who were the sources of the quote provided?

6. Explain the extent to which Imam Al-Nawawi's hadith is a reliable source of evidence about Muhammad's statements.

Sira

Sira are traditional Muslim biographies of Muhammad. The earliest surviving biographies are the Life of the Apostle of God, by Ibn Ishaq (d. 768), edited by Ibn Hisham (d. 833); and al-Waqidi's (d. 822) biography (sira) of Muhammad. Ibn Ishaq wrote his biography some 120 to 130 years after Muhammad's death.

7. What is sira?

8. According to the excerpt above, what is the earliest surviving example of sira?

9. Explain the extent to which Ibn Ishaq's *Life of the Apostle* is a reliable source of evidence about the events in Muhammad's life.

FA

SQ 13. How do we know what we know about Muhammad?

➡ **Directions: Given what you learned in this lesson, complete the tasks below.**

Identify three sources that historians use to learn about Muhammad and answer the following questions about each source.

	How is this source a reliable source of evidence for learning about Muhammad?	**What are the limitations/problems with this source?**
Source 1:		
Source 2:		
Source 3:		

What was the context for the founding of Islam?

Objective:

- **<u>Contextualize</u>** the founding of Islam.

Introduction

➡ **Directions: Respond the questions below.**

angry by Gan Khoon Lay from the Noun Project

Have you ever said something that most of the people around you disagree with?

What *<u>negative</u>* effects could come from saying something that most of the people around you disagree with?	**What *<u>positive</u>* effects could come from saying something that most of the people around you disagree with?**

The Life of Muhammad

➡ **Directions:** Read and watch the video clips. Answer the questions that follow.

Muhammad's Early Life

Contextualize

Watch the excerpt of ***The Message*** and respond to the questions. (05:18-06:52)

Context: The film, *The Message* is a 1976/1977 film and Quranic epic directed by Moustapha Akkad. It chronicles the life and times of Muhammad and serves as an introduction to early Islamic history. In accordance with Muslim beliefs regarding depictions of Muhammad, he was not shown on-screen nor was his voice heard because Islamic tradition generally forbids any direct representation of religious figures.

Muhammad. (2017, June 26). In *Wikipedia, The Free Encyclopedia*. Retrieved 17:02, July 3, 2017, from here.

Start at 05:18 of the video.

1. Why is Prophet Muhammad's face not be shown in this film?

570 C.E.

Born approximately in 570 CE in the Arabian city of Mecca, Muhammad was orphaned at an early age. He was raised under the care of his paternal uncle Abu Talib. After his childhood, Muhammad primarily worked as a merchant.

Watch 5:37-6:32 of the video.

2. How long after Jesus' time was Muhammad born?

Pre-Islamic Arabian gods or goddesses were viewed as protectors and their spirits were associated with sacred trees, stones, springs and wells. The Kaaba shrine in Mecca housed 360 idols.

Muhammad. (2017, June 26). In *Wikipedia, The Free Encyclopedia*. Retrieved 17:02, July 3, 2017, from here.

Watch 6:32-7:00 of the video.

3. What was the name of the city Muhammad was born in?

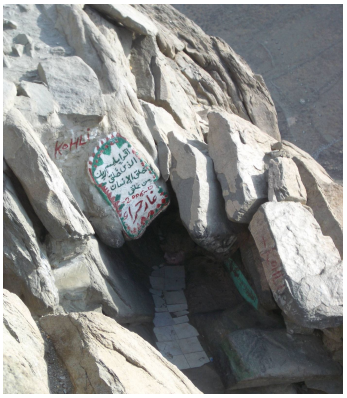
4. Were the people there monotheistic or polytheistic? How do you know?

The Revelation in Cave Hira

Watch the excerpt of ***The Message*** and respond to the questions. (13:22-14:44)

595 C.E.

Muhammad, a merchant, met a rich merchant named Khadijah. Khadijah and Muhammad married. She was a wealthy widow and their marriage improved Muhammad's status in society. Muhammad began to occasionally retreat to a cave named Hira in the mountains for several nights of seclusion and prayer to meditate and think about many of the problems he saw in Mecca.



The cave Hira in the mountain where, according to Muslim belief, Muhammad received his first revelation.

Image is courtesy of Wikimedia Commons and is public domain.

610 C.E.

At the age of 40, Muhammad was visited by the angel Gabriel while meditating in a cave (Hira) near Mecca. The angel told him that he was God's prophet. According to Muslim belief, the angel Gabriel ordered him to:

Recite in the name of thy lord who created,
Created man from a clot;
Recite in the name of thy lord,
Who taught by the pen,
Taught man what he knew not.

This was considered the first revelation of the Qur'an.

Watch 13:22-16:22 of the video.

5. According to the film, what did Angel Gabriel say to Muhammad in the cave?

6. How did Muhammad respond?

Muhammad Begins Spreading Islam

Watch the excerpt of ***The Message*** and respond to the questions. (17:52-18:52; 22:52-24:52; 27:52-36:52; 39:52-41:52)

610-612 C.E.

Muhammad was told to call his people to the worship of the one God, and he began to spread this new message throughout Mecca. Shortly after his revelation in 610, he began to gather followers in Mecca in secret.

Watch 16:25-18:48 of the video.	**7. What did Muhammad's uncle, Abu Bakr warn him will happen if he continues to speak about his revelation and his new religious ideas?** **8. How did Muhammad respond to this warning?**
Watch 21:00-22:52 of the video.	**9. What new and "dangerous ideas" did Muhammad spread throughout Mecca?**

610-612 C.E.

Muhammad slowly began to attract some followers. Muhammad began to criticize the traditional polytheism that others followed in Mecca. The rich and powerful merchants of Mecca grew angry because the gods and idols were their source of income. The merchants earned income from pilgrims when they came to the polytheistic shrine, the Kaaba. If there was only one God and polytheism did not exist as Muhammad preached, the merchants would lose pilgrims and thus lose lots of money. The ruling elite rallied against Muhammad and his followers, and began to persecute them.

10. Why did the rich and powerful merchants dislike Muhammad?	**11. How did the ruling elite respond to Muhammad and his followers?**

Stop at 26:56 of the video.	**12. In the scene where a follower of Muhammad's teachings is being questioned by the ruling elites, what do we learn of Muhammad's teaching about equality**?

Stop at 29:00 of the video.	**13. When the slave named Bilal is told to whip Muhammad's follower, what does he do?** **14. Why does he make this decision?**
Watch 30:29-31:50 of the video.	**15. What happens to Bilal as a consequence of his choice?** **16. What does he say while he is enduring his consequence?**

613 C.E.

Muhammad began publicly spreading the message of Islam to all Meccans.

Watch 33:42-34:10 of the video.	**17. How do the ruling elites respond to Muhammad spreading Islam publicly throughout Mecca?**
Watch 34:15-36:52 of the video.	**18. How do the Meccans treat Muhammad and the early followers of Islam?** **19. How is this similar to the ways early Christians were treated during the Roman Empire?** **20. Why are they treated in this way?**

The Hegira

The Hegira and Early Migrations

622 C.E.

The local rulers of Mecca forced Muhammad and his small group of followers to leave the city. After enduring persecution in Mecca, Muhammad and his followers migrated to the nearby town of Yathrib (later to be known as Medina). Here, the people accepted Islam as their religion. This migration is called "the hegira." In Medina, Muhammad was able to establish an Islamic state based on the laws revealed in the Quran. He and his followers continued to spread Islam to the other tribes in Medina.

