Christina School District Assignment Board

Grade Level: 10th

Week of April 20th, 2020

	Day 1	Day 2	Day 3	Day 4	Day 5
ELA	Make a two-column chart. In the first column brainstorm the benefits of technology. In the second column brainstorm the disadvantages or cons of technology. Now think about items that make our lives easier. Come up with an invention that has not yet been created that would make our lives easier. In your explanation give it a name, explain what it does, what materials are needed to produce it, why it is needed and identify your target audience. Draw a picture of your invention.	Make a three-column chart on a sheet of paper. As you read 'There Will Come Soft Rains', complete the chart. <u>Label column 1-</u> Time of Day. As you read the story, find five examples where Bradbury explicitly gives the time. Write the time. <u>Label column 2</u> - What Seems Ordinary? Write what seems ordinary, use as many specific details as possible. <u>Label column 3-</u> What Seems Unusual? Write what seems unusual, use as many specific details as possible.	In "There Will Come Soft Rains", Bradbury uses setting to establish plot. In a 1-2 paragraph essay, analyze the setting by comparing what seems normal to what seems unusual. Be sure to use specific details from the story to support your response. Would the story have been different if the setting were different?	Reread the dystopian short story "There Will Come Soft Rains" As you read, identify words, phrases or events that demonstrate dystopian characteristics. Then answer the questions.	Choose one of the prompts below to write a brief response. Be sure to use evidence from the text to support your response. ---------- -What makes the actions of the house senseless? Might it be dangerous to put too much of our lives in the hands of machines? Why, or why not? - What comment is Bradbury making about the essential stupidity of machines? Of mankind?
Math (IM2)	*What's the Angle?*	Use the examples from pages 58-61 as a	Use the examples from pages 58-61 as a	Use the examples from pages 58-61 as a	Use the examples from pages 58-61 as a

Christina School District Assignment Board

		Read pages 58-61 (attached). Use the examples as a guide. Complete p. 61-62 #1-6. (attached)	guide to complete p. 62 #7-12. (attached)	guide to complete p. 62 #13-18. (attached)	guide to complete p. 63 #19-28. (attached)	guide to complete p. 63 #29-34. (attached)
Science		**What Causes DNA Mutation?** Read article. Highlight, underline, and/or annotate for understanding.	**Jake and Alice (part 1):** Read article. Highlight, underline, and/or annotate for understanding.	**Jake and Alice (part 2):** Reread notations from previous day. Write your best answers to the following: a) Sometimes, changes in genetic code will appear within a new generation that cannot be traced back to a parental source. What evidence from the text supports this conclusion? b) Based on the information in the passage, what can be concluded about the traits that siblings have? c) According to the passage, why is it in the best interest of the human population that lots of different genes are mixed together? d) Explain why it is unlikely for children to have an identical combination of traits to their parents. Use information from the passage to support your answer.	**Variation of Traits (part 1):** Read article. Highlight, underline, and/or annotate for understanding.	**Variation of Traits (part 2):** Reread notations from previous day. Write your best answers to the following: a) What determines the traits of offspring? b) Mutation in the genes of an organism is a cause. What is a possible effect? c) Reproduction is "a sort of complex lottery in which the third organism - the offspring of the first two - inherits a combination of the parent organisms' genetic material." What evidence from the passage supports this statement? d) What is a difference between physical and personality traits? e) What can people create by engineering mutations in food crops? f) Why might genetically engineered "superfoods" be a threat to naturally grown food? Support your answer with information from the passage.
Social Studies	**Civics**	Complete Activity 1 from the document titled, "Pandemics, Presidents & Precedents"	Complete Activity 2 from the document titled, "Pandemics, Presidents & Precedents"	Complete Activity 3 from the document titled, "Pandemics, Presidents & Precedents"	Complete Activity 4 - first 3 "stop" set of questions - from the document titled, "Pandemics, Presidents & Precedents"	Complete Activity 4 - last 2 "stop" set of questions - from the document titled, "Pandemics, Presidents & Precedents"
	Economics	Complete Questions 1 & 2 from the document titled, "Choices Are Everywhere: Why	Complete Questions 3 & 4 from the document titled, "Choices Are Everywhere: Why	Complete Questions 5 & 6 from the document titled, "Choices Are Everywhere: Why	Complete Scenario 1 from the document titled, "Choices Are Everywhere: Why Can't We Just Have it	Complete Scenario 2 from the document titled, "Choices Are Everywhere: Why Can't We Just Have it

		Can’t We Just Have it All?”	Can’t We Just Have it All?”	Can’t We Just Have it All?”	All?”	All?”

"August 2026: There Will Come Soft Rains" (1950) [1]

Ray Bradbury

In the living room the voice-clock sang, *Tick-tock, seven o'clock, time to get up, time to get up, seven o'clock!* as if it were afraid that nobody would. The morning house lay empty. The clock ticked on, repeating and repeating its sounds into the emptiness. *Seven-nine, breakfast time, seven-nine!*

In the kitchen the breakfast stove gave a hissing sigh and ejected from its warm interior eight pieces of perfectly browned toast, eight eggs sunnyside up, sixteen slices of bacon, two coffees, and two cool glasses of milk.

"Today is August 4, 2026," said a second voice from the kitchen ceiling, "in the city of Allendale, California." It repeated the date three times for memory's sake. "Today is Mr. Featherstone's birthday. Today is the anniversary of Tilita's marriage. Insurance is payable, as are the water, gas, and light bills."

Somewhere in the walls, relays clicked, memory tapes glided under electric eyes.

Eight-one, tick-tock, eight-one o'clock, off to school, off to work, run, run, eight-one! But no doors slammed, no carpets took the soft tread of rubber heels. It was raining outside. The weather box on the front door sang quietly: "Rain, rain, go away; rubbers, raincoats for today…" And the rain tapped on the empty house, echoing.

Outside, the garage chimed and lifted its door to reveal the waiting car. After a long wait the door swung down again.

At eight-thirty the eggs were shriveled and the toast was like stone. An aluminum wedge scraped them into the sink, where hot water whirled them down a metal throat which digested and flushed them away to the distant sea. The dirty dishes were dropped into a hot washer and emerged twinkling dry.

Nine-fifteen, sang the clock, *time to clean.*

Out of warrens in the wall, tiny robot mice darted. The rooms were acrawl with the small cleaning animals, all rubber and metal. They thudded against chairs, whirling their mustached runners, kneading the rug nap, sucking gently at hidden dust. Then, like mysterious invaders, they popped into their burrows. Their pink electric eyes faded. The house was clean.

Ten o'clock. The sun came out from behind the rain. The house stood alone in a city of rubble and ashes. This was the one house left standing. At night the ruined city gave off a radioactive glow which could be seen for miles.

Ten-fifteen. The garden sprinklers whirled up in golden founts, filling the soft morning air with scatterings of brightness. The water pelted windowpanes, running down the charred west side where the house had been burned evenly free of its white paint. The entire west face of the house was black, save for five places. Here the silhouette in paint of a man mowing a lawn. Here, as in a photograph, a woman bent to pick flowers. Still farther over, their images burned on wood in one titanic instant, a small boy, hands flung into the air; higher up, the image of a thrown ball, and opposite him a girl, hands raised to catch a ball which never came down.

The five spots of paint—the man, the woman, the children, the ball—remained. The rest was a thin charcoaled layer.

The gentle sprinkler rain filled the garden with falling light.

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[1] Ray Bradbury, *The Martian Chronicles* (Toronto: Bantam Books, 1985), 166-172.

Until this day, how well the house had kept its peace. How carefully it had inquired, "Who goes there? What's the password?" and, getting no answer from lonely foxes and whining cats, it had shut up its windows and drawn shades in an old maidenly preoccupation with self-protection which bordered on a mechanical paranoia.

It quivered at each sound, the house did. If a sparrow brushed a window, the shade snapped up. The bird, startled, flew off! No, not even a bird must touch the house!

The house was an altar with ten thousand attendants, big, small, servicing, attending, in choirs. But the gods had gone away, and the ritual of the religion continued senselessly, uselessly.

Twelve noon.

A dog whined, shivering, on the front porch.

The front door recognized the dog voice and opened. The dog, once huge and fleshy, but now gone to bone and covered with sores, moved in and through the house, tracking mud. Behind it whirred angry mice, angry at having to pick up mud, angry at inconvenience.

For not a leaf fragment blew under the door but what the wall panels flipped open and the copper scrap rats flashed swiftly out. The offending dust, hair, or paper, seized in miniature steel jaws, was raced back to the burrows. There, down tubes which fed into the cellar, it was dropped into the sighing vent of an incinerator which sat like evil Baal in a dark corner.

The dog ran upstairs, hysterically yelping to each door, at last realizing, as the house realized, that only silence was here.

It sniffed the air and scratched the kitchen door. Behind the door, the stove was making pancakes which filled the house with a rich baked odor and the scent of maple syrup.

The dog frothed at the mouth, lying at the door, sniffing, its eyes turned to fire. It ran wildly in circles, biting at its tail, spun in a frenzy, and died. It lay in the parlor for an hour.

