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2016 deSTEMber

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31 Days of STEM Fun!

Visit the interactive calendar at www.deSTEMber.org | Topics Subject to Change

Homemade Compass

Can you find north? Discover how to recreate the first manmade compass used over 1,000 years ago. Compasses find the Earth's naturally occurring magnetic fields. With just a few materials you will be able to find north in no time.

TEKS:

5.3A: The student is expected to, in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student.
4.6D: The student is expected to design an experiment to test the effect of force on an object, such as a push or a pull, gravity, friction, or magnetism.
3.6C: The student is expected to observe forces such as magnetism and gravity acting on objects.

Materials:

- Blunt sewing needle
- Bowl of water
- Compass
- Magnet wand
- Small cork (2-3 cm thick)
- Tape

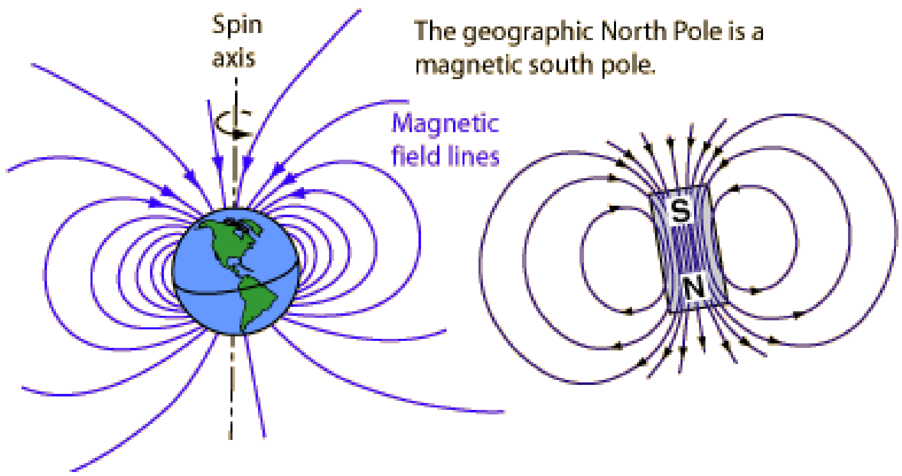
How To:

1. Rub the sharp end of the needle against the magnet wand for at least 10 to 15 seconds to magnetize the needle.
2. Attach the magnetized needle to the cork using tape. To do this, you'll need a piece of tape long enough to wrap around the entire piece of cork. Place the needle on top of the round part of the cork so that the needle is lying flat and aligned with the cork's length. Then wrap the piece of tape around both the needle and the cork to secure it. You'll want to make sure that the needle doesn't come off when you start testing your cork compass!

3. Drop your cork compass (the magnetized needle attached to the cork) into the bowl of water. Observe what the needle does. Let the needle settle and then use the regular compass to determine which direction the needle is pointing. (Note: Be careful to keep the magnet wand away from both the compass and the needle!) Record your results - - did your needle point north, south, east, or west?
4. Repeat this process 4 or 5 times to see if your results are consistent. Record your results each time. Between each test, you may need to repeat step 1 to re-magnetize your needle. (Note: You don't have to take the needle off the cork to re-magnetize it; you can just rub the needle against the magnet).
5. After you've tested your cork compass, see what happens when you bring the magnet near the needle when it is in the water. Does it change the direction the needle points? Why do you think this happens?

STEM Explanation:

What direction did your needle point most often? It should have pointed north. Compasses work by finding the Earth's naturally occurring magnetic fields. Magnetic fields are the 3D force fields around a magnet, and they are strongest at the ends of a magnet (the poles). The Earth acts like a gigantic magnet, and it has a magnetic north and a magnetic south pole. The magnetic poles are the opposite of the geographic poles that we normally think of. This means that the place we call the North Pole is actually the magnetic south pole! The needle of your compass is a magnet that has the ability to move around, and the needle always points north no matter which way you turn. When you created a compass with the needle and cork, you had to magnetize the needle by rubbing it against a magnet so that it could act like a magnet and find the Earth's magnetic fields, just like a compass you find at a store.



http://hyperphysics.phy-astr.gsu.edu/hbase/magnetic/imgmag/mearthbar.gif

Career Connection:

Geophysicists study the Earth using gravity, magnetism, electricity, and seismic waves. They study features of the Earth and often help determine if there are environmental hazards in areas such as dam construction sites. They also study the internal structure of the Earth. These scientists use advanced physics and calculus in their daily research.

Resource:

http://www.giftofcuriosity.com/how-to-make-a-compass/

deSTEMber
SCIENCE ★ TECHNOLOGY ★ ENGINEERING ★ MATH

PRESENTED BY: girlstart

Human Slingshot

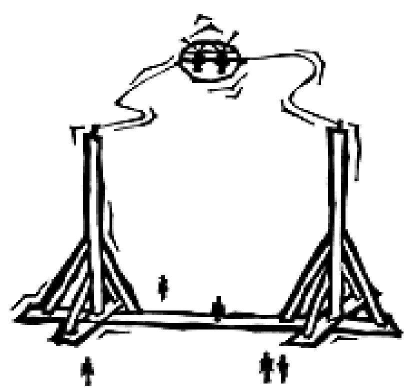
Have you ever gone to an amusement park and wanted to experience the slingshot cage ride? The cage is stretched to the ground for passengers to be harnessed in; then the tension is released and the cage goes flying. Explore how potential and kinetic energy make this exhilarating and terrifying ride possible as you create your own human slingshot prototype!

TEKS:

6.8A: Force, motion, and energy. The student knows force and motion are related to potential and kinetic energy. The student is expected to compare and contrast potential and kinetic energy.
6.9C: Force, motion, and energy. The student knows that the Law of Conservation of Energy states that energy can neither be created nor destroyed; it just changes form. The student is expected to demonstrate energy transformations, such as how energy in a flashlight battery changes from chemical energy to electrical energy to light energy.

Materials:

- 1 12” elastic cord
- Masking tape
- 5 paint stirrers
- 4 paperclips
- 4 rubber bands (all sizes)
- 1 small whiffle ball
- Tacky glue
- 8 tongue depressors



http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/newton/slshot.gif

How To:

1. If you were to design a human slingshot ride for an amusement park, what would it look like? Dream up a design, and then create a model of it using the materials above.
2. Make sure that your design includes a place for riders to sit. (In the model you build, the whiffle ball is meant to be seats for the riders.) Use the paint stirrers, tongue depressors, rubber bands, bungees, paperclips, tape, and glue to build a model of your design. Remember, you have limited materials so use them wisely. A big part of designing is making sure that you don't plan to use more materials than you actually have.
3. This is YOUR design. You can create it any way you would like. When you are finished making your slingshot ride, try it out!