21. Why did Muhammad and his followers leave Mecca? Where did they go?	**22. What did Muhammad do when he arrived in the new town?**
23. How did "the Hegira" spread Islam?	

Battles

Battle of Badr as illustrated in a book from 1594

Image is courtesy of Wikimedia and is in the public domain.

622-628 C.E.

Relations between Mecca and Medina rapidly worsened after Muhammad and his followers left. Meccans confiscated all the property that the Muslims had left in Mecca. Because Muslims owned no land in Medina, they would have to live on charity and on the rare chance for wage labor. Muhammad began to engage in the old Arabian practice of raiding caravans bound for Mecca for money. These raids led to battles between Meccans and Muslims. In 624, near a place called Badr, the Meccans and the Muslims clashed again. Even though the Muslims were outnumbered, they were successful. The Battle of Badr was the beginning of successful Muslim military campaigns. The victory strengthened Muhammad's position in Medina and he became the unofficial ruler of the city. After the victory over the Meccans in the Battle of Badr, the Meccans continued to fight against Muslims in future battles.

24. Why was there fighting between the Muslims in Medina and the Meccans?

25. Why was the Battle of Badr an important point in Islamic history?

628 C.E.

The Treaty of Hudaybiyyah was signed between Muhammad, representing the state of Medina, and the Quraish tribe of Mecca. This treaty reduced fighting between the cities.

26. Why was the Treaty of Hudaybiyyah important?

Return to Mecca

The Kaaba in Mecca long held a major economic and religious role for the area. Seventeen months after Muhammad's arrival in Medina, it became the Muslim Qibla, or direction for prayer (salat). The Kaaba has been rebuilt several times; the present structure was built in 1629.

630 C.E.

Muhammad returned to Mecca with a large number of followers. Prior to his arrival, in 628, Muhammad negotiated a truce with the Meccans. When he returned, most Meccans accepted Islam as their religion. The prophet cleared the idols and images out of the Kaaba and rededicated it to the worship of Allah. With the conversion of the city of Mecca, the greater part of the Arabian world came under Muhammad's authority.

27. What happened when Muhammad and his followers returned to Mecca?

Muhammad's Death and the Sunni/Shi'ite Split

Al-Masjid an-Nabawi ("the Prophet's mosque") in Medina, Saudi Arabia, with the Green Dome built over Muhammad's tomb in the center.

632-633 C.E.

After a short illness, Muhammad died in the city of Medina at the age of 63. Before Muhammad's death, he united the tribes of Arabia into a single Arab Muslim religious government. With his death, disagreement broke out over who his successor would be. The once unified Arab Muslim community broke apart into two groups: **Sunni Muslims** and **Shiite Muslims**. The majority of Muslims, who became known as Sunni Muslims, believed that the community of Muslims should determine who would succeed Muhammad. However, the Shiite Muslims, the smaller group of Muslims, believed that only descendants and family members of Muhammad should be the successor. The Sunnis prevailed and selected the first caliph or successor to Muhammad. Eventually, Ali (Muhammad's son-in-law) was chosen as the fourth caliph but the division between Sunni and Shiites created repeated tension and violence. The violence and war split the small community of Muslims into two branches that have never reunited.

28. What happened the the unified Muslim community when Muhammad died?

FA

SQ 14. What was the context for the founding of Islam?

➡ **Directions: Use the information you learned about Islam to complete the tasks below.**

Contextualize

Expand each sentence below.

Example:

She started the fight.

Who?	Mary
When?	During lunch period
Where?	Cafeteria
Why?	because she thought Sarah copied her test answers during chemistry class
Contextualization Sentence(s):	
During the lunch period, Mary started a fight in the cafeteria **because** she thought Sarah copied her test answers during chemistry class.	

He founded Islam.

Who?	
When?	
Where?	
Why?	
Contextualization Sentence(s)	

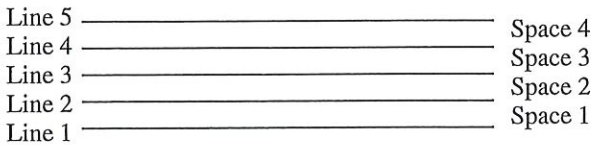
St. Louis Public School

Performing Arts - Gr. 6-8

At Home Learning Packet

Lesson 1: The Staff

The musical **staff** is made up of five **lines** and four **spaces**.



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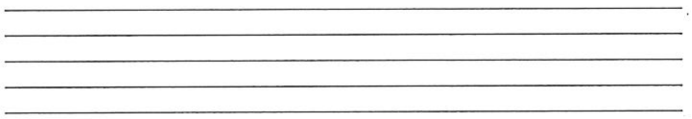
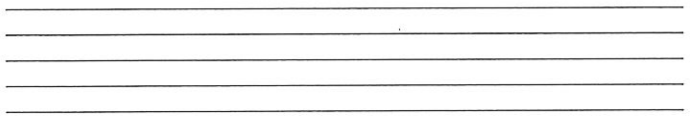
1. Practice drawing a staff by connecting the hyphens.

- -
- -
- -
- -
- -

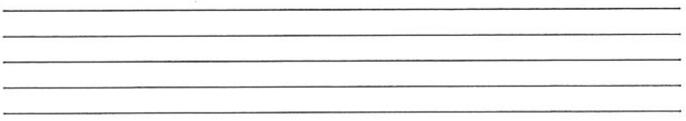
2. On this staff, number the lines from low to high.



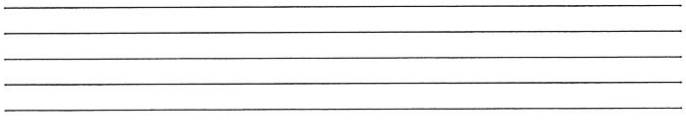
3. On this staff, number the spaces from low to high.



4. Draw a note on each line of the staff below.

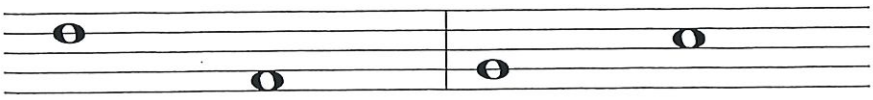


5. Draw a note on each space of the staff below.



The Staff - High and Low

Musical sounds (low or high) are shown by the position of notes on the staff. Notes that are higher on the staff have a higher sound or pitch than those that are lower on the staff.

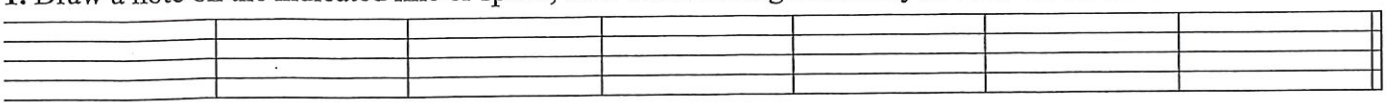


The first note sounds higher than the second note.