Two o'clock, sang a voice.

Delicately sensing decay at last, the regiments of mice hummed out as softly as blown gray leaves in an electrical wind.

Two-fifteen.

The dog was gone.

In the cellar, the incinerator glowed suddenly and a whirl of sparks leaped up the chimney.

Two thirty-five.

Bridge tables sprouted from patio walls. Playing cards fluttered onto pads in a shower of pips. Martinis manifested on an oaken bench with egg-salad sandwiches. Music played.

But the tables were silent and the cards untouched.

At four o'clock the tables folded like great butterflies back through the paneled walls.

Four-thirty.

The nursery walls glowed.

Animals took shape: yellow giraffes, blue lions, pink antelopes, lilac panthers cavorting in crystal substance. The walls were glass. They looked out upon color and fantasy. Hidden films docked through well-oiled sprockets, and the walls lived. The nursery floor was woven to resemble a crisp, cereal meadow. Over this ran aluminum roaches and iron crickets, and in the hot still air butterflies of delicate red tissue wavered among the sharp aroma of animal spoors! There was the sound like a great matted yellow hive of bees within a dark bellows, the lazy bumble of a purring lion. And there was the patter of okapi feet and the murmur of a fresh jungle rain, like other hoofs, falling upon the summer-starched grass. Now the walls dissolved into distances of

parched weed, mile on mile, and warm endless sky. The animals drew away into thorn brakes and water holes.

It was the children's hour.

Five o'clock. The bath filled with clear hot water.

Six, seven, eight o'clock. The dinner dishes manipulated like magic tricks, and in the study a click. In the metal stand opposite the hearth where a fire now blazed up warmly, a cigar popped out, half an inch of soft gray ash on it, smoking, waiting.

Nine o'clock. The beds warmed their hidden circuits, for nights were cool here.

Nine-five. A voice spoke from the study ceiling:

"Mrs. McClellan, which poem would you like this evening?"

The house was silent.

The voice said at last, "Since you express no preference, I shall select a poem at random." Quiet music rose to back the voice. "Sara Teasdale. As I recall, your favorite….

"There will come soft rains and the smell of the ground,
And swallows circling with their shimmering sound;
And frogs in the pools singing at night,
And wild plum trees in tremulous white;
Robins will wear their feathery fire,
Whistling their whims on a low fence-wire;
And not one will know of the war, not one
Will care at last when it is done.
Not one would mind, neither bird nor tree,
if mankind perished utterly;
And Spring herself, when she woke at dawn
Would scarcely know that we were gone."

The fire burned on the stone hearth and the cigar fell away into a mound of quiet ash on its tray. The empty chairs faced each other between the silent walls, and the music played.

At ten o'clock the house began to die.

The wind blew. A failing tree bough crashed through the kitchen window. Cleaning solvent, bottled, shattered over the stove. The room was ablaze in an instant!

"Fire!" screamed a voice. The house lights flashed, water pumps shot water from the ceilings. But the solvent spread on the linoleum, licking, eating, under the kitchen door, while the voices took it up in chorus: "Fire, fire, fire!"

The house tried to save itself. Doors sprang tightly shut, but the windows were broken by the heat and the wind blew and sucked upon the fire.

The house gave ground as the fire in ten billion angry sparks moved with flaming ease from room to room and then up the stairs. While scurrying water rats squeaked from the walls, pistoled their water, and ran for more. And the wall sprays let down showers of mechanical rain.

But too late. Somewhere, sighing, a pump shrugged to a stop. The quenching rain ceased. The reserve water supply which had filled baths and washed dishes for many quiet days was gone.

The fire crackled up the stairs. It fed upon Picassos and Matisses in the upper halls, like delicacies, baking off the oily flesh, tenderly crisping the canvases into black shavings.

Now the fire lay in beds, stood in windows, changed the colors of drapes!

And then, reinforcements.

From attic trapdoors, blind robot faces peered down with faucet mouths gushing green chemical.

The fire backed off, as even an elephant must at the sight of a dead snake. Now there were twenty snakes whipping over the floor, killing the fire with a clear cold venom of green froth.

But the fire was clever. It had sent flames outside the house, up through the attic to the pumps there. An explosion! The attic brain which directed the pumps was shattered into bronze shrapnel on the beams.

The fire rushed back into every closet and felt of the clothes hung there.

The house shuddered, oak bone on bone, its bared skeleton cringing from the heat, its wire, its nerves revealed as if a surgeon had torn the skin off to let the red veins and capillaries quiver in the scalded air. Help, help! Fire! Run, run! Heat snapped mirrors like the brittle winter ice. And the voices wailed Fire, fire, run, run, like a tragic nursery rhyme, a dozen voices, high, low, like children dying in a forest, alone, alone. And the voices fading as the wires popped their sheathings like hot chestnuts. One, two, three, four, five voices died.

In the nursery the jungle burned. Blue lions roared, purple giraffes bounded off. The panthers ran in circles, changing color, and ten million animals, running before the fire, vanished off toward a distant steaming river....

Ten more voices died. In the last instant under the fire avalanche, other choruses, oblivious, could be heard announcing the time, playing music, cutting the lawn by remote-control mower, or setting an umbrella frantically out and in the slamming and opening front door, a thousand things happening, like a clock shop when each clock strikes the hour insanely before or after the other, a scene of maniac confusion, yet unity; singing, screaming, a few last cleaning mice darting bravely out to carry the horrid ashes away! And one voice, with sublime disregard for the situation, read poetry aloud in the fiery study, until all the film spools burned, until all the wires withered and the circuits cracked.

The fire burst the house and let it slam flat down, puffing out skirts of spark and smoke.

In the kitchen, an instant before the rain of fire and timber, the stove could be seen making breakfasts at a psychopathic rate, ten dozen eggs, six loaves of toast, twenty dozen bacon strips, which, eaten by fire, started the stove working again, hysterically hissing!

The crash. The attic smashing into kitchen and parlor. The parlor into cellar, cellar into sub-cellar. Deep freeze, armchair, film tapes, circuits, beds, and all like skeletons thrown in a cluttered mound deep under.

Smoke and silence. A great quantity of smoke.

Dawn showed faintly in the east. Among the ruins, one wall stood alone. Within the wall, a last voice said, over and over again and again, even as the sun rose to shine upon the heaped rubble and steam:

"Today is August 5, 2026, today is August 5, 2026, today is…"

There Comes a Soft Rain by Ray Bradbury

Comprehension

1. When and where does the story take place?

   _____
   _____
   _____

2. List three functions the house performs.

   _____
   _____
   _____

3. Describe the changes the house undergoes during the story.

   _____
   _____
   _____

4. What has happened to the McClellan family and the town? Use details to support your conclusion.

   _____
   _____
   _____

Text Analysis

5. What do you think is the theme, or main message, of the story? Cite evidence from the story to support your answer.

   _____
   _____
   _____

6. Consider how the story would have been different if it had included numerous flashbacks, or scenes that recall earlier experiences. Why might Bradbury have chosen to follow chronological order? Cite evidence from the story to support your opinion.

   _____
   _____
   _____

IM2 – Week of April 20th

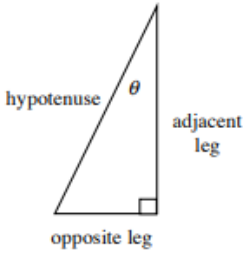
What's the Angle?

MORE TRIGONOMETRY 5.1.1 – 5.1.3

We next introduce two more trigonometric ratios: sine and cosine. Both of them are used with acute angles of right triangles, just as the tangent ratio is. Using the diagram below:

$$\sin\theta = \frac{\text{opposite leg}}{\text{hypotenuse}} \qquad \cos\theta = \frac{\text{adjacent leg}}{\text{hypotenuse}}$$

and from Chapter 4: $$\tan\theta = \frac{\text{opposite leg}}{\text{adjacent leg}}$$



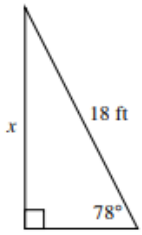
Note: If you decide to use the other acute angle in the triangle, then the names of the legs switch places. The opposite leg is always across the triangle from the acute angle you are using.

See the Math Notes boxes in Lessons 5.1.2 and 5.1.4.

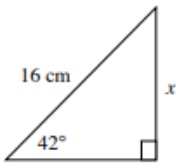
Example 1

Use the sine ratio to find the length of the unknown side in each triangle below.

a.



b.