STEM Explanation:

How do slingshots work? Have you ever launched a rubber band across the room using your fingers? When you pull back on something elastic (like a rubber band), you input potential energy into the system. Potential energy is the energy an object can store based on its position. The farther back the rubber band is pulled (the more it stretches), the more potential energy it has. When you let go, the potential energy is converted into kinetic energy, and the rubber band launches across the room! Kinetic energy is the energy of motion. The heavier an object is and the faster it moves, the greater the kinetic energy that it has. These ideas about potential and kinetic energy apply to human slingshot rides, just like your prototype, but on a larger scale.

Career Connection:

Amusement park ride engineers are creative, innovative, and have a strong understanding of math and civil engineering. They design new attractions on the computer with their knowledge of physics, collaborate with other engineers to create the ride using proper materials, and decide how to efficiently maintain it. They often work closely with park owners and a construction team to ensure the ride meets all the required standards and to solve any problems that arise during building.

Resource:

http://www.4science.org.uk/assets/files/pdf/engineering/thrills_P_Activity_3.pdf

Marshmallow Slingshot

How far do you think you can launch a marshmallow across the room? Use your knowledge of potential and kinetic energy to make your own marshmallow slingshot!

TEKS:

4.6A: Force, motion, and energy. The student knows that energy exists in many forms and can be observed in cycles, patterns, and systems. The student is expected to differentiate among forms of energy, including mechanical, sound, electrical, light, and heat/thermal.
6.8A: Force, motion, and energy. The student knows force and motion are related to potential and kinetic energy. The student is expected to compare and contrast potential and kinetic energy.

Materials:

- Golf pencil
- Hole puncher
- Jumbo marshmallow (or other object to launch, like a small ball)
- Pen or marker
- Scissors
- Tape
- 2 thin rubber bands
- 2 toilet paper tubes, or one paper towel tube cut in half

How To:

1. Cut one toilet paper tube in half lengthwise and squeeze it so that it makes a tube about half of its original diameter. Tape it closed so that it doesn't uncurl.
2. Punch two holes half an inch in from one end of the tube you just made, opposite from each other. The holes should both be on the same end of the tube, just on opposite sides.
3. Push the pencil through the two holes. Be careful not to tear the holes! If you do, you'll need to make new ones.

4. On one end of the other toilet paper tube, draw two short lines (about half an inch long each) straight down from the rim, about as far apart as the width of your pointer finger. Cut each line, making two slits. Do the same thing on the other side of the same rim, opposite the first set.
5. Push one rubber band onto each set of slits. Try not to bend the cardboard! If they bend open, tape them in place with the rubber band wrapped around them.
6. Slide the smaller tube (the plunger) into the larger tube (the grip) so that the small tube's pencil end is sticking out of the end of the big tube that does not have slits. The pencil should be on the opposite end of the rubber bands.
7. Stretch each rubber band and hook it around the end of the pencil.
8. Load a marshmallow into your slingshot. It should be resting on top of the plunger. Holding the outer tube, pull the pencil back to stretch the rubber bands. Release the plunger and watch your marshmallow fly across the room!
9. Do you think your marshmallow would go even farther if you pulled the slingshot back more? Compare how far your marshmallow flies when you pull the plunger back different amounts. Do you think it would make a difference if you used a smaller marshmallow?

STEM Explanation:
Things like slingshots work by storing energy in elastic materials, such as the rubber bands in this activity. The stored energy is called potential energy. The farther the rubber bands are stretched, the more potential energy is stored. When the rubber bands are released, the potential energy that has been stored up is converted into kinetic energy, which causes motion. This is how your marshmallow slingshot works! Some other things that work like this are trampolines, bows-and-arrows, and the shock absorbers on a bike.

Career Connection:
Physicists are scientists who do research in physics, which involves the study of matter and its motion through space and time, along with related concepts such as energy and force. More broadly, it is the general analysis of nature conducted in order to understand how the universe behaves.

Resource:
http://pbskids.org/designsquad/build/indoor-slingshot/

Balancing Pencil

Do you think you can balance a pencil using only magnets and tape? Discover how you can make a pencil stand on its tip by harnessing the power of magnets! Magnets are either attracted to each other (that's how they hold things up on a refrigerator!) or repel each other. Arrange the magnets so that they repel each other and make your pencil spin!

TEKS:

3.6C: The student is expected to observe forces, such as magnetism and gravity, acting on objects.
4.6D: The student is expected to design an experiment to test the effect of force on an object, such as a push or a pull, gravity, friction, or magnetism.

Materials:

- One ring magnet (can be purchased here)
- Plastic cup (12 ounce or larger)
- Sharpened pencil
- Tape
- Three bar magnets (can be purchased here)

How To:

1. On a flat surface, arrange the three bar magnets in a triangle shape so that they repel each other equally. They should not be sticking together!
2. While keeping the magnets in this repelling arrangement, tape the magnets to the top of the inside of the cup. They should be about equally spaced.
3. Stand your pencil up next to the cup, pencil tip down. Wrap tape around the pencil at about the same height as the magnets in the cup. Wrap the tape thick enough to hold the ring magnet on the pencil without letting it slide down.
4. Slide your ring magnet onto the pencil. The height of the ring magnet should be slightly above the magnets that are taped to the cup. The ring magnet should repel the bar magnets equally. If it seems to be attracted to the bar magnets, try sliding the ring magnet off the pencil, flipping it over, and sliding it on again.

5. Now, balance your pencil in the center of the cup. It should stay standing up! If not, try adjusting the height of your ring magnet or the positions of your bar magnets.
6. Try spinning your pencil in the cup! Does it spin for a long time? What happens when it stops?

STEM Explanation:

The pencil stays standing up in the center of the cup because the magnets repel each other. Magnets have north poles and south poles. Opposite poles attract and like poles repel. When you positioned your magnets, you arranged them so that the like poles were facing each other. This position causes the magnets to repel each other. The magnetic field the magnets produce as they repel each other pushes on the pencil from all sides, causing the pencil to stand up. At any given point in a magnet's magnetic field, the field has a magnitude (or strength) and direction. When the bar magnets repel each other on the inside of the cup, the magnetic field lines all come in towards the center of the cup and create a high pressure magnetic vortex. When the ring magnet's static magnetic field is placed within this magnetic vortex, it creates motion and causes the pencil to spin. In a perfect system, with the magnetic forces equally balanced and friction between the pencil and the cup eliminated, the pencil would be able to spin continually on its own.

Career Connection:

Physicists are scientists who do research in physics, which involves the study of matter and its motion through space and time, along with related concepts such as energy and force. More broadly, it is the general analysis of nature conducted in order to understand how the universe behaves.

Resources:

https://www.ligo.caltech.edu/LA/system/media_files/binaries/260/original/11-20_Magnetic_Spinning_Pencil_(updated).pdf?1448309002
http://frugalfun4boys.com/2016/02/10/spinning-pen-magnet-science-experiment/
https://www.youtube.com/watch?v=b-MSiQTXIG0

Edible Plate Tectonics

Divergent, convergent, and transform! Learn how Earth's tectonic plates interact in this delicious activity. Model the plates' movements using frosting and graham crackers to understand how Earth's landscape can change over time.