The first note sounds lower than the second note.

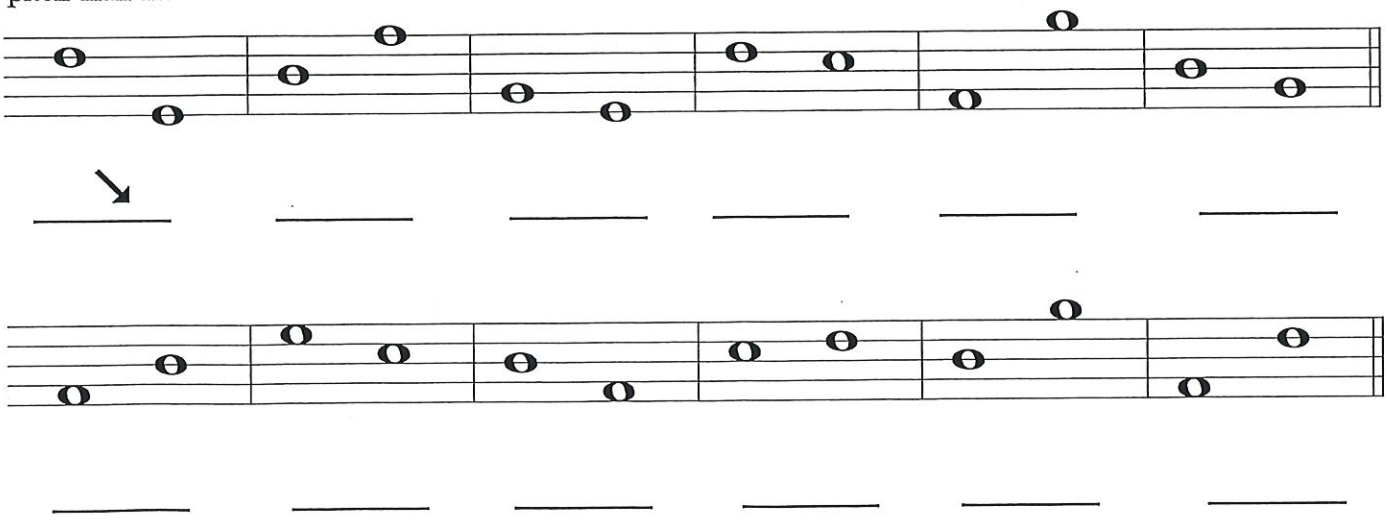
---

1. Draw a note on the indicated line or space, then circle the highest note you drew on the staff.

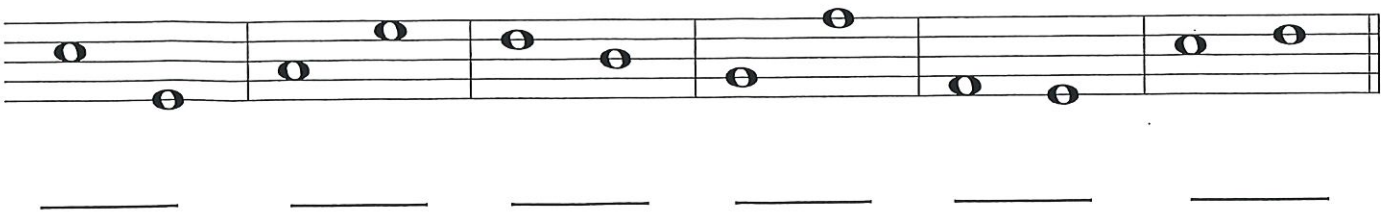


Line 3 Line 4 Space 1 Line 5 Line 2 Space 3 Line 1

2. Use an arrow to indicate whether the second note of each measure sounds higher ↗ or lower ↘ in pitch than the first note.



3. Use the letters H and L to indicate wheather the first note of each measure sounds higher (H) or lower (L) in pitch than the first note.



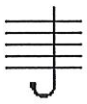
The Staff - Treble Clef

At the beginning of each staff there is a clef. The treble clef (also known as G clef) looks like this:

The treble clef gives establishes a landmark on the note G on the 2nd line of the treble staff.

To draw the treble clef, draw:

the line and tail



1.

the top loop

2.

the left loop

3.

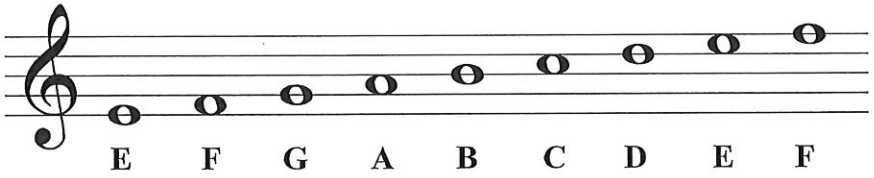
the right loop

4.

the curl

5.

Notes are named after the first sevel letters of the alphabet (A through G).



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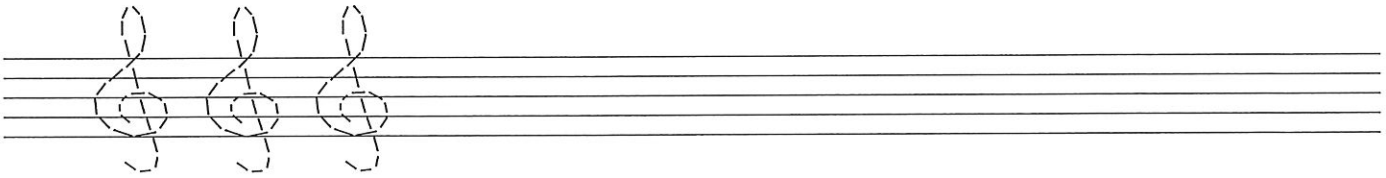
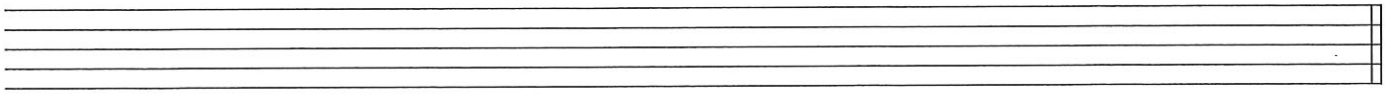
1. Try drawing the treble clef sign by tracing over the dotted lines. Then draw five more of your own.



2. Draw a treble clef at the beginning of the staff. Then write the letter names of each note.

__ __ __ __ __ __ __ __ __ __

3. Draw a treble clef at the beginning of the staff. Then draw the notes indicated. If a note can be written on more than one place on the staff, choose one.



G E B C D B A C D F

The Staff - Bass Clef

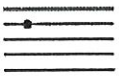
The bass clef (also known as F clef) looks like this:

F

The bass clef gives a landmark on the note F on the 4th line of the bass staff.

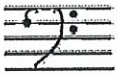
To draw the bass clef, draw:

a black dot

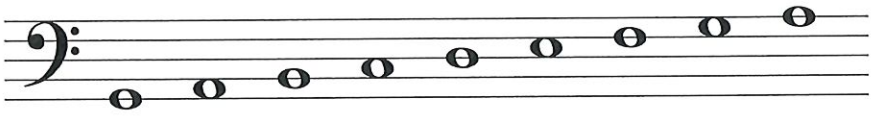


a curve

two dots



Notes are named after the first seven letters of the alphabet (A through G).