The sine of the angle is the ratio $\frac{\text{opposite leg}}{\text{hypotenuse}}$. For part (a) we will use the 78° as θ. From the 78° angle, we find which side of the triangle is the opposite leg and which side is the hypotenuse. The hypotenuse is always the longest side, and it is always opposite the right angle. In this case, it is 18. From the 78° angle, the opposite leg is the side labeled x. Now we can write the equation at right and solve it.

$$\sin 78° = \tfrac{x}{18} \quad \left(\tfrac{\text{opposite}}{\text{hypotenuse}}\right)$$
$$18 \sin 78° = x$$
$$x \approx 17.61 \text{ ft}$$

In part (b), from the 42° angle, the opposite leg is x and the hypotenuse is 16. We can write and solve the equation at right. Note: In most cases, it is most efficient to wait until the equation has been solved for x, then use your calculator to combine the values, as shown in these examples.

$$\sin 42° = \tfrac{x}{16}$$
$$16(\sin 42°) = x$$
$$x \approx 10.71 \text{ cm}$$

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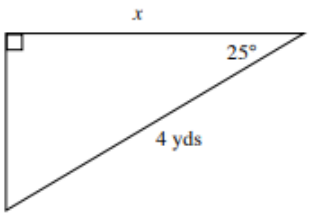
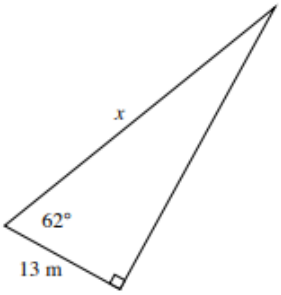
Example 2

Use the cosine ratio to find the length of the unknown side in each triangle below.

a.



b.



Just as before, we set up an equation using the cosine ratio, $\frac{\text{adjacent leg}}{\text{hypotenuse}}$. Remember that you can always rotate the page, or trace and rotate the triangle, if the figure's orientation is causing confusion. The key to solving these problems is recognizing which side is adjacent, which is opposite, and which is the hypotenuse. (See the box above Example 1 for this information.) For part (a), the angle is 25°, so we can write and solve the equation at right.

$$\cos 25° = \tfrac{x}{4} \quad \left(\tfrac{\text{adjacent}}{\text{hypotenuse}}\right)$$
$$4(\cos 25°) = x$$
$$x \approx 3.63 \text{ yds}$$

In part (b), from the 62° angle, the adjacent leg is 13 and the hypotenuse is x. This time, our variable will be in the denominator. As we saw in earlier chapters, this will add one more step to the solution.

$$\cos 62° = \tfrac{13}{x}$$
$$x \cos 62° = 13$$
$$x = \tfrac{13}{\cos 62°} \approx 27.69 \text{ m}$$

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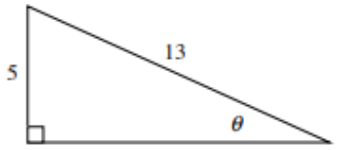
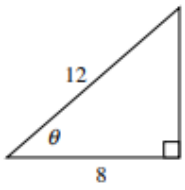
Example 3

In each triangle below, use the inverse trigonometry buttons on your calculator to find the measure of the angle θ to the nearest hundredth.

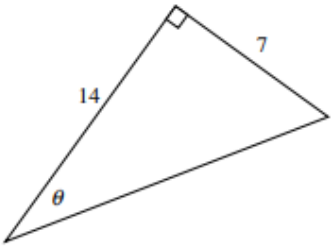
a.



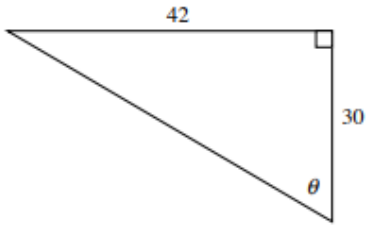
b.



c.



d.



For each of these problems you must decide whether you will be using sine, cosine, or tangent to find the value of θ. In part (a), if we are standing at the angle θ, then 5 is the length of the opposite leg and 13 is the length of the hypotenuse. This tells us to use the sine ratio. For the best accuracy, enter the ratio, not its decimal approximation.

$$\sin\theta = \frac{5}{13}$$
$$\sin\theta \approx 0.385$$

To find the value of θ, find the button on the calculator that says $\sin^{-1}$. (Note: Calculator sequences shown are for most graphing calculators. Some calculators use a different order of keystrokes.) This is the "inverse sine" key, and when a ratio is entered, this button tells you the measure of the angle that has that sine ratio. Here we find $\sin^{-1}\frac{5}{13} \approx 22.62°$ by entering "2nd," "sin," (5 ÷ 13), "enter." Be sure to use parentheses as shown.

In part (b), 8 is the length of the adjacent leg and 12 is the length of the hypotenuse. This combination of sides fits the cosine ratio. We use the $\cos^{-1}$ button to find the measure of θ by entering the following sequence on the calculator: "2nd," "cos," (8 ÷ 12), "enter."

$$\cos\theta = \frac{8}{12}$$
$$\cos\theta \approx 0.667$$
$$\theta = \cos^{-1}\frac{8}{12}$$
$$\theta \approx 48.19°$$

In part (c), from θ, 7 is the length of the opposite leg and 14 is the length of the adjacent leg. These two sides fit the tangent ratio. As before, you need to find the $\tan^{-1}$ button on the calculator.

$$\tan\theta = \frac{7}{14} = 0.5$$
$$\tan\theta = 0.5$$
$$\theta = \tan^{-1} 0.5 \approx 26.57°$$

If we are standing at the angle θ in part (d), 42 is the length of the opposite leg while 30 is the length of the adjacent leg. We will use the tangent ratio to find the value of θ.

$$\tan\theta = \frac{42}{30} = 1.4$$
$$\tan\theta = 1.4$$
$$\theta = \tan^{-1} 1.4 \approx 54.46°$$

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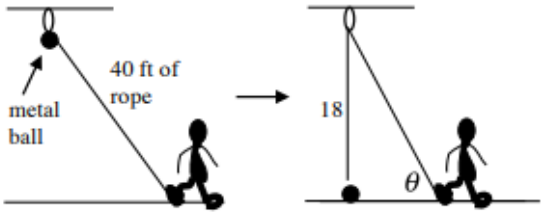
Example 4

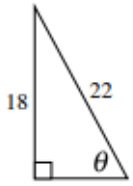
Kennedy is standing on the end of a rope that is 40 feet long and threaded through a pulley. The rope is holding a large metal ball 18 feet above the floor. Kennedy slowly slides her feet closer to the pulley to lower the ball. When the ball hits the floor, what angle (θ) does the rope make with the floor where it is under her foot?

As always, we must draw a picture of this situation to determine what we must do. We start with a picture of the beginning situation, before Kennedy has started lowering the ball. The second picture shows the situation once the ball has reached the floor. We want to find the angle θ. You should see a right triangle emerging, made of the rope and the floor. The 40-foot rope makes up two sides of the triangle: 18 feet is the length of the leg opposite θ, and the rest of the rope, 22 feet of it, is the hypotenuse. With this information, draw one more picture. This one will show the simple triangle that represents this situation.



From θ, we have the lengths of the opposite leg and the hypotenuse. This tells us to use the sine ratio.

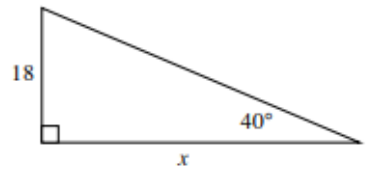
$$\sin\theta = \frac{18}{22}$$
$$\theta = \sin^{-1}\frac{18}{22}$$
$$\theta \approx 54.9°$$



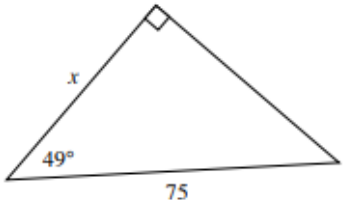
Problems

Using the tangent, sine, and cosine buttons on your calculator, calculate the value of x to the nearest hundredth.

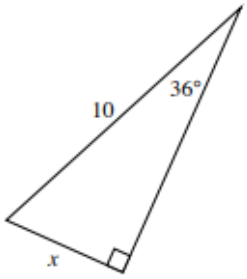
1.



2.



3.



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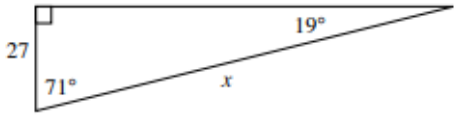

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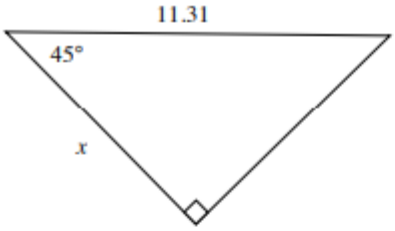
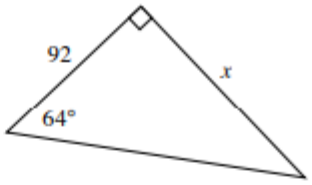
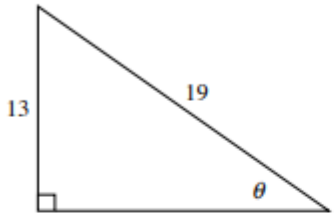
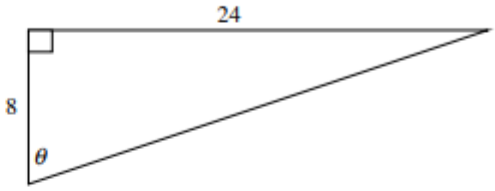
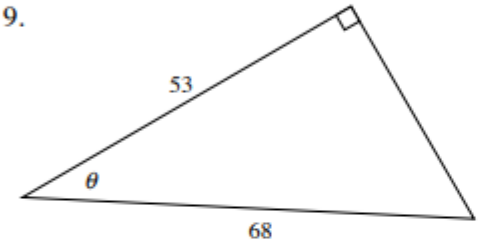
5. 