TEKS:

3.7B: The student knows that Earth consists of natural resources and its surface is constantly changing. The student is expected to investigate rapid changes in Earth's surface such as volcanic eruptions, earthquakes, and landslides.
4.7B: The students know that Earth consists of useful resources and its surface is constantly changing. The student is expected to observe and identify slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice.

Materials:

- 4 dollops of frosting
- Marker
- Paper plate
- ½ rice cake
- Small dish of water
- Spoon
- 4 graham cracker squares

How To:

Part 1: Divergent Plate Boundaries

1. Using a marker, divide your paper plate into four equal sections.
2. Put a dollop of frosting in each section.
3. Break one graham cracker square in half. In one section of your plate, lay the two pieces of graham cracker side by side on top of the frosting. The graham cracker pieces should lay so that they are touching.
4. Press down on the crackers as you slowly pull them apart in opposite directions. You've just made a model of diverging oceanic plates!

Part 2: Convergent Plate Boundaries – Oceanic and Continental Subduction

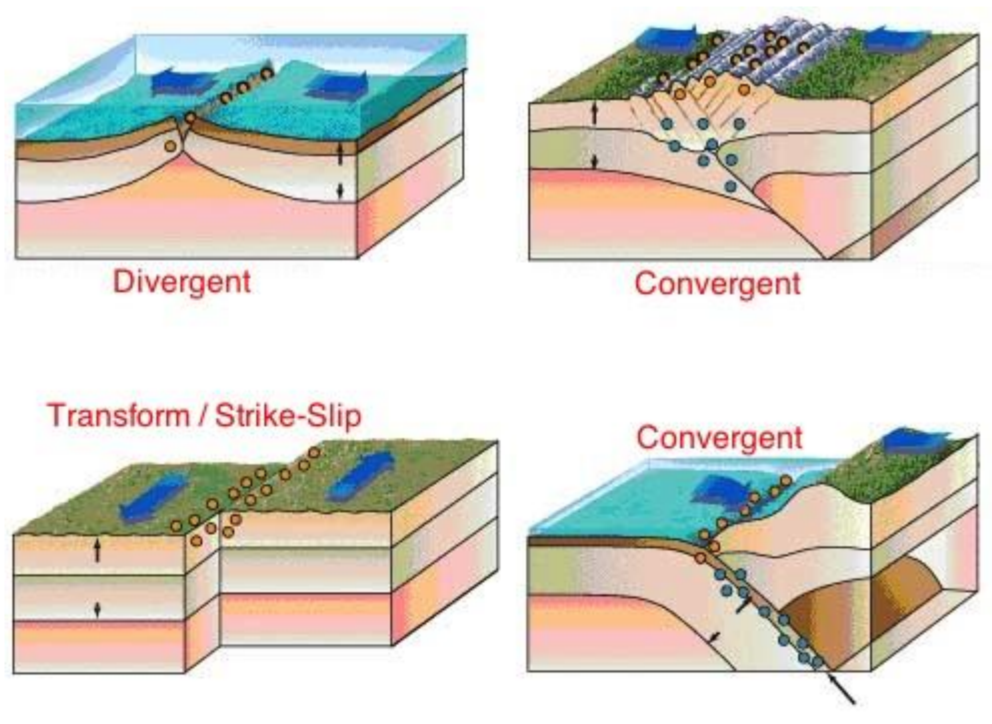
1. In a different section of your plate, take another graham cracker and lay it on top of the frosting next to the straight side of the rice cake half so that they are almost touching. The graham cracker represents an oceanic plate, and the rice cake represents a continental plate.
2. Push the two "plates" slowly towards each other. Which plate rides up over the other? The oceanic plate (graham cracker) is subducted, or sinks, under the continental plate (rice cake).

Part 3: Convergent Plate Boundaries – Continental Mountains

1. Take another graham cracker square and break it in half. Each piece represents a continental plate.
2. Dip one end of each of the two cracker pieces into a cup of water. Don't let them soak too long or they will fall apart!
3. In a third section of your plate, lay the crackers end to end on the frosting with the wet edges almost touching.
4. Slowly push the two crackers together. What happens? What feature is formed?

Part 4: Transform Plate Boundaries

1. Take your last graham cracker square and break it in half. In the last section of your plate, lay the two pieces side by side on top of the frosting so that the pieces are touching.
2. Push the pieces together while sliding them in opposite directions – one towards the top of the plate and one towards the bottom of the plate. This can be a bit tricky, but if done correctly the cracker will eventually break due to the opposite forces!



http://edwinllarkin.blogspot.com/2012/09/plate-tectonics-and-continental-drift.html

STEM Explanation:

Plate tectonics explains how many of Earth's surface formations have formed. Earth's lithosphere (surface) is broken into 15 major pieces called plates. The plates move approximately 2 cm to 10 cm per year. The plates can collide (convergent plate boundary), separate (divergent plate boundary), or slide past each other (transform boundary). Movement of the plates causes earthquakes and creates mountains and volcanoes.

There are two different types of plates. Oceanic plates are thin, but dense and heavy. Continental plates are thicker, but less dense than oceanic plates. If a continental plate and an oceanic plate collide, the oceanic plate is subducted (sinks) because it is heavier. As it sinks under the continental plate, it begins to melt in the Earth's mantle. The melted rock (magma) rises up to form volcanoes. When plates diverge (pull apart), this also can cause volcanoes to form. Much like when you cut yourself and a scab forms, when the earth's surface pulls apart (at divergent plate boundaries), hot magma rises up to form new land and volcanoes. Sometimes valleys form when either plates diverge or at transform boundaries where plates slide past each other. In California, for example, the San Andreas Valley is formed by 2 plates sliding past each other at a transform boundary. Earthquakes occur every time the plates shift (move). Plate movement can also create mountains. When continental plates collide, the edges push up to form mountains.

Career Connection:

Geology is the study of Earth's history, formation, and the forces that continuously shape Earth's surface. *Geologists* study a wide range of subjects including plate tectonics, rocks and minerals, floods, and landslides. Much like your graham cracker simulations, geologists use simulations to understand geologic movement in the past, present, and future. Geologic time is immense (covering more than 4 billion years!) and events happen very slowly. Geologists accumulate an enormous amount of data and it is helpful when they can put this data into a visual simulation.

Resource:

http://evavarga.net/2014/09/18/modeling-plate-tectonics/

Sound Glove

Use the inventive Makey Makey keyboard and the programming power of Scratch to create your own musical instrument. Design a one of a kind sound glove using thimbles, alligator clips, and an aluminum foil ball. Program your favorite tune and play your unique instrument for your friends!