G A B C D E F G A

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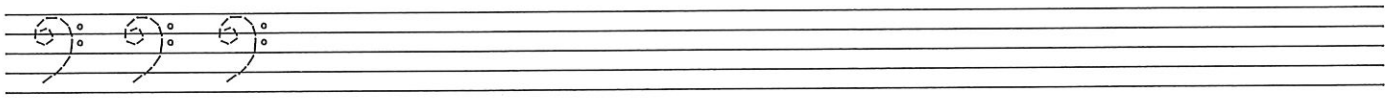
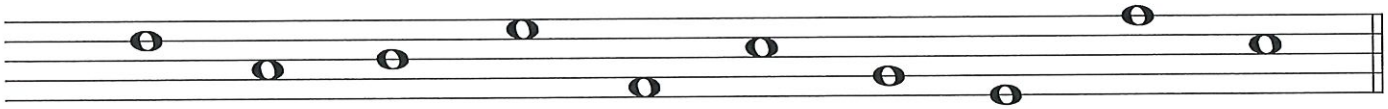
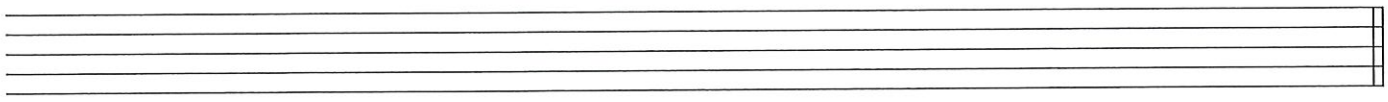
1. Try dawing the bass clef sign by tracing over the dotted lines. Then draw five more of your own.



2. Draw a bass clef at the beginning of the staff. Then write the letter names of each note.



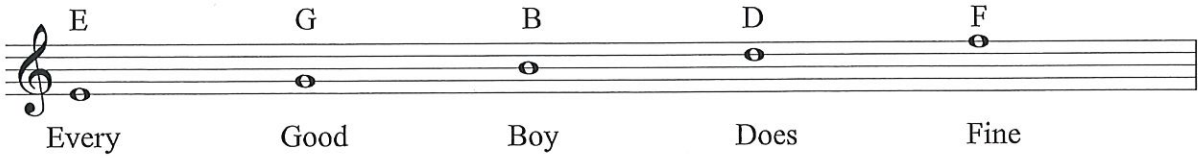
3. Draw a treble clef at the beginning of the staff. Then draw the notes indicated. If a note can be written on more than one place on the staff, choose one.



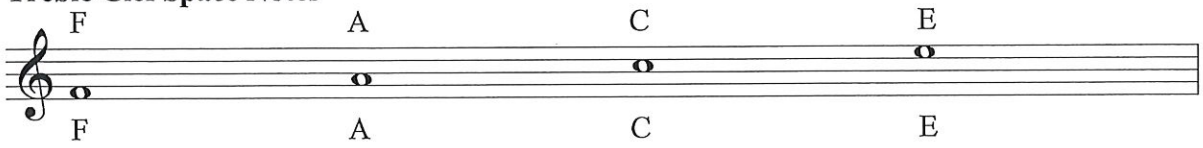
F G A D F C B G D E

Lesson 5: Note Reading Worksheet

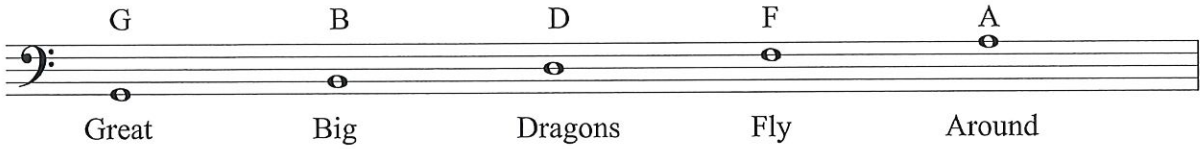
Treble Clef Line Notes



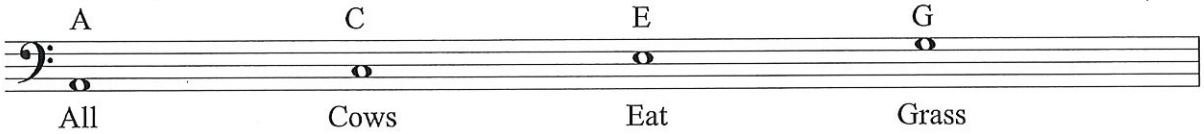
Treble Clef Space Notes



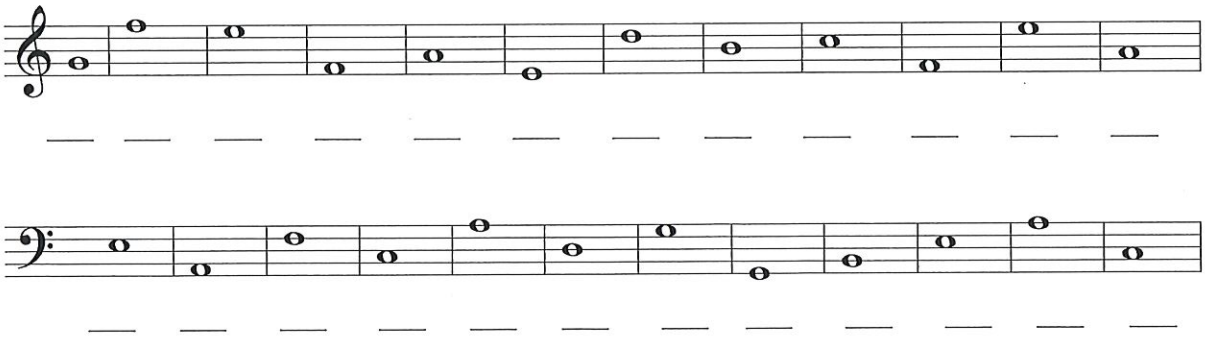
Bass Clef Line Notes



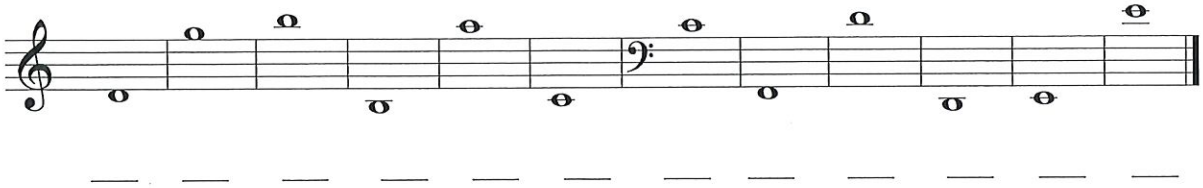
Bass Clef Space Notes



Please indicate the following notes on the indicated space.



❖ Challenge! Please indicate the following notes that lie oustide of the staff.