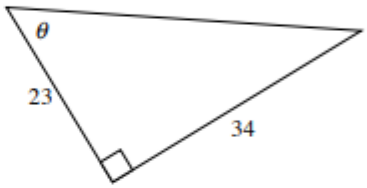
6. 

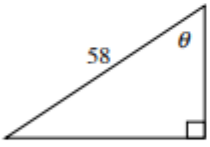
Using the $\sin^{-1}$, $\cos^{-1}$, and $\tan^{-1}$ buttons on your calculator, calculate the value of θ to the nearest hundredth.

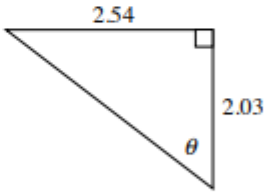
7. 

8. 

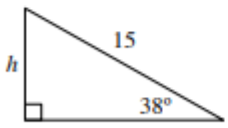
9. 

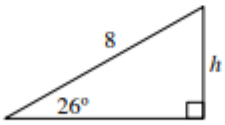
10. 

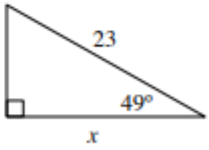
11. 

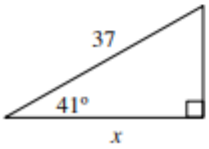
12. 

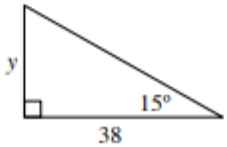
Use trigonometric ratios to solve for the variable in each figure below.

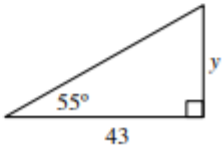
13. 

14. 

15. 

16. 

17. 

18. 

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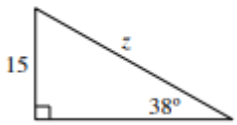
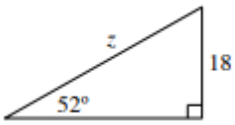
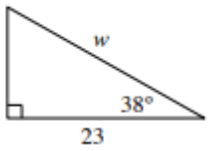
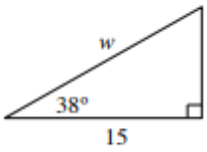
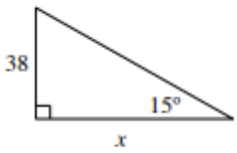
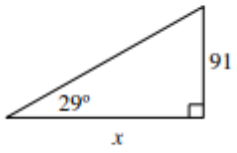
19. 

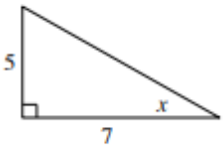
20. 

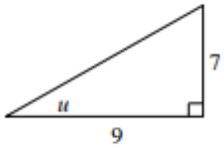
21. 

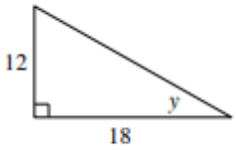
22. 

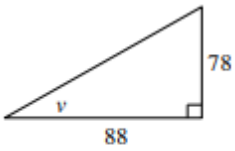
23. 

24. 

25. 

26. 

27. 

28. 

Draw a diagram and use trigonometric ratios to solve each of the following problems.

29. Juanito is flying a kite at the park and realizes that all 500 feet of string are out. Margie measures the angle of the string with the ground with her clinometer and finds it to be 42.5°. How high is Juanito's kite above the ground?

30. Nell's kite has a 350 foot string. When it is completely out, Ian measures the angle to be 47.5°. How far would Ian need to walk to be directly under the kite?

31. Mayfield High School's flagpole is 15 feet high. Using a clinometer, Tamara measured an angle of 11.3° to the top of the pole. Tamara is 62 inches tall. How far from the flagpole is Tamara standing?

32. Tamara took another sighting of the top of the flagpole from a different position. This time the angle is 58.4°. If everything else is the same, how far from the flagpole is Tamara standing?

33. Standing 140 feet from the base of a building, Alejandro uses his clinometer to site the top of the building. The reading on his clinometer is 42°. If his eyes are 6 feet above the ground, how tall is the building?

34. An 18 foot ladder rests against a wall. The base of the ladder is 8 feet from the wall. What angle does the ladder make with the ground?

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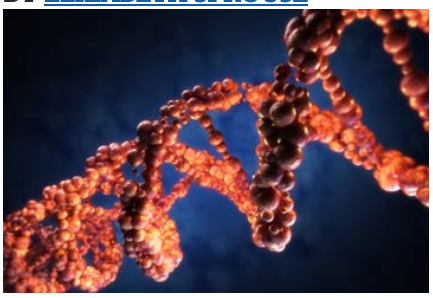
What causes DNA mutation?

BY ELIZABETH SPROUSE



Just what can mess this up?
ISTOCKPHOTO.COM/HENRIK5000

Think of your community's traffic. When the lights are functioning, drivers (usually) behave. Break a light, and everything comes to a standstill. Within our bodies, we could liken that broken traffic light to a DNA mutation -- one that has the potential to mess up our body's everyday operations. So where lightning might knock out a traffic light, what causes DNA mutations?

First, you need an understanding of what DNA is. DNA is composed of four chemicals: cytosine, guanine, thymine and adenine. Our cells are made up of DNA, which is strung together in chromosomes. We have our parents to thank for these chromosomes -- 23 pairs from each.

Genes, which make up our DNA, provide directions for producing our body's proteins. These proteins are vital to survival. They provide function, regulation and structure for our tissues and organs. So if you mess up those directions through a genetic mutation, you might put a needed protein at risk. What's behind a mess-up? We can point fingers at two main culprits: mistakes in cell replication and environmental causes.

Because we continually need new cells, our DNA replicates itself. During this duplication process, errors sometimes occur. During replication, double strands of DNA are separated. Each strand is then copied to become another double strand. About 1 out of every 100,000,000 times, a mistake occurs during copying, which can lead to a mutation. We can certainly take comfort in that statistic, as well as the fact that our DNA does a stand-up job of repairing itself when mutations occur [source: Learn. Genetics. Genetic Science Learning Center].

Mutations can also be caused by environmental foes. Tobacco, ultraviolet light and other chemicals are all potential enemies of DNA. One way these hazards attack our genes is very sneaky: They have the ability to damage the chemicals making up DNA. For example, the mutagens like to swap the chemicals out or disguise one for another. This becomes a big deal when our DNA starts replicating itself because those chemicals don't behave correctly [source: Learn. Genetics. Genetic Science Learning Center].

This type of environmental mutation is referred to as a substitution. Two other examples of the many types of DNA mutations are:

Deletion, when a section of DNA is deleted, meaning part of the recipe for making a protein is completely gone.

Insertion, when extra genetic code is inserted. This is like adding an extra ingredient to a recipe for cookies and hoping they still turn out right.

When you think of the multiple ways our DNA can mutate, it can seem scary. Bur remember, a lot is happening with our 25,000 to 35,000 genes [source: TeensHealth]. Sometimes, mutations don't matter at all, or they can help us evolve in helpful ways. Think of when that traffic light is out on your street. Likely, you still make it to your destination. You slow down and watch for oncoming traffic. You become your own advocate. That's just what we can do when it comes to our DNA. There's a world of life taking place inside of us, and we can cut down on power outages through healthy habits and watching out for our well-being.

Jake and Alice

Jake and Alice are siblings. Alice was born in 1988, and Jake was born in 1992. Although there is a four-year difference in age, they get along well. When Jake was in high school, Alice helped him choose classes she had enjoyed, with teachers that she liked and thought he would find interesting. Naturally, Jake and Alice don't share all the same interests. Alice is fascinated with natural science and took all the advanced biology courses in high school, eventually selecting a major in plant biology in college. Jake likes science but he's more interested in making things, like complicated recipes he finds in his collection of cookbooks, and painting over the mural in his bedroom. There must be at least 16 layers of mural on the largest wall of his room—he just can't seem to settle on a design.

When Alice's friends threw her a surprise 20th birthday party, Jake helped them coordinate with his and Alice's parents to make sure the party was kept a secret until the big day. Alice recommends new music to Jake, and he does the same for Alice. Both Alice and Jake's friends are impressed that they have such a broad knowledge of obscure bands in different musical genres. Jake is interested in becoming a chef someday—he often tries out new recipes on his family. Alice likes to cook, but doesn't get as excited about new food combinations like her brother.

Both siblings are medium height, with dark blonde hair and hazel eyes. Their mother, Rachel, has dark brown hair, and Pete, their father, when he had hair on his head, was blonde. The whole family is lightly freckled. While they all love music, none are particularly excellent singers, and only Jake knows how to read music and play an instrument: the trumpet. They all have small feet except Rachel, who wears a size 10 women's sneaker when she jogs on the treadmill.