TEKS:

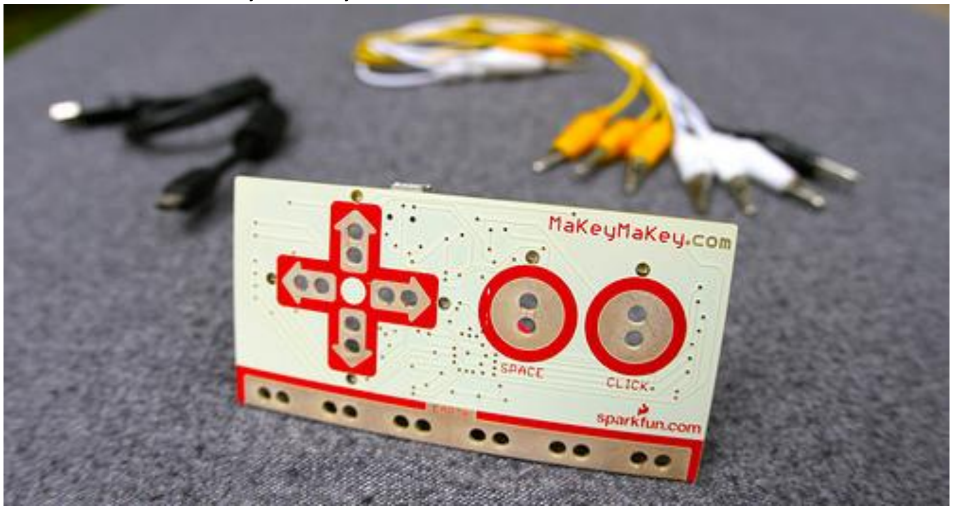
6.4B: Plan and manage activities to develop a solution, design a computer program, or complete a project.
FCS.4E: Demonstrate coding proficiency in contemporary programming language by developing solutions that create stories, games, and animations.

Materials:

- 10 alligator clips (less if only using 3 finger thimbles)
- Aluminum foil
- Computer (with internet access)
- Makey Makey kit (http://makeymakey.com/)
- Rubber dishwashing glove
- Scratch account (it's really easy to make one if you don't have one and it's FREE: Go to http://scratch.mit.edu/, click Join Scratch and follow the instructions)
- Small ball
- Tape
- 3-4 thimbles

How To:

Part 1: Create Sound Glove with Makey Makey



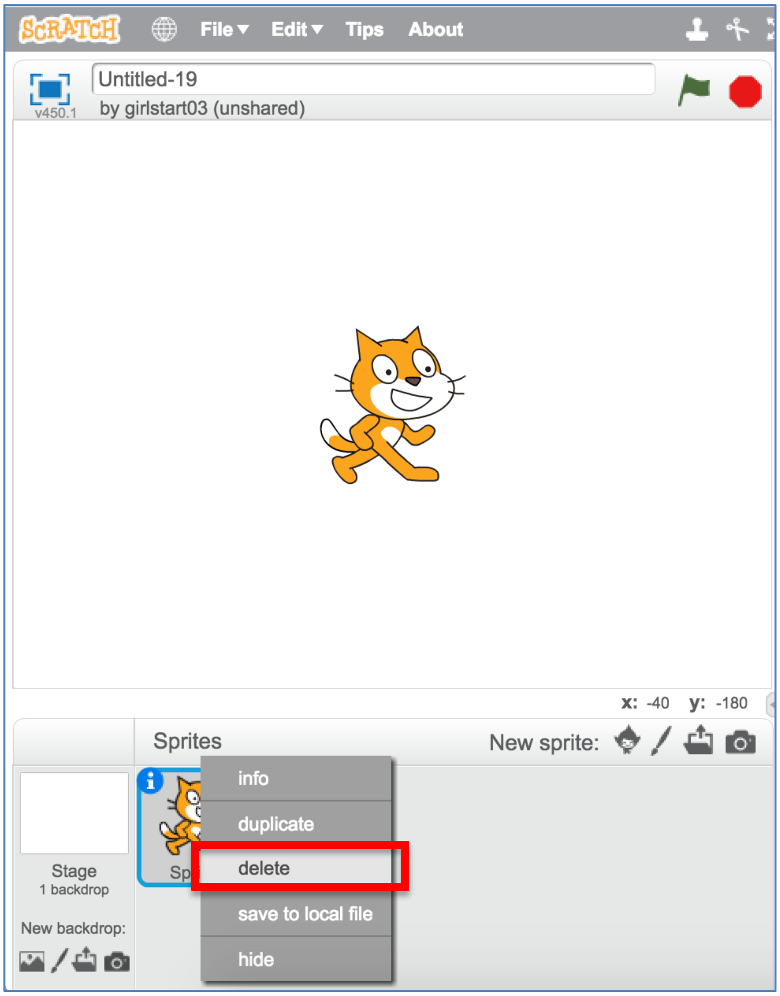
http://makeymakey.com/

1. Attach an alligator clip to each thimble. (You can choose to use either three or four thimbles, depending on how many notes you want to play. Each thimble will play one note.)
2. Place glove onto preferred playing hand.
3. Place thimbles with attached alligator clips on the glove fingers and use tape to secure them onto the glove. (Note: Make sure to connect enough alligator clips so that the wires can reach the Makey Makey board from your hand with ease.)
4. Connect the ends of the alligator clips to the right, left, up, and down areas on the Makey Makey.
5. After making the glove, create the conductive ball by wrapping the ball with a sheet of aluminum foil.
6. Attach another alligator clip from the aluminum foil ball to the Earth area on the Makey Makey.
7. Connect the Makey Makey to your computer.

Part 2: Create music program on Scratch

1. Login to Scratch and click 

.
2. Delete the current sprite on the screen by right clicking the picture of it at the bottom and clicking delete.



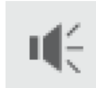
3. You will then want to add a new sprite, which will be your musical instrument at rest. To do this, either choose one from the library by clicking , or draw your own by clicking .
4. Now click on the 

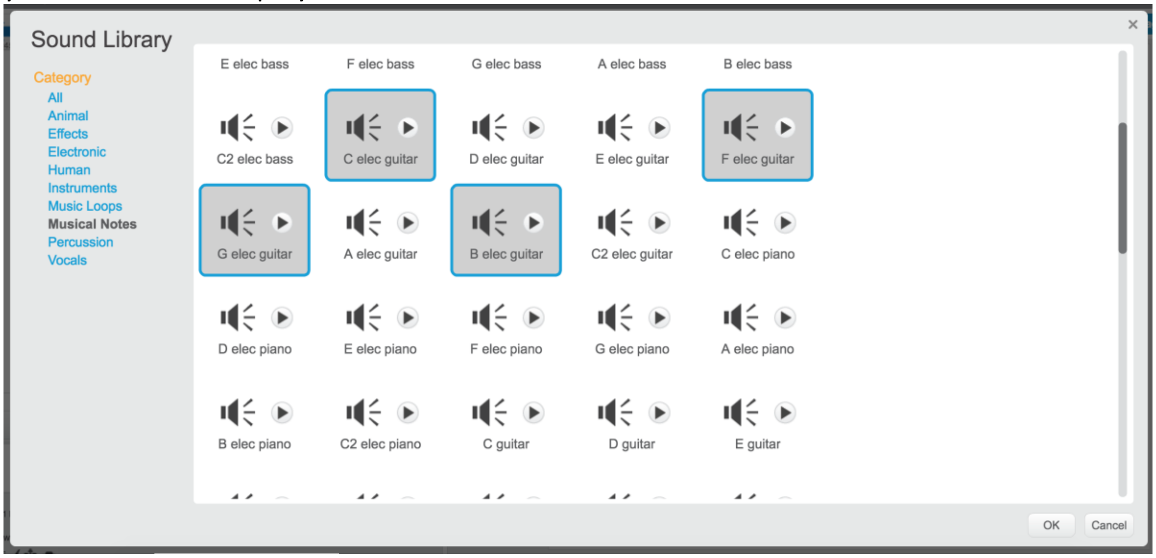
tab.
5. This is where we will begin programming. First grab and drag 