Lesson 6: Basic Rhythm: Note Types and 4/4 Time

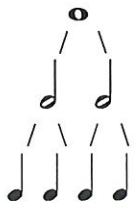
The duration of musical sounds is indicated by different types of notes. These indicate how long or short to hold the note.

quarter note	**half note**	**whole note**
1 beat	2 beats	4 beats

One whole note equals four quarter notes.

One half note equals two quarter notes.

One whole note equals two half notes.



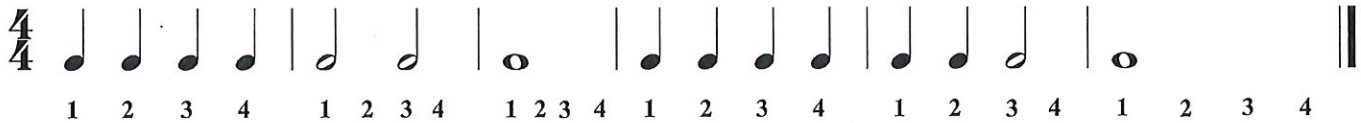
Time signatures are placed at the beginning of a piece of music. They are made up of two numbers.

The top number shows the number of beats per measure.
The bottom number shows what kind of note will get one beat.

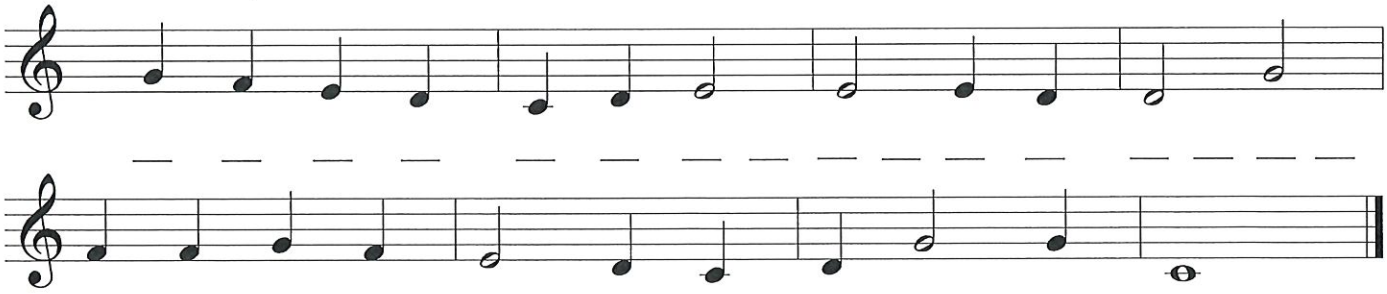
In $\frac{4}{4}$ time there are four beats in each measure. A quarter note gets one beat.

---

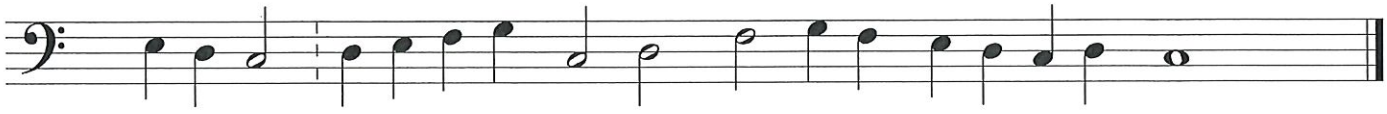
1. Tap & Count the rhythm of the notes while counting the beats out loud.



2. Write a $\frac{4}{4}$ time signature after the clef sign. Write in the beat below the notes indicated. Then clap the rhythm while counting the beats out loud.



3. Write a $\frac{4}{4}$ time signature after the clef sign. Write in the beat below the notes indicated. Draw the missing bar lines.



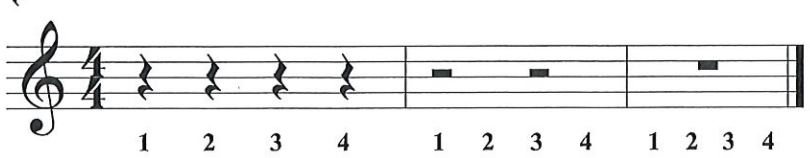
Lesson 7: Basic Rhythm - Rests and Stems

The duration of musical silence is indicated by different types of **rests.**

quarter rest
1 beat

half rest
2 beats

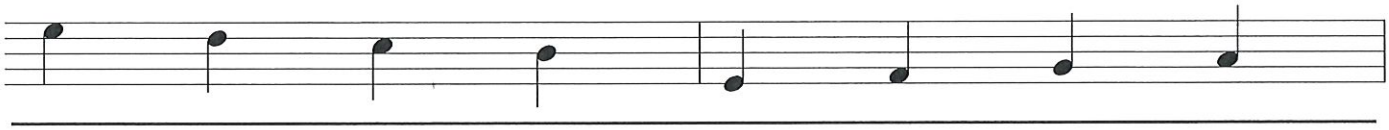
whole rest
4 beats



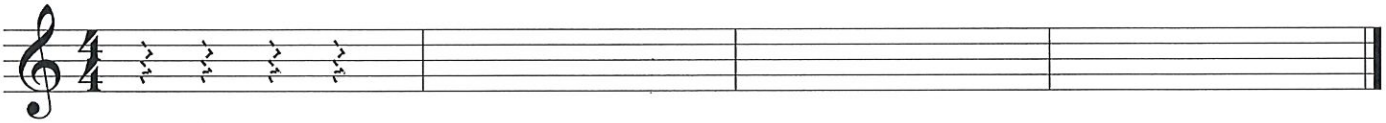
There are rules to follow when drawing **stems** on half notes and quarter notes.

If the notes are on or above the third line, the stems for half notes and quarter notes are drawn downward on the left side of the notehead.

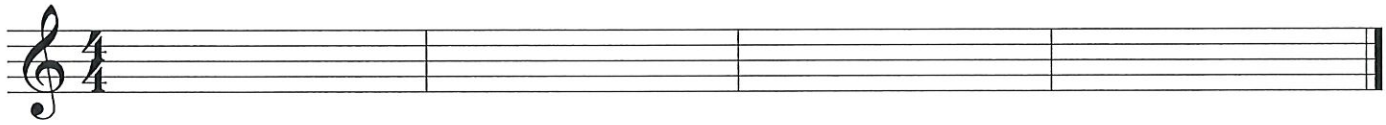
If the notes are below the middle line, the stems are drawn upward on the right side of the notehead.



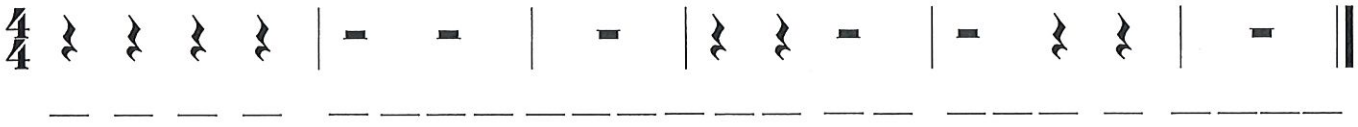
1. Practice drawing quarter rests by tracing over the dotted lines. Draw four quarter rests in each blank measure.