Jake and Alice each have a collection of traits that make them unique that distinguish them from their family and friends. Some of these traits are physical—dark blonde hair, light eyes, freckles—and some are behavioral—curious about the world around them, generous, heavy-sleepers.

Where do traits come from?

What would Alice and Jake be without their traits? Is there some essential "Alice-ness" or "Jake-ness" that would still exist without blonde hair, hazel eyes, a gentle demeanor and great taste in underground folk music?

When two organisms—in this case, those organisms would be Alice and Jake's parents: Pete and Rachel—create a third organism through reproduction, many variables come into play. It's a complex lottery in which an offspring of the first two organisms inherits a combination of their genetic material. The possible variations inherent in recombining the parents' DNA is very, very broad—larger than the pool of entries in the state lotto jackpot! And that's where we get so much variation even within the population of a particular sexually reproducing species.

Although Alice and Jake's unique collection of traits is originally the product of chance, there are systems to which every freckle, hair, and skin tag can be traced. Personality quirks are another story altogether.

When we think about how our personalities are formed, we can certainly think about genes we acquired from our parents—but we also have to think about other complexly intertwined factors like environment and upbringing. For now, we'll simplify things by just focusing on the physical aspect of inherited traits.

It would be very, very unlikely for two parents with identically coded chromosomes to sexually reproduce. Even in the case of intrafamilial (or consanguine) pairings, which are discouraged in our society, the chromosome pairings would never be perfectly identical—that's a good thing for us as a civilization! The worst thing for our survival is for like to be paired with like. It's in the best

interest of our population that lots of different genes are mixed together in an evolutionary soup, so that many new variations on living organisms can be exposed to the environment; develop adaptations to changing conditions; and promote the survival of the species.

Another interesting variable that lets organism populations adapt to changing environments is mutation in genes. Sometimes, unpredictable changes in genetic code will appear within a new generation, not traceable back to a parental source.

Our blonde-haired, tone-deaf siblings, Alice and Jake, almost definitely have some sort of mutation somewhere within their respective makeups. A mutation can be as tiny as a freckle, or as conspicuous as an extra finger. As long as a trait has never appeared in an organism's lineage before, it is a mutation. Jake, for example, has an oddly shaped toe in his left foot. It cleaves down the center. It doesn't hurt, and he's never had an infection or needed to buy special socks for the condition. It's just a benign mutation that exists because something in his DNA has instructed that mass of protein to cleave. If he has children someday, they may inherit this trait. But it didn't come from Pete, his father, and it didn't come from Rachel, his mother. It is a mutation.

Mutation is a fascinating concept, so it's not surprising that artists and writers have latched onto it as a metaphor. Creators of superheroes like the X-men and Teenage Mutant Ninja Turtles have used the idea of extreme mutation as a narrative device to provide commentary on racism. Mutations are where new adaptations to existing or dynamic conditions are field tested in competition to whatever has worked for a population in the past. If a mutation pops up that happens to be advantageous for a particular organism within a population, that organism is more likely to survive and therefore more likely to procreate.

Who knows? Maybe Jake's funny big toenail will come in handy someday.

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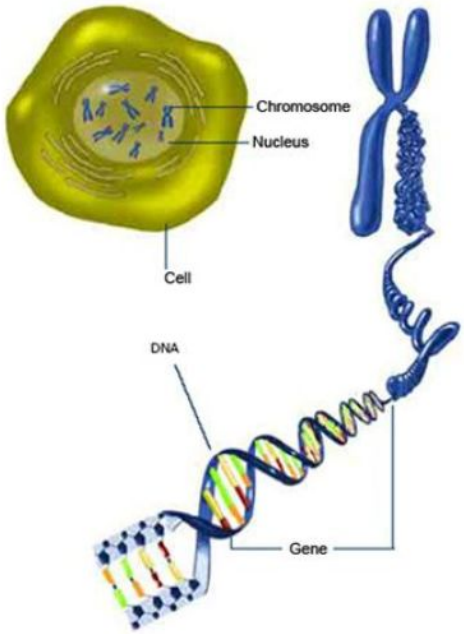
Variation of Traits



When two organisms create a third organism through reproduction, a number of variables come into play. It's a sort of complex lottery in which the third organism—the offspring of the first two—inherits a combination of the parent organisms' genetic material. The possible variations inherent in recombining the parents' DNA are very, very broad and infinitely larger than the pool of entries in the state lotto jackpot! That's why we get so much variation even within the population of a particular sexually reproducing species. Each new organism receives two of each chromosome, and within those chromosomes, two versions of each parents' set of genes. These genes contain instructions for protein production within the body of the offspring, and the way those proteins are prescribed determines the traits of the offspring. So, although your unique collection of traits, the combination of characteristics, physical and otherwise, that make you uniquely yourself are originally the product of chance, there are machinations going on behind the scenes to which every freckle, hair and character trait can be traced.

Personality traits are another story altogether. When we think about how our personalities are formed, we can certainly think about genes we acquired from our parents—but we also have to think about other complexly intertwined factors like environment and upbringing. For now, we'll simplify things by just focusing on the physical aspect of inherited traits. For example, if both parents exhibit the trait of red hair, their offspring have a greater chance of acquiring the genes that code for red hair. Certain traits are characteristically dominant or recessive, depending on the makeup of their alleles. This can make predicting traits tricky, but it is still very possible to estimate the likelihood, even the mathematic probability, that certain traits will manifest in the offspring of partners who exhibit those traits.

Red hair happens to be a kind of gene called incomplete dominant, which means it will blend with other genes, rather than dominate or be dominated. Since this is the case, the likeliest candidate to be coded for red hair is offspring with two red-headed parents.

It would be very, very unlikely for two parents with identically coded chromosomes to sexually reproduce. Even in the case of intrafamilial (or consanguine) pairings, which are discouraged in our society, the chromosome pairings would never be perfectly identical—that's a good thing for us as a civilization! As you will see, the absolute worst thing for our survival is for like to be paired with likes. It's in the best interests of our population that lots of different genes get mixed together in an evolutionary soup, so that many new variations on living organisms can be exposed to the environment, develop new adaptations to changing conditions, and promote the survival of the species.

Another variable that lets organism populations adapt to changing environments is mutation in genes. Sometimes, unpredictable changes in genetic code will appear within a new generation, not traceable back to a parental source.

Creators of superheroes like the X-Men and Teenage Mutant Ninja Turtles have used the idea of extreme mutation as a narrative device to invent colorful characters, bizarre scenarios, and literary metaphors. *Mutant* and *mutation* have exciting, exotic connotations to us, but actually, mutation is simply a necessary part of a species' evolution. Mutation can be something as mundane as two parents with brown eyes giving birth to a child with hazel eyes; or a type of moth whose wings are a different color from all the other moths in that species. Mutations are where new adaptations to existing or dynamic conditions are field tested in competition to whatever has worked for a population in the past. If a mutation pops up that happens to be advantageous for a particular organism within a population, that organism is more likely to survive, and therefore, more likely to procreate. Eventually, that chance mutation is reflected more widely in the community, and is passed on further to later generations. Once new challenges appear in the environment, new adaptations are likely to crop up for a fortunate few.

This is not to say that mutations are always helpful. Sometimes they are simply inconvenient, odd or unsupportable. They can even be indicative of a disruption in the environment.

Human interference in genetic coding is a pretty common practice these days. By deliberately engineering mutations in plants, most often food crops, humans can create larger, more resilient food sources. Since these "superfoods" are synthetically equipped with attributes that make them disproportionately competitive in the ecosystem they share with naturally grown food crops, they pose a threat to those populations. This is a controversial practice many food activists are working to curb.

Whether the mutation occurs naturally or is forced upon a population by biogenetic scientists, mutations are essential to the system by which ecosystems change and grow. © 2013 ReadWorks®, Inc. All rights reserved.

Pandemics, Presidents, and Precedents
Social Studies Home Learning Activities

Standard Benchmark **Civics 2b**	Students will understand that the functioning of the American government is a dynamic process which combines the formal balances of power incorporated in the Constitution with traditions, precedents, and interpretations which have evolved over time.
Grade Band	9-12
Vocabulary/Key Concepts	dynamic, precedent, interpretation, tradition, constrain, disability, inability,

Words You Will Need to Know (defined for purposes of this activity)

- **Constrain** – to limit how much change is allowed to happen
- **Disability** - a physical or mental condition that limits a person's movements, senses, or activities
- **Dynamic** – something characterized by constant change, activity, or progress.
- **Inability** - being unable to do something
- **Interpretation –** a way of explaining or understanding something
- **Precedent** – a decision made in the past that dictates or strongly influences similar decisions made later
- **Tradition** – a custom or belief passed down from generation to generation

DIRECTIONS: Read the following information and complete the "Stop" questions on a separate sheet of paper. You can fill out the chart in this document (you do not have to copy on another sheet of paper).