under the 

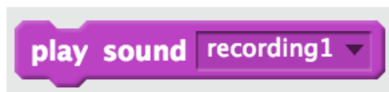
section.
6. Change where it says 'space' to one of the four arrow keys.
7. Click on the 

tab.

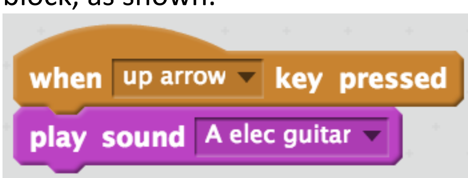
8. Make sure the the musical notes for your instrument are listed. If they are not, you will need to add four musical notes by clicking , then **Musical Notes**, and selecting which notes you want your instrument to play.



9. Click on the **Scripts** tab.

10. Then, under **Sound**, grab, drag, and attach 

in to the bottom of the block, as shown.



11. Change where it says 'recording1' to one of the musical notes.
12. Repeat steps 5, 6, and 9 through 11, switching each arrow key and musical note you use each time, until you have a block batch for each arrow key. When you are through, your screen should look something like this:

Congratulations, you have now finished programming your musical instrument. Now you should be able to play music by touching the thimbles to the aluminum ball to switch between musical notes!

STEM Explanation:

Scratch is a programming language used to design your own interactive stories, games, and animations. Aluminum is a conductor, meaning it is a material that allows electricity to flow. When your thimble touches the aluminum ball, you are creating a closed circuit that allows energy to be transferred through the wires. By allowing the energy to flow, your program will run smoothly and play music!

Career Connection:

Computer programmers write the instructions for software programs on computers. Once software developers and engineers create design specifications for a particular program, like an app or a game, computer programmers create directions for the program that the computer can understand. They will write code (the computer language), solve problems, debug, test, and rewrite the code until the program works effectively and efficiently. Some of the most common computer languages in existence include C++ and Python.

Resource:

http://scratch.mit.edu/

Smart Light

Use your smart phone to program a light bulb to do amazing things! The energy-efficient FLUX Smart LED Light Bulb lasts for up to 20,000 hours and can be controlled from your iPhone or Android. The bulb can respond to music, be used as an alarm clock, and has a palette of over 16 million colors! By simply using the FLUX app on your phone, this revolutionary light bulb has endless environmentally-friendly programming capabilities.

TEKS:

6.2B: The student is expected to design and implement experimental investigations by making observations, asking well-defined questions, formulating testable hypotheses, and using appropriate equipment and technology.
TA.1C: Creativity and innovation. The student uses creative thinking and innovative processes to construct knowledge and develop digital products. The student is expected to explore virtual environments, simulations, models, and programming languages to enhance learning.

Materials:

- 1 FLUX LED Smart Light Bulb (https://www.fluxsmartlighting.com/)
- 1 FLUX power cord
- 1 Smartphone (iPhone or Android)

How To:

1. Download the FLUX app for iPhone or Android on your smartphone:
   iPhone: https://itunes.apple.com/us/app/flux-bluetooth/id1050558235?mt=8&ign-mpt=uo%3D4
   Android: https://play.google.com/store/apps/details?id=com.Westwingx.LEDBluetoothFlux
2. Once the app has been downloaded, screw the FLUX light bulb into the power cord.
3. AFTER attaching the light bulb to the power cord, plug the cord into a power outlet and turn the bulb on using the switch on the cord.
4. Open the FLUX app on your smartphone and pair your plugged-in bulb with the app. (Note: The FLUX bulb must be turned ON for this to work!)
5. Once paired, feel free to give your light bulb a fun name, and then open the app to begin programming!
6. Complete CHALLENGE #1 and CHALLENGE #2 below.

CHALLENGE #1: THE COLOR CHALLENGE!

- Using the settings in your FLUX app, discover how to make the light bulb change colors!
- Once you have successfully figured out how to change the color of your bulb, try and make the following colors:
    1. **HOT PINK**
    2. **DARK GREEN**
    3. **SKY BLUE**
    4. **BURNT ORANGE**
    5. **CHRISTMAS RED**
    6. **YOUR FAVORITE COLOR**
- Once you have successfully made all 6 colors, try to change the BRIGHTNESS (there is more than one way to do this) of the bulb and see how it affects the way the colors look.
- **EXTRA COLOR CHALLENGE**: Use the FLUX app to make the light bulb shine the color of your shirt! (HINT: Look for a "CAMERA" function in the FLUX app.)

CHALLENGE #2: THE SOUND CHALLENGE!

- Use the FLUX app to make the light bulb play along to your favorite songs!
- Open the "MUSIC" tab of the FLUX app and connect it to the music that you already have on your phone.
- Select your favorite song and watch what happens to your light bulb.
- NOTE: If you don't have any music downloaded on your phone, this app can also be linked to Pandora or Spotify!
- **EXTRA SOUND CHALLENGE**: Use the FLUX app to make the bulb light up when you clap your hands. Then see what happens when you say your name, or sing a song!

7. Once you have successfully completed CHALLENGE #1 and CHALLENGE #2, discover all of the amazing things the FLUX Smart LED Light Bulb can do! Check out the pre-programmed lighting under the FUNCTIONS tab, set light-based timers and alarms, and even program more than one bulb to make your own custom light show!

STEM Explanation:

Programming is an important part of our lives. It is what makes our computers, our electronics, the appliances in our houses, and even stoplights on the street work! It is a way for us to communicate with electronic things to tell them what to do. If we don't tell a computer (or a light bulb in this case) what to do, it won't do anything! In the FLUX app, you are able to give your light bulb directions about what color to shine or when to shine. How does the light bulb receive these instructions? It connects to your phone using Bluetooth. Bluetooth enables the FLUX light bulb to communicate with radio waves rather than a wire, allowing it to receive communication from your phone from a short distance away. If you get really far away, you won't be able to change the color of your light! Bluetooth is also used in many cars to talk on the phone hands-free, and is the science behind wireless headphones.