2. Draw two half rests in each of the first 2 measures. Then draw one whole rest in each of the last 2 measures.

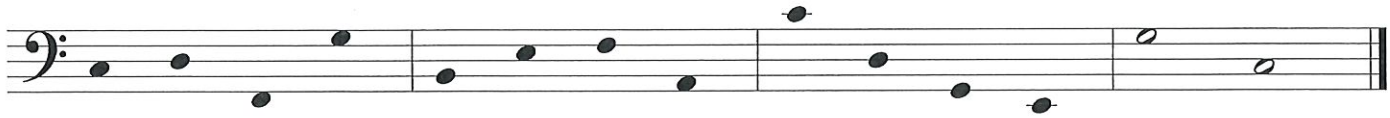


3. Write the count below the rests.



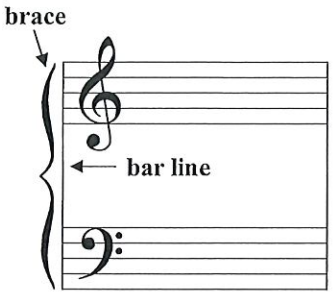
4. Write the count below the notes and rests, then add the missing bar lines.

5. Draw the appropriate stems on the following noteheads.



Name: _____

Lesson 8: The Grand Staff

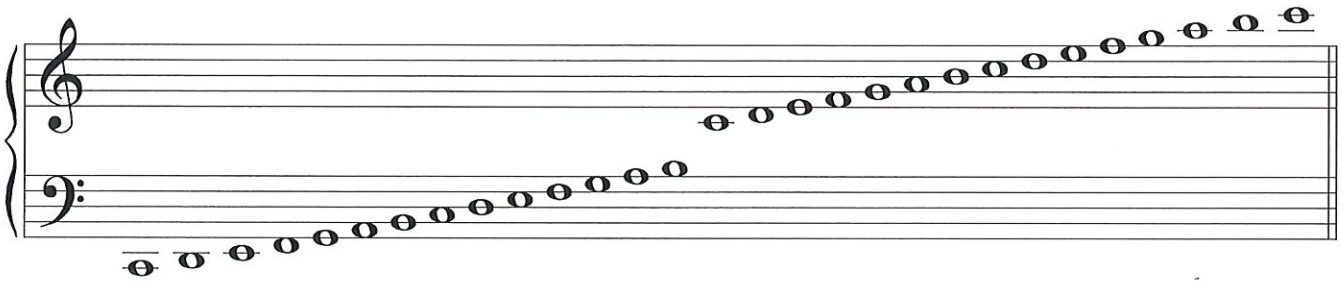


The **grand staff** represents the treble staff and bass staff joined together.

The brace is a curved line and bar line that combines the treble and bass staff.

A ledger line is a small line added to the note when it is either above or below the staff.

The Middle C note is on the ledger line that is between the treble and bass staff.



C D E F G A B C D E F G A B C D E F G A B C D E F G A B C

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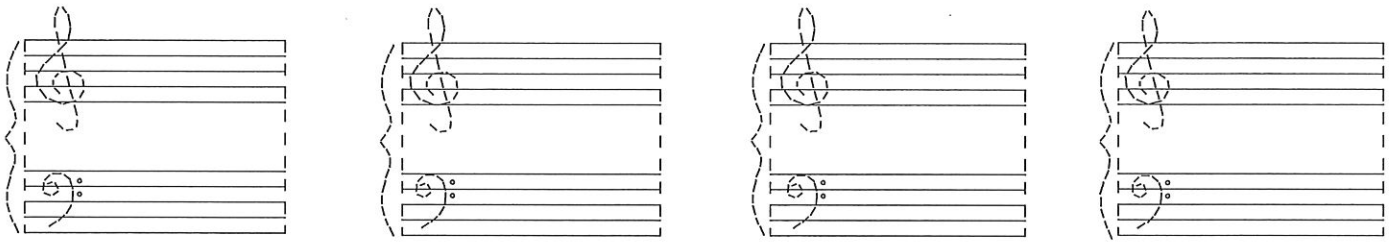
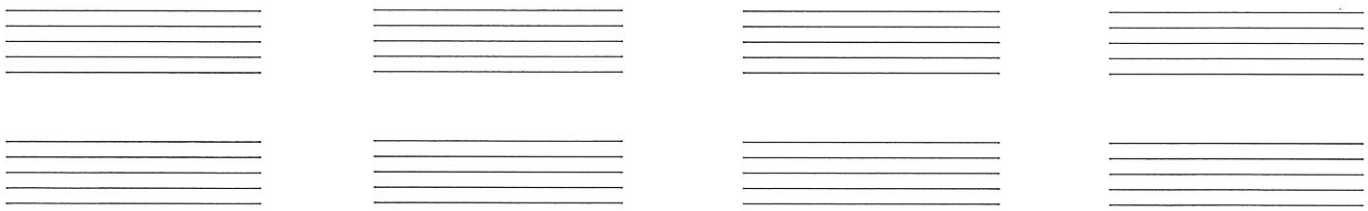
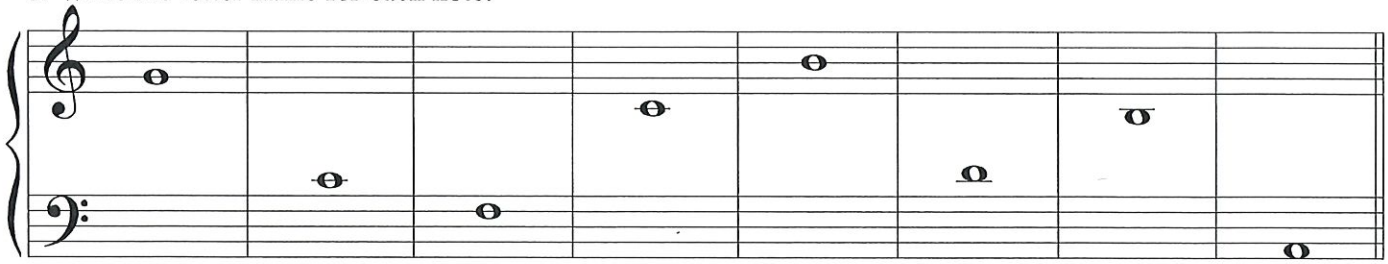
1. Draw the grand staff by tracing the braces, bar lines, and clefs.