Activity 1: Building Background Knowledge

Governments in Times of Emergencies

A pandemic is just one example of national emergencies that might destabilize any government. Invasions and terrorist attacks are other examples. Can you think of others?

These emergencies raise awareness of the need for change. Government officials often respond to them with new policies that they hope will reduce the dangers associated with the emergencies. There have been many of these new policies lately. The various levels (local, state, and federal) and branches (legislative, executive, judicial) of governments in the United States have issued stay at home orders, closed schools and "non-essential" businesses, prohibited gatherings of more than 10 people, stopped residents of one state from travelling to other states, and prohibited people from certain areas of the world from entering the United States. In Delaware, meetings of our state legislature have been postponed to support social distancing policies, and Legislative Hall where state laws are made remains closed until further notice.

This ability to change or be "***dynamic***" is an extremely important characteristic of any government. If a government cannot or does not change in ways that (1) adapt to new circumstances, (2) respond to changes in what citizens want, and/or (3) cope with national emergencies…it probably won't last very long.

But, too much change can be equally problematic. If citizens believe that proposed or enacted changes carry risks that are unreasonable or exceed those brought on by an emergency, or that the changes pose threats to individual rights or happiness, resistance or rebellion may follow. The trick, as the *Goldilocks Principle* suggests, is finding solutions that are "just right" - not too extreme.

The authors of our Constitution understood the need to devise a dynamic government that…

a. …allows change to occur. For example, they included Article V which allows the Constitution to be amended i.e. changed.
b. …limits the amount to change that can occur. For example, they incorporated the Bill of Rights to ensure that government cannot constitutionally take actions that deny citizens their legitimate individual rights.
c. …is equipped to respond reasonably well to potentially destabilizing changes. For example, they separated government into three branches so that one branch can always check extreme actions proposed by the other branches.

STOP **Why must any government be dynamic? Can you think of other evidence to support the claim that governments (local, state, or federal) in the United States are dynamic?**

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The COVID-19 pandemic offers a reminder of one way that the authors of our Constitution anticipated and planned for emergencies that could destabilize our federal government. After deciding to have an executive branch, they asked themselves – what should happen if a sitting President fell ill and suffered, in their words, an "inability" or "disability"?

Fortunately, this has not happened in the United States during the COVID-19 pandemic. However, that has not been the case elsewhere. Several world leaders have contracted the virus. See their images and the areas they preside over illustrated in Figure 1 below. Do you recognize any of them, or the countries they lead?

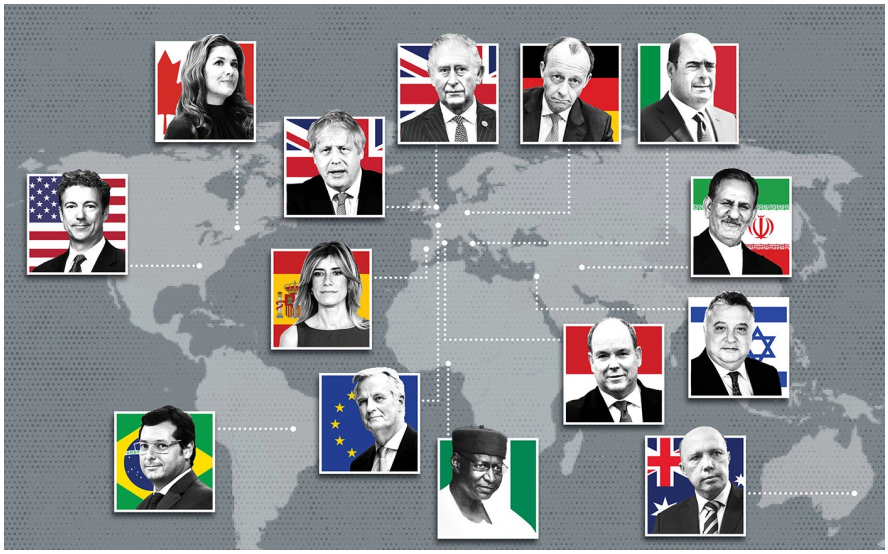

Figure 1 Source: https://foreignpolicy.com/2020/03/18/coronavirus-corridors-power-which-world-leaders-have-covid-19/

While most of the affected leaders have symptoms that have not been disabling, Prime Minister Boris Johnson (United Kingdom) was placed in intensive care and turned over his duties to his Foreign Minister on April 6. Thankfully, he appears to be recovering and resumed his position but only after creating quite a scare throughout Britain.

It is a bit unsettling but also wise to remember that germs do not discriminate by status, wealth, race, gender, or age. No one, to our knowledge, is yet immune.

The important point here is that presidential disabilities have occurred in United States history just as our Founding Fathers anticipated. And, they will likely happen again.

Activity 2: **Document Analysis**
So how did the authors of our Constitution plan for possibility of presidential disabilities or vacancies? Did they do it in a manner that created the kind of dynamic government that is "just right" for such emergencies?
Here is what they wrote…their plan:

Article II, Section 1, Clause 6. United States Constitution (ratified June 21, 1788)

> *"In Case of the Removal of the President from Office, or of his Death, Resignation, or Inability to discharge the Powers and Duties of the said Office, the Same shall devolve on the Vice President, and the Congress may by Law provide for the Case of Removal, Death, Resignation or Inability, both of the President and Vice President, declaring what Officer shall then act as President, and such Officer shall act accordingly, until the Disability be removed, or a President shall be elected."*

STOP **Comprehension Check**

1. How does this clause make it possible for the American government to survive extreme changes or emergencies?
2. How does this clause in our Constitution illustrate how government in the United States can be dynamic?
3. Describe one way that this clause allows change to take place.
4. Describe one way that this clause constrains change or helps ensure that it happens in ways that are "just right".

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Activity 3: Evaluate the Clarity of the Clause: How well does it answer the questions?

Directions: Evaluate Article II, Section 1, Clause 6 of the Constitution for clarity. If a president were to become unable to perform his or her duties does occur, which parts of this clause are clear? Which are unclear?

QUESTION	CLARITY Is the Constitution clear or unclear on this? (Circle one)	EVIDENCE FROM THE TEXT If clear, what wording in Article II, Section 1, Clause 6 provides the clarity?
1- Who takes over the duties of the President if he or she dies while in office?	Clear Unclear	
2- Who takes over the duties of the President if he or she resigns as President?	Clear Unclear	
3-Who takes over the duties of the President in the event of a disability or an inability?	Clear Unclear	
4-What counts as a *disability*?	Clear Unclear	
5-What counts as an *inability*?	Clear Unclear	
6-Must a disability or inability last a certain length of time before a President's powers can be removed?	Clear Unclear	
7-Who has the authority to decide whether a President has a disability or inability?	Clear Unclear	
8-Can a president declare himself or herself "able" again?	Clear Unclear	
9-Does the "disability clause" offer opportunities for balances of power? Can one branch check the others?	Clear Unclear	
10-Does the person who takes over the duties of a disabled President become the President or is or he merely an "Acting President"?	Clear Unclear	
11-Can a President who turns over his or her duties due to an inability or disability return to being the President?	Clear Unclear	
12-What happens if a president suffers an inability and there is no Vice-President?	Clear Unclear	

Draw a Conclusion: Was the work of the men who wrote our Constitution good enough to deal with an emergency involving a vacancy, disability, or inability in the office of the president?

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Activity 4: Case Studies and Thought Exercise

The First Scare

In June of 1813, members of the United States Senate received the following note:

> *"[President] James Madison is sorry that a continuance of his indisposition will not permit him to see the committee of the Senate today, nor can he at present fix a day when it will be in his power."*

Why would this note lead some to believe that there might be a national emergency?

Word circulated quickly around the nation's capital that the President was suffering from a "bilious fever" and that *death* was possible! Members of Congress started reading Article II, Section 1, Clause 6 of the Constitution.

On July 2, relief arrived. Madison's wife Dolley wrote that the President's fever broke. He slowly began resuming his duties on July 7, 1813…three weeks after the fever set in. Three weeks is a pretty long time for a President to be "inable".

Side note here: President Madison's two terms are noteworthy for a number of reasons. Among them - two of his Vice-Presidents died while in office – George Clinton and Elbridge Gerry. President Madison had no Vice-President for a total of three years! What was the plan if Madison died or suffered an inability during that time?

Regardless, luck prevailed and our government survived.

***Luck Runs Out:* Things Get Dynamic with No President and No Precedent**

On 4 April 1841, exactly thirty days after becoming president, sixty-nine year old President William Henry Harrison – so delirious in his final hour that he spoke to his doctor as if he was his Vice-President - died of what appeared to have been pneumonia. Our nation's luck had run out.

John Adams, who once served as George Washington's Vice-President once said, "*"I am Vice President. In this I am nothing, but I may be everything."*

Like Adams, Harrison's Vice-President John Tyler thought so little of his position that he left the nation's capital after Harrison's inauguration and was now 230 miles or at least 21 hours away at his home in Richmond, Virginia. Remember, there were no phones, no telegraph, and no internet in 1841. Now, there was no President and no precedent. Harrison was the first President to die while in office – the first to leave the Office of the President vacant. A crisis unfolded and Article II, Section 1, Clause 6 kicked in.