Career Connection:

Lighting engineers use the principles of electrical engineering to design, develop, test, and supervise the manufacture of lighting equipment for consumer, business, and industry use. Lighting engineers, and the companies that employ them, are focused on the development of energy-efficient lighting.

Resources:

http://bluetoothlightbulb.com/
https://www.fluxsmartlighting.com/

Circuit Bugs

Have you ever made a circuit to light something up? Channel your inner electrical engineer to create your own light up circuit bug! Using a coin battery, copper wire, and LED lights, build your circuit on a clothespin; then decorate your clothespin with pipe cleaners to look like your favorite insect.

TEKS:

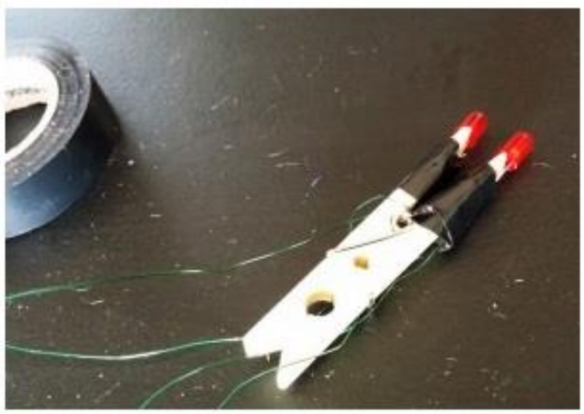
4.3D: Connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.
4.6B: Differentiate between conductors and insulators.
4.6C: Demonstrate that electricity travels in a closed path, creating an electrical circuit, and explore an electromagnetic field.
5.3D: Connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.
5.5A: Classify matter based on physical properties, including mass, magnetism, physical state (solid, liquid, and gas), relative density (sinking and floating), solubility in water, and the ability to conduct or insulate thermal energy or electric energy.
5.6A: Explore the uses of energy, including mechanical, light, thermal, electrical, and sound energy.
5.6B: Demonstrate that the flow of electricity in circuits requires a complete path through which an electric current can pass and can produce light, heat, and sound.

Materials:

- 1 clothespin
- 1 coin battery (CR2032 3V)
- Electrical tape
- 2 LED lights
- 4 pieces (6-8" each) insulated copper magnet wire
- 5 pipe cleaners
- Scissors or wire strippers (Adult supervision is needed to strip wires!)

How To:

1. Test your LED lights and battery to make sure they work. The LEDs should light up when you insert the battery between their legs/pins. If not, try turning the battery around. If the LEDS still won't light up, try a different battery. You may also have to try a new LED. You need to be sure everything works before creating your circuit bug!
2. Take two pieces of wire and have an adult help you strip 2-3" off both ends of each wire. The longer leg of the LED is the positive leg. Take one wire and wrap it around the positive leg of one of the LEDs. Take the second wire and wrap it around the positive leg of the other LED. (The *stripped* part of the wires must be touching the positive legs of the LEDs.) Then twist the 2 wires together.
3. Repeat Step 2 with two more pieces of wire and the negative legs (the shorter legs) on both LEDS.
4. Take your two sets of twisted wires (one set of positive wires and one set of negative wires) and test them on the battery to be sure your circuit is working. If the LEDS don't light up, try rewrapping the wires on the positive and negative legs.
5. Attach the LEDs to the legs of the clothespin by positioning each leg of the LED on either side of the wood. This prevents the positive and negative wires from touching, which could cause a short circuit (a disruption to the circuit). Wrap the LED legs onto the clothespin with electrical tape.



6. Run the wires from the LEDs down the sides of the clothespin and tape them to the clothespin with electrical tape. There should be extra wire dangling from the end of the clothespin. Before creating your bug design, check that the circuit is working by touching the wires to the battery. This creates a closed circuit that will make the LEDs light up if the circuit is okay!
7. Create a design for your bug using pipe cleaners. Wrap the pipe cleaners around the clothespin to make wings and a body. Be creative, but be careful—the pipe cleaners should not get twisted with the circuit wires because they can interfere with the circuit. When you've created your bug design, once again touch the wires to the battery to make sure your circuit is still working.
8. When you have finished your design, wrap the negative wire around one half/side of the clothespin clamp (the part that closes tightly shut) and then wrap the other half/side of the clothespin clamp with the positive wire. Make sure the stripped part of the wire is on the inside of the clamp! If your wires are too long and bulky, you can trim them before wrapping them around the clamp of the clothespin. *If you do trim the wires, you will have to strip the ends again.* The stripped part of the wires needs to get tucked into the clamping part of the clothespin because that's where the battery will go. The stripped wires need to touch the battery to complete the circuit that will light the LEDs.

9. Place the battery in the clamp of the clothespin to bring your circuit bug to life! The positive wire should be touching the positive side of the battery and the negative wire should be touching the negative side of the battery. If your bug is not working, try turning the battery around. If this doesn't fix the problem, you will need to disassemble your bug to find what is interrupting your circuit! To turn your bug off, simply remove the battery.

STEM Explanation:

The components of a circuit in this activity include a battery, wires, and LED bulbs. Power travels from the battery through the wires to turn on the LED light. Electricity flows from the battery and through the bulbs. When the circuit is incomplete, or open, the wires are not connected to the battery source and therefore there is no flow of electricity. To make the LED lights turn on, the battery must be connected to the circuit. This makes a closed circuit in which the electric current is able to pass through the circuit and make the LED lights work.

Career Connection:

Electrical engineers design and build small and large scale electrical systems. In the circuit design area of electrical engineering, engineers use their knowledge of the conductivity of materials to design circuit boards that are used in cell phones, TVs, toaster ovens, computers, and many other devices. Understanding the dangers of mixing electricity and water helps engineers design for safety.

Resource:

http://www.steampoweredfamily.com/activities/circuit-bugs/

deSTEMber
SCIENCE ★ TECHNOLOGY ★ ENGINEERING ★ MATH

PRESENTED BY: girlstart

Museum Scavenger Hunt

Directions: Type the coordinate numbers below into Google Earth to find some of the world's most fascinating museums! Zoom in and out of the image and click on the picture available for each museum to further explore these amazing places. Answers on the next page. Happy Travels!