2. Turn the following staff into grand staff by adding braces, bar lines, and clefs.



3. Write the letter name for each note.



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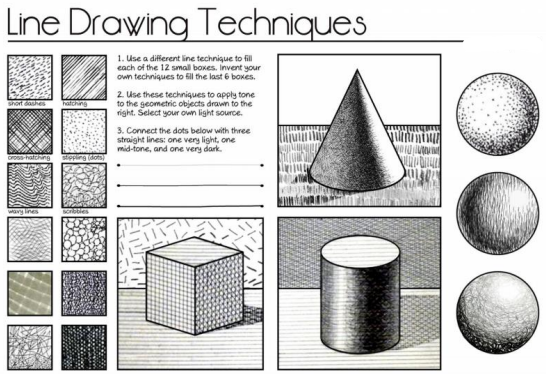
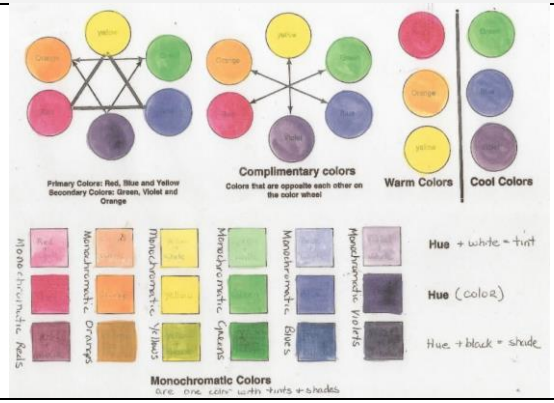
Visual Art Activities

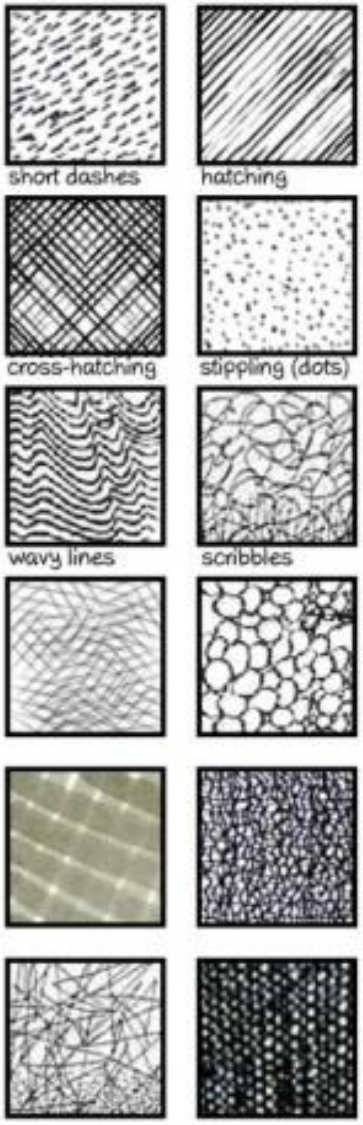
Students are encouraged to maintain contact with their home school and classroom teacher(s). If you have not already done so, please visit your child's school website to access individual teacher web pages for specific learning/assignment information. If you cannot reach your teacher and have elected to use these resources, please be mindful that some learning activities may require students to reply online, while others may require students to respond using paper and pencil. In the event online access is not available, please record responses on paper. Completed work should be dropped off at your child's school. Please contact your child's school for the dates and times to drop off your child's work.

If you need additional resources to support virtual learning, please visit: https://www.slps.org/extendedresources

St. Louis Public Schools
Continuous Learning Plans
Grades 6-8 Visual Art ** Students are encouraged to free draw every week.**

Jan. WEEKS 1 & 2	**Activities: "What do I do?"** ***What needs to be done in order to learn the material?***	**Resources: "What do I need to do it?"** ***What print and electronic resources are available to support your learning? What materials are needed?***	**Examples: "What does it look like?"**
	<u>Drawing Value with Various Techniques</u> Practice various shading (value) techniques with pencil or pen by completing the attached "Line Drawing Techniques" worksheet.	• Pen or pencil • See worksheet attached	
Jan. WEEKS 3 & 4	**Activities: "What do I do?"** ***What needs to be done in order to learn the material?***	**Resources: "What do I need to do it?"** ***What print and electronic resources are available to support your learning? What materials are needed?***	**Examples: "What does it look like?"**
	<u>Practice Color Theory</u> • Practice creating various colors by blending with primary color colored pencils. • Complete the attached color wheel worksheet.	• Only primary color colored pencils (red, yellow, and blue) • See worksheet attached	

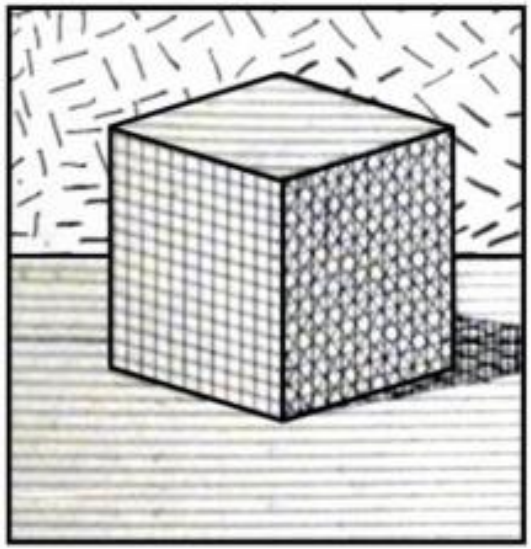
Line Drawing Techniques

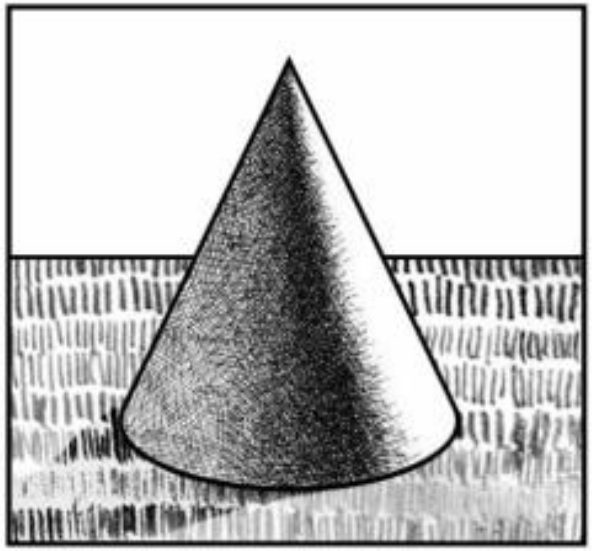


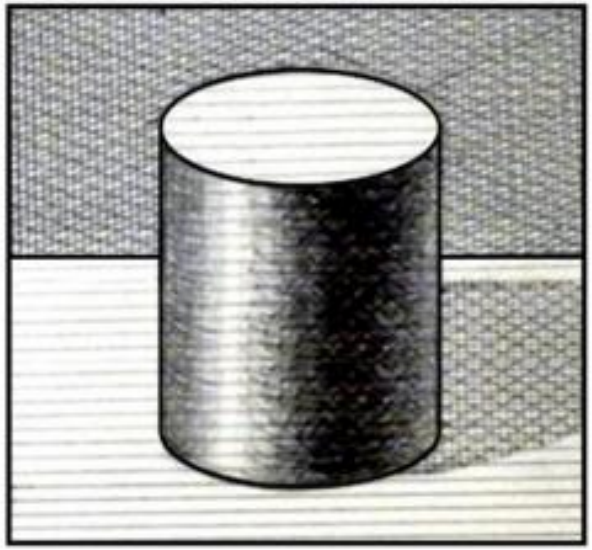
1. Use a different line technique to fill each of the 12 small boxes. Invent your own techniques to fill the last 6 boxes.

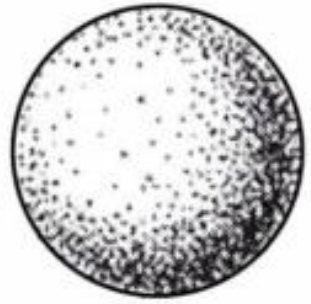
2. Use these techniques to apply tone to the geometric objects drawn to the right. Select your own light source.