Secretary of State Daniel Webster quickly called a meeting of the President's Cabinet. They sent two men by carriage, then train, then boat to John Tyler's home to notify him of the President's death. They arrived at dawn, woke-up the Vice-President and delivered the tragic news. Clearly stunned, Tyler exclaimed, "My God, the President is dead!"

Adding to the crisis – Tyler's wife was gravely ill, partially paralyzed, and he had seven children at home.

Thought Exercise:

1. Before moving on to the next section, pretend for a few minutes that you are Vice-President John Tyler. What do you do? What steps will you take to deal with this national emergency? Remember, the nation has never faced this emergency. Our government is now operating in a very dynamic way. There is no precedent to guide your decisions but every one that you are about to make may become one.

Questions to Consider:

2. Does Article II, Section 6, Clause 1 of the Constitution help you deal with the emergency? Explain.
3. Does that clause constrain your decisions? Explain. Are you now President of the United States?

Tyler's Decisions

Hoping to leave little doubt that the crisis was under control, that the American government would continue to function well, that the country was in good hands, and that there would be an orderly transition of power, Vice-President John Tyler took the following steps:

1. He returned to Washington almost immediately with two of his sons arriving on April 6
2. He immediately had a federal judge administer the presidential oath of office

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3. He called members of his cabinet into a meeting
4. He told his Cabinet, "I, as *president*, will be responsible for my administration."
5. He delivered an inaugural address on April 14th and moved into the White House

The following statement appeared in the New Your American newspaper on April 16th:

"It is impossible for an American not to feel…great pride at the quiet, orderly, and, as it were, matter of course transition, by which so important a movement has been operated."

Acting decisively, John Tyler declared himself President of the United States.

How well do you think Tyler handled the emergency? Were his actions constitutional?

Hold On! What About the Balance of Power?

Recall that there are three branches that make-up the federal government – executive, legislative, and judicial. The men who wrote the Constitution separated powers so that the branches could check one another if there appeared to be abuses of power. The emergency that the government now faced involved the executive branch. Any decision that John Tyler made, or you pretending to be him, could be checked by Congress.

You should also keep in mind that John Tyler's decisions were based in part on *his* ***interpretation*** of Article II, Section 6, Clause 1. As you discovered earlier, that clause was quite unclear. What if others had different interpretations?

Here is Congressman and former President John Quincy Adams' interpretation:

> *"…it* [Tyler's interpretation of the Constitution] *is a construction in direct violation both of the grammar and context of the Constitution, which confers upon the Vice-President, on the decease of the President, not the office, but the powers and duties of the said office."*

While others agreed with Adams' interpretation, the House voted 38-8 to call Tyler "President of the United States." The nation now had a President and a precedent.

A Lingering Question

1. What if a different type of Presidential emergency arises e.g. a president exhibits an "inability" or "disability"? What happens? Is Article II, Section 6, Clause 1 offer good guidance?

What Followed: 7-1-6-3 then 25

There is not enough time to examine all of the executive emergencies that occurred from 1841 to the present but here is a quick overview if you are interested in following up:

Seven other Presidents since William Henry Harrison died while in office. On every occasion the Tyler precedent influenced decisions made and actions taken.

- Zachary Taylor
- Abraham Lincoln
- James Garfield
- William McKinley
- Warren Harding
- Franklin Delano Roosevelt
- John Kennedy

One President resigned.

- Richard Nixon

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Six Presidents (at least) were disabled for varying lengths of time including Woodrow Wilson whose disability lasted 180 days. In some cases, Americans remained unaware of the disabilities.

- Abraham Lincoln
- James Garfield
- Woodrow Wilson
- Franklin Roosevelt
- Dwight Eisenhower
- Lyndon Johnson

Three Presidents voluntarily turned over the duties of the Presidency for relatively minor reasons.

- Ronald Reagan (went under anesthesia for colon surgery)
- George W. Bush twice (went under anesthesia for colonoscopies)

Twenty-Five

Following President Kennedy's assassination the states ratified the Twenty-Fifth Amendment to the United States Constitution in 1967 (read here). Its purpose is to eliminate uncertainties surrounding Article II, Section 6, Clause. The hopes are that this change to our Constitution (another example of a dynamic government) will

1. improve the manner by which future presidential emergencies are handled;
2. and allow government to function in dynamic ways that minimize dangers that crises create by permitting and constraining change in ways that are "just right".

References (for further reading)

- Cohen, Jared (2019). *Accidental Presidents: Eight Men Who Changed America*.
- Coronavirus in the Corridors of Power: which politicians and senior officials have the Coronavirus? Accessed at https://foreignpolicy.com/2020/03/18/coronavirus-corridors-power-which-world-leaders-have-covid-19/
- Feerick, John D. (1965) *From Failing Hands: The Story of Presidential Succession*
- Feerick, John D. (2014) *The Twenty Fifth Amendment: Its complete history and applications. (Third Edition)*

Movies and Television Episodes Dealing with Executive Crises

- "25" the final episode in Season 4 of the West Wing television series (available on Netflix)
- Air Force One
- *Deterrence*
- *The Contender*
- *The Enemy Within*
- *By Dawn's Early Light*

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Choices Are Everywhere: Why Can't We Just Have It All?

Benchmark Standard	Economics 1a: Students will demonstrate how economic choices are made in a market economy in which markets and the actions of the government influence the production and distribution of goods and services.
Grade	10
Vocabulary / Key Concepts	Government debt: The sum of accumulated budget deficits. Also known as national debt. Opportunity cost: the value of the next-best alternative when a decision I made; it's wha is given up. Scarcity: The condition that exists because there are not enough resources to produce everyone's wants

This Lesson is from *Page One Economics Newsletter, January 2013* – Condensed by CSD for Home Use

Scott A. Wolla, Senior Economic Education Specialist

"You can't always get what you want." – The Rolling Stones

The public debate about the best way to reduce the level of **government debt** highlights our difficult situation: Our wants greatly exceed our ability to pay for them. In the case of government, purchases require current revenue through taxation or borrowing; the fiscal cliff arose from a level of debt caused by wanting more (and purchasing more) than we can pay for.

If we wish to reduce debt, we must make difficult choices. One choice is to cut government spending on goods and services—but which spending priorities should be cut? The other choice is to raise taxes—but who should pay more?

You might prefer one choice or the other or a combination of both. In fact, you may have very similar thoughts about your personal or family budget. These issues are based on understanding the economic concepts of *scarcity* and *opportunity cost*.

Personal and Household Spending

Let's use a specific example to get a better grasp of these ideas. Suppose you receive a $20 gift card during the holidays. The $20 limit acts like a budget that constrains your spending. In other words, your resources are limited. How about your wants? Are they limited? If you are like most people, they are not—you would like to have much more than you can afford. This condition of limited resources and unlimited wants is called **scarcity**. The $20 limit means that you can't have all the CDs, movies, or games you want; you must choose the one you want the most. Deciding between the recently released CD from your favorite band and the newest hit movie requires a choice, which involves an **opportunity cost**—the value of the next-best alternative when a decision is made. The opportunity cost is what is given up. So, choosing the CD from your favorite band means giving up the movie.

People make such decisions all the time. Managing a family budget is also an exercise in managing scarcity and opportunity costs. Household income determines the amount of money a family has to spend; that is, it constrains spending. And, unlike our gift card example, household wants are not limited to CDs, movies, and games. Rather, they include basics such as housing, medical care, education, food, and clothing. But, just like the gift card example, because our wants exceed our ability to spend, we must make choices, which involve opportunity costs. So, more money spent by a family on food might require less spent on clothing.

Credit cards and other forms of credit make it possible (and quite tempting) to exceed spending limits. Does debt negate scarcity? Does it permit you to buy more than your income would allow? It might seem so, but you still have a limit.