Coordinates:

1. **39.8106° N, 86.1579° W** The _______________ is the world's largest children's museum! The building is nearly 500,000 square feet in size, and features over 110,000 exhibits and artifacts. Bonus: try the street view feature on the southwest corner of the building to see some dinosaur fun!
2. **22.2943° N, 114.1719° E** Are you looking for an experience out of this world? The _______________ has a popular exhibit where you can be harnessed up in a way that makes you feel like you are walking on the moon!
3. **39.9577° N, 75.1723° W** _______________ is the most prominent of American mechanics institutes. One of its core exhibits features a 350-ton Baldwin steam locomotive where you can be a train engineer for the day.
4. **48.1299° N, 11.5835° E** The _______________ in Munich, Germany is the world's largest science and technology museum. One of the highlights of the museum is a reconstruction of the Cave of Altamira in Spain, where some of the world's oldest cave paintings were discovered.
5. **38.8876° N, 77.0199° W** _______________ in Washington is the world's best aviation and human flight history museum. This museum maintains the largest collection of historic aircraft and spacecraft in the world. All of the aircraft and spacecraft on display were actually flown or used as backup vehicles.
6. **51.4967° N, 0.1764° W** The _______________ in London is most famous for its dinosaur exhibits, which include some of the world's most rare and amazing fossilized dinosaur skeletons.
7. **39.9571° N, 75.1712° W** The _______________ in Philadelphia is the world's oldest museum of natural science. If you visit this museum, the skeleton of a 43-foot T-Rex will greet you!
8. **41.7923° N, 87.5804° W** The _______________ in Chicago is the Western Hemisphere's largest science museum. One of its exhibits features the U-505 – a submarine from WWII, which weighs 3 times as much as the Statue of Liberty!

31 Days of STEM FuN!

STEM Explanation:

Google Earth allows you to virtually fly to anywhere on Earth, view satellite imagery, maps, terrain, 3D buildings, landmarks, and more! You can view Earth from as close as the front door of your house and as far away as if you are looking at Earth from space. *How does this technology work?* The Google Earth software simplifies the Earth into a sphere covered by a polygon of flat tiles on the surface. As you zoom in on Google Earth, the larger tiles explode into smaller tiles with higher resolution. This allows for the computer to transmit less data across the Internet so users can quickly move about Earth's surface at different angles and altitudes. Take some time to explore the many exciting features Google Earth has to offer!

Answers:

1. The Children's Museum of Indianapolis
2. The Hong Kong Space Museum
3. The Franklin Institute
4. The Deutsches Museum
5. The National Air and Space Museum
6. The Natural History Museum
7. The Academy of Natural Sciences
8. The Museum of Science and Industry

Sound Sandwich

Create your own musical instrument using tongue depressors, rubber bands, and a straw to explore how sound is caused by vibrations. Sound moves in waves, and different sized waves produce different pitches of sound. Experiment with your Sound Sandwich to find the perfect tune to play for your friends!

TEKS:

3.6A: The student is expected to explore different forms of energy, including mechanical, light, sound, and heat/thermal in everyday life.
4.6A: The student is expected to differentiate among forms of energy, including mechanical, sound, electrical, light, and heat/thermal.

Materials:

- 2 small rubber bands
- 1 straw
- 2 tongue depressors
- 1 wide rubber band

How To:

1. Place a wide rubber band lengthwise over one tongue depressor.
2. Cut off two small pieces of straw about 1 to 1½ inches in length each.
3. Tuck one piece of straw under the rubber band, about an inch from the end of the tongue depressor. Set the other piece of straw on top of the rubber band about an inch from the other end of the tongue depressor. The length of each straw should be perpendicular to the long axis of the tongue depressor and rubber band.
4. Place another tongue depressor on top of the straws.
5. Wrap a small rubber band around both of the tongue depressors on one end of the "sandwich" to hold them in place. Use another small rubber band to hold the other end of the tongue depressors in place. There should be a small space between the two tongue depressors created by the straw pieces.
6. Hold your Sound Sandwich up to your mouth and blow through the spaces between the tongue depressors. What happens? What does it feel like?
7. What happens if you move the straws closer together and blow through the sandwich again? Does anything change?

STEM Explanation:

When you blow through the Sound Sandwich, you should feel it vibrating against your lips. Sound is produced when a vibration is transmitted through a solid, liquid, or gas. The air that you blew between the tongue depressors caused the rubber band to vibrate between the two depressors, and that vibration produced a sound. Sound moves in waves, and different sized waves produce different sounds. Longer sound waves produce lower pitches; shorter sound waves produce higher pitches. When you moved the straws closer together, a shorter part of the rubber band vibrated to produce shorter sound waves. This is why the Sound Sandwich produced a higher pitched sound when you moved the straws closer together.

Career Connection:

Acoustical engineers deal with the science of sound and vibrations. They look for ways to limit unwanted sound and maximize desired sound. Acoustical engineers are an important part of the music industry.

Resource:

http://www.exploratorium.edu/snacks/sound-sandwich

Chemical Magic

Is it possible to change the color of a liquid without adding food coloring? This experiment may appear to be magic, but it is actually chemistry. Make your own pH indicator to explore the acidity and basicity of common household liquids.

TEKS:

6.5D: Identify the formation of a new substance by using the evidence of a possible chemical change, such as production of a gas, change in temperature, production of a precipitate, or color change.
7.6: Matter and energy. The student knows that matter has physical and chemical properties and can undergo physical and chemical changes.

Materials:

- Blender
- ½ of a purple cabbage
- 14 small clear plastic cups (for example, clear 2 ounce portion cups)
- Knife and cutting board (to chop cabbage)
- Paper and pencil
- Permanent marker
- 1 pipette or eye dropper
- Safety goggles
- Strainer
- Test liquids: Orange juice, milk, salt water, laundry detergent, vinegar, lime juice, water, ammonia, clear soda (7UP), finger nail polish remover, shampoo, mouth wash, baking soda in water, and hydrogen peroxide
- Water (about 4 cups)

Safety Reminders:
Maintain good lab practices during this experiment. This means wear your safety goggles at all times and do not taste, smell, or touch any of the liquids. ***Adult supervision is required for this activity.***

How To:

1. Ask an adult to help with cutting the cabbage and using the blender.
2. Cut the cabbage in half and chop into smaller pieces. Add your chopped cabbage to the blender. Pour enough water in the blender to reach the halfway mark (about 4 cups). Blend until liquefied. Then pour the purplish liquid through a strainer to filter out chunks. The strained liquid will be your pH indicator. Discard the cabbage chunks.
3. With a permanent marker, label the cups with the names of the different test liquids you are using. Fill each cup ¼ full with its designated test liquid. You should have 14 different cups if you plan on investigating all of the test liquids.
4. Use a pipette or eyedropper to add 10 drops of cabbage juice to each test liquid. Watch closely as a chemical reaction occurs and record any color changes you observe in the table below:

Test Liquid	Color Change
1. Orange juice	1.
2. Milk	2.
3. Salt water	3.
4. Laundry detergent	4.
5. Vinegar	5.
6. Lime juice	6.
7. Water	7.
8. Ammonia	8.
9. Clear soda (7UP)	9.
10. Finger nail polish remover	10.
11. Shampoo	11.
12. Mouth wash	12.
13. Baking soda in water	13.
14. Hydrogen peroxide	14.

5. If the liquid turns reddish, this means it is an acid and if it turns greenish, it is a base. No color change means the substance is neutral. Use the table below to identify and categorize each of the substances you tested as either acidic, neutral, or basic.

Acid	Neutral	Base

STEM Explanation:

Liquids have many properties, and one of them is pH. The pH scale ranges from 1 to 14 and tells us how acidic or basic a substance is. A 1 on the pH scale is the most acidic, and a 14 is the most basic. A pH of 7 is neutral. An indicator can be used to determine whether a liquid is basic, acidic, or neutral. Indicators change color in the presence of an acid or base. Cabbage juice is a natural indicator. In this case, liquids turn reddish if they are acidic and greenish if they are basic. No color change occurs for neutral substances.

Career Connection:

Analytical chemists use a diverse range of methods to investigate the chemical and physical properties of substances. Their goal is to identify and understand the substance and how it behaves in different conditions. They can work in pharmaceuticals, forensics, quality control, or toxicology fields.

Resources:

http://teams.lacoe.edu/documentation/classrooms/gary/chemistry/activities/indicators.html
http://www.stevespanglerscience.com/experiment/48

Age on Planets

Did you know that time is measured differently on each planet? One Earth year is equivalent to the amount of time it takes for Earth to make one trip around the sun. On other planets, this time is shorter or longer. Using the age chart, calculate what your age in Earth years would be if you lived on another planet!

TEKS:

Math 5.3B: The student is expected to multiply with fluency a three-digit number by a two-digit number using the standard algorithm.
Math 5.3C: The student is expected to solve with proficiency for quotients of up to a four-digit dividend by a two-digit divisor using strategies and the standard algorithm.
Math 5.3G: The student is expected to solve for quotients of decimals to the hundredths, up to four digit dividends and two digit whole number divisors, using strategies and algorithms, including the standard algorithm.

Materials:

- New Age Chart (attached)
- Paper and pencil (to do calculations)

How To:

1. Calculate your age in Earth *days*. This is your age multiplied by 365. Record this on the *New Age Chart* below.
2. Determine how old you are on the four terrestrial planets (Mercury, Venus, Earth, and Mars). To do this, divide your age in *Earth days* by the number of days in a planet's year (this information is on the age chart). Your answer is your "new" age. For example, a 20 year old on Earth would be 83 years old on Mercury! (20 x 365 = 7,300 Earth days; 7,300/88 = 83). Fill in your new age on the age chart as you calculate it for each planet.
3. To find your age on the outer planets (Jupiter, Saturn, Uranus, Neptune, and Pluto), divide your age in *Earth years* by the approximate length of the planet's year in Earth years. This is your "new" age. For example, a 20 year old on Earth would only be 1.7 years old on Jupiter because 20 / 12 = 1.7. Again, record your new age for each planet on the chart.

STEM Explanation:

One year on Earth is the amount of time it takes for Earth to orbit, or travel around, the Sun one time. Each planet in the solar system has a different orbit path around the Sun, so each planet takes a different amount of time to orbit the Sun. This is why each planet has a different length year than Earth's year. Since we know how long another planet takes to orbit the Sun, we can calculate what our age would be on other planets! In our example above, a person 20 years old on Earth is only 1.7 years old on Jupiter. This is because in the time it takes Earth to orbit the Sun 20 times, Jupiter only completes 1.7 orbits! If someone is 124 years old on Mercury, can you determine how old they are on Earth? The age that you are on different planets wouldn't really change how old you are—if you went to Pluto, you wouldn't become a baby. You would still look the same way you do right now; your age would just be different!

Check your math on the Exploratorium's *Your Age on Other Worlds* online calculator.

Career Connection:

Mathematicians do research to develop and understand mathematical principles. They analyze data and use mathematical techniques to help solve problems in the world. They often work with teams of scientists and engineers. To be a mathematician, you need to get at least a master's degree in mathematics.

Resource:

http://www.spacegrant.hawaii.edu/class_acts/HowOld.html

New Age Chart

My age in Earth days (age x 365) =__________ Earth days.

Terrestrial Planets	Approximate length of year	Your "new" age
Mercury	88 Earth days	
Venus	225 Earth days	
Earth	365 Earth days	
Mars	687 Earth days	

Outer Planets	Approximate length of year	Your "new" age
Jupiter	12 Earth *years*	
Saturn	29.5 Earth *years*	
Uranus	84 Earth *years*	
Neptune	165 Earth *years*	
Pluto	248 Earth *years*	

Dinosaur DNA

Do you know what makes you unique? What determines your eye color or whether or not you are double jointed? DNA is what makes you – YOU! All living things have a genetic code, called DNA. Discover unique characteristics of dinosaur DNA in this tasty activity!

TEKS:

4.10B: Demonstrate that some likenesses between parents and offspring are inherited, passed from generation to generation, such as eye color in humans or shapes of leaves in plants.
7.14C: Recognize that inherited traits of individuals are governed in the genetic material found in the genes within chromosomes in the nucleus.

Materials:

- Dinosaur Characteristics Cards (attached)
- Dino DNA Resource page (attached)
- 36 multicolored gumdrops
- 30 toothpicks

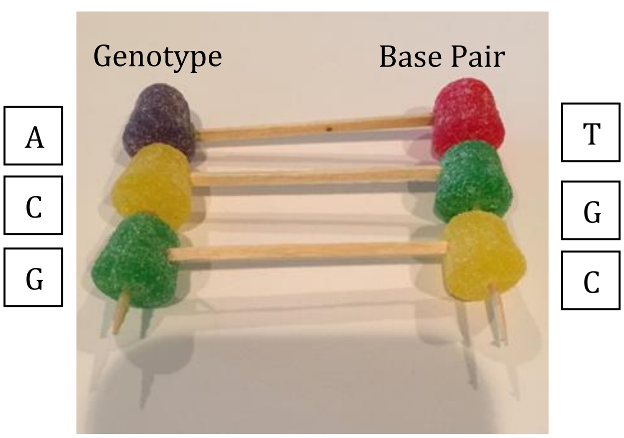
How To:

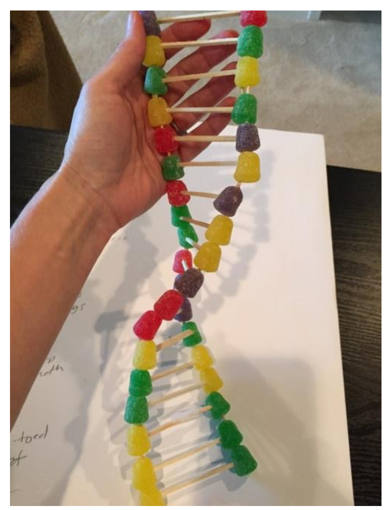
1. Choose a dinosaur from the *Dinosaur Characteristics Cards*. Your card will tell you the physical characteristics of your dinosaur.
2. Look at the *DNA Color Key* on the *Dino DNA Resource* page. Each gumdrop color represents a different building block, or nucleotide, in DNA. The four nucleotides in DNA are Adenine (A), Thymine (T), Guanine (G), and Cytosine (C). The sequence, or order, of these four nucleotides is what determines an individual’s traits.
3. Next, look at the *Dinosaur DNA Code Table*. The left