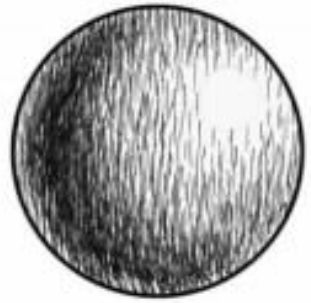
3. Connect the dots below with three straight lines: one very light, one mid-tone, and one very dark.











Line Drawing Techniques

short dashes

hatching

cross-hatching

stippling (dots)

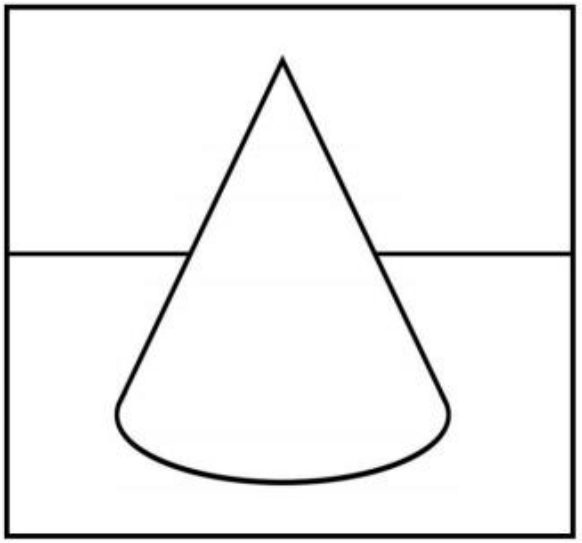
wavy lines

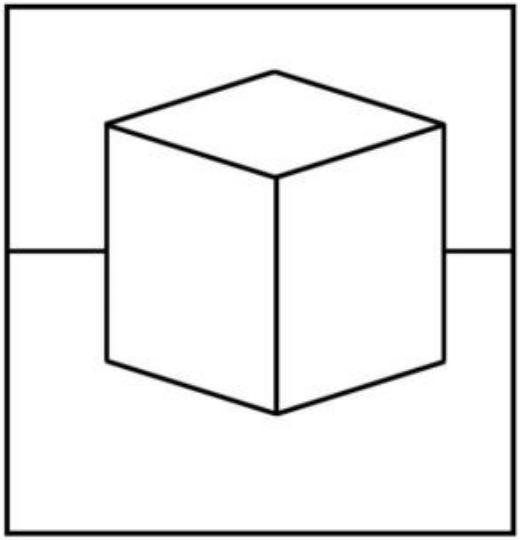
scribbles

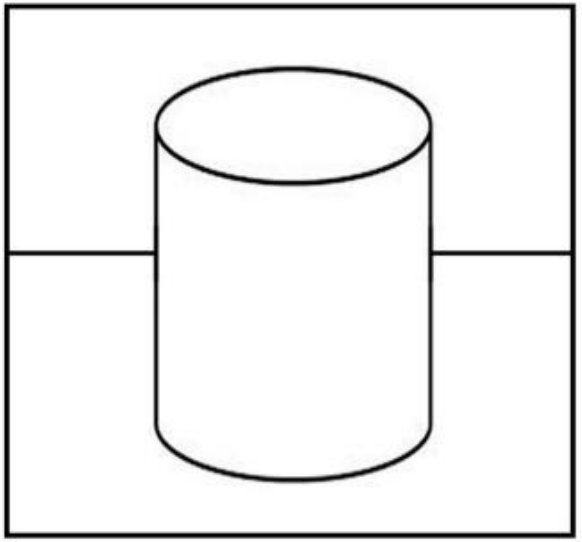
1. Use a different line technique to fill each of the 12 small boxes. Invent your own techniques to fill the last 6 boxes.

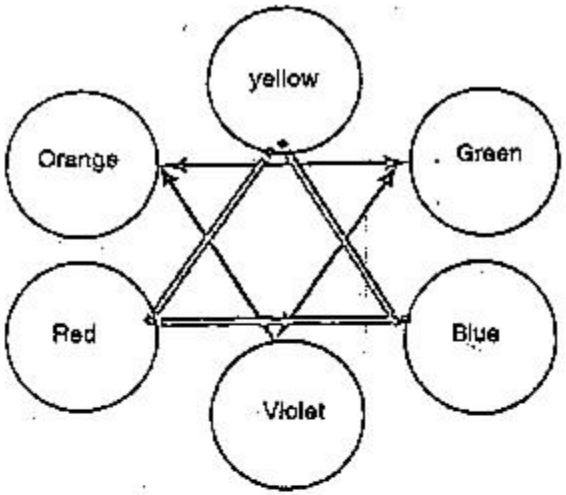
2. Use these techniques to apply tone to the geometric objects drawn to the right. Select your own light source.

3. Connect the dots below with three straight lines: one very light, one mid-tone, and one very dark.

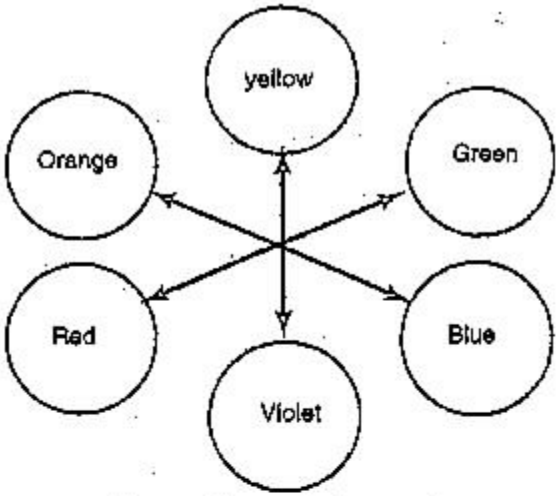






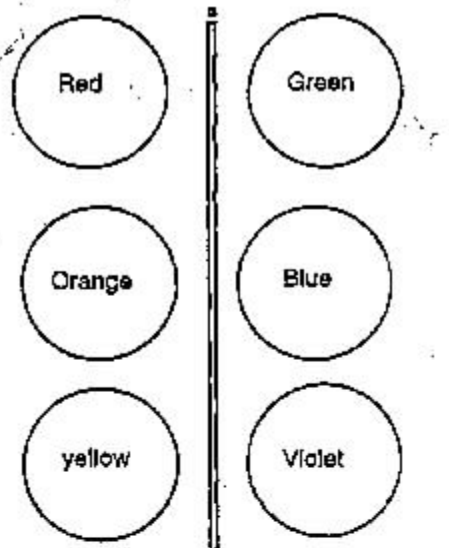


Primary Colors: Red, Blue and Yellow
Secondary Colors: Green, Violet and Orange



Complimentary colors

Colors that are opposite each other on the color wheel



Warm Colors | **Cool Colors**

Red + white	orange + white	Yellow + white	Green + white	Blue + white	Violet + white
Red	Orange	Yellow	Green	Blue	Violet
Red + Black	orange + Black	Yellow + Black	Green + black	Blue + Black	Violet + black

Hue + white = tint

Hue (color)

Hue + black = shade

Monochromatic Colors

are one color with tints + shades