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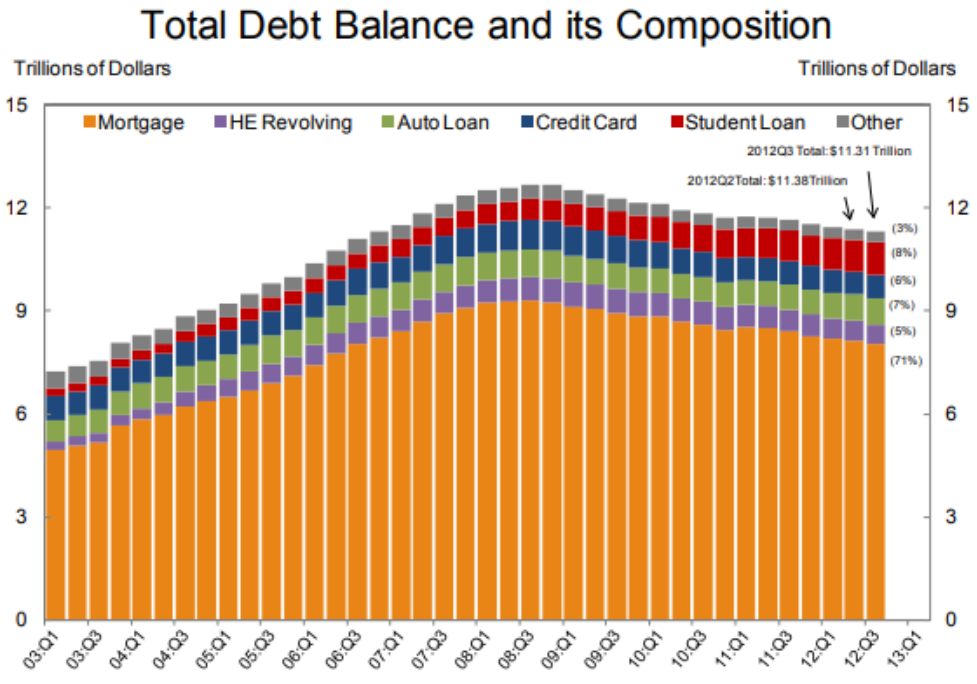
Using debt means that you are borrowing your future income to buy goods today. As you repay the debt (plus interest) over time, you will have less income in the future to buy goods and services then. And remember that credit cards have limits, and lenders avoid lending beyond the borrower's ability to repay the loan. At the end of the third quarter of 2012 (August 31), total consumer debt stood at $11.31 trillion (see first chart).

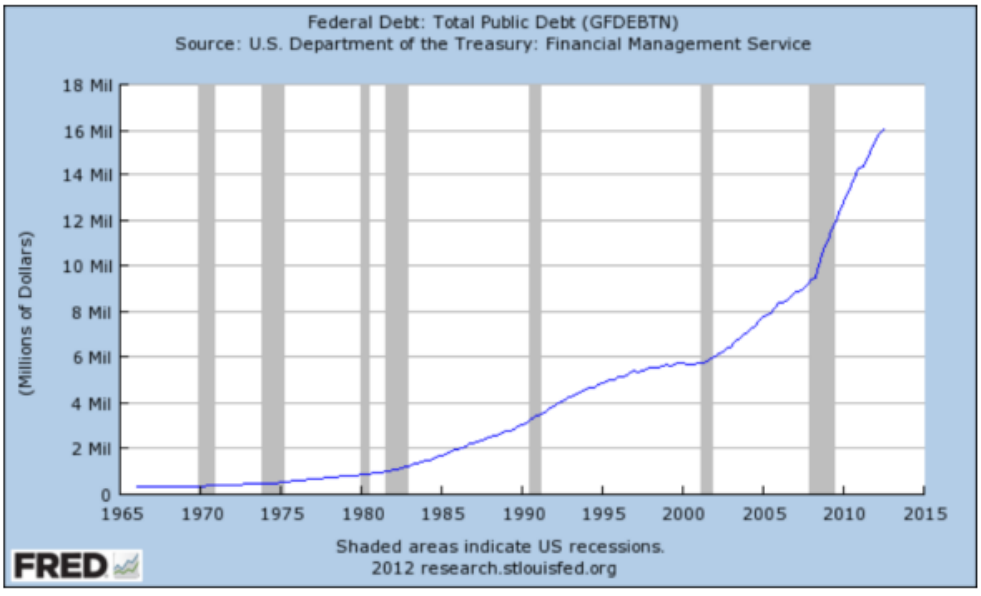
Government Spending

In many ways, the government faces these same choices. Citizens have collective wants and the government attempts to satisfy these wants through its spending. Social Security, health care programs such as Medicare and Medicaid, and national defense are among the top federal spending categories. But the ability to satisfy our society's wants is constrained by the level of government income, which is generated primarily by taxing workers and companies. Just like individuals who make spending choices, when the government chooses, there is an opportunity cost. If more money is spent on national security, the result might be less spending on health care. It is possible to raise taxes to provide additional income for the government to allocate, but that imposes further budget constraints on workers and companies who pay taxes—so, this policy choice also has opportunity costs. Of course, the government's spending is not limited to tax revenue. Just as families can, the government can use debt to pay for some of its goods and services. At the end of the third quarter of 2012 (August 31), total federal debt stood at $16.07 trillion (see second chart).



NOTE: The total level of household debt has decreased since 2008. While mortgages still represent the largest portion of household debt at $8.03 trillion, the level has been falling. Outstanding student loan balances have been growing and currently stand at $956 billion. HE, home equity.

SOURCE: Federal Reserve Bank of New York Credit Panel/Equifax; http://www.newyorkfed.org/research/national_economy/householdcredit/DistrictReport_Q32012.pdf.



NOTE: The total federal debt stood at $16.07 trillion at the end of the third quarter of 2012 (August 31); see http://research.stlouisfed.org/fred2/series/GFDEBTN. For an up-to-date view of the federal debt, see the U.S. Treasury's "The Debt to the Penny and Who Holds It:" www.treasurydirect.gov/NP/BPDLogin?application=np.

SOURCE: Federal Reserve Bank of St. Louis FRED database.

What is the downside of government debt? Using debt to buy goods and services today means the government is

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Views expressed do not necessarily reflect official positions of the Federal Reserve System.

borrowing future income (that is, tax revenue)—which means less income in the future for buying goods and services then. In addition, there is a limit to how much credit lenders (or investors) will extend to a country; they will avoid lending beyond the government's ability or willingness to repay the loan or will do so only at very high interest rates.

Conclusion

An understanding of scarcity and opportunity cost is crucial to making good economic decisions. Remember that scarcity describes the condition in which our wants exceed the resources necessary to satisfy those wants. Scarcity requires us to make choices and choosing involves an opportunity cost—the value of the item given up when a choice is made. So, making wise (and sometimes difficult) choices requires considering the opportunity costs. ■

After reading the article, answer the following questions on a separate sheet of paper:

1. State the difficult choices that government leaders face in solving our long-term budget problems:
2. Why does scarcity mean that people must choose?
3. Explain why choices involve opportunity costs.
4. How is a family budget an exercise in managing scarcity? What role does income play?
5. Why is it tempting to think that credit cards, and other forms of credit, negate scarcity?
6. What are the downsides of government debt?

Consider the Opportunity Cost

Opportunity cost is a foundational concept in economics. It is also a key thinking skill in the practical art of daily decision making. Unfortunately, people often fail to consider opportunity cost until they learn to use it as a thinking skill. Once you have mastered the idea of opportunity cost, you will think differently about all sorts of routine choices. The table shows a few examples.

This:	Becomes this:
I'm tired. I think I will sleep in this morning.	If I sleep in this morning, then I give up the opportunity to go to chemistry class.
This new video game is awesome, and it's This new video game is awesome, but if I spend only $40.	$40 on it, I give up the opportunity to spend it on _____ or save it for _____.

In the end, you might still decide to sleep in and buy the new video game, but recognizing the opportunity costs will increase your chances of making a rational decision.

Scenario 1:

Free Lunch? Economists are fond of saying "There is no such thing as a free lunch." Of course, they are not talking about lunches literally. In fact, many people miss the point of this phrase. Imagine Fred is walking to school when he notices a sign on the front lawn of the high school: "Free lunch here today at noon." Fred is a little skeptical, but later that day he looks out the window and, sure enough, he sees a table with pizza and soda and a big sign that reads "Free." But Fred remembers his teacher saying "There is no such thing as a free lunch." Fred decides to ask his best friend, Frank, why the lunch is not free. Frank shrugs and responds, "Someone had to pay for it." While this is true, the real question is this: Why is the lunch not free for Fred?

What do you think (on the same sheet of paper you answered the previous questions, respond to the above scenario on "free lunch")?

Consider this scenario (Scenario 2):
You received $50 from your grandmother for your birthday. You decide to buy some new clothes. Because the money was a gift, you believe your new clothes are free. You could have, however, used the $50 to buy the new calculator required for your math class next semester. So, are the clothes you bought really free?

You Decide: Opportunity Cost or Consequence?
The difference between opportunity costs and consequences can be confusing. Remember that the *opportunity cost* is the value of the next-best alternative when a decision is made; it's what is given up. A consequence is a result or effect of an action or decision, and consequences may be positive or negative. While opportunity cost and consequences sound like similar ideas, they are not the same. One way to think about the difference is to remember that the opportunity cost occurs when the decision is made, while the consequences lie in the future. Imagine you decide to go to college after you graduate from high school. If you choose to go to college, you give up the opportunity to get a full-time job—this is part of the opportunity cost of attending college. The consequences of your decision lie in the future, such as the higher income you will likely receive with a college degree.

- Choice: Go to college
- Opportunity cost: Full-time employment
- Consequence: Higher income in the future

Identify the opportunity cost and the consequence in this scenario: You have one dollar, which you have decided to use to buy a candy bar. Your favorite candy bar is GooeyNut followed closely by LuvChoc. Your dentist has warned you about your candy habits; he is fond of saying “Forget the Alamo, remember the Enamel.”

- Choice: _____
- Opportunity cost: _____
- Consequence: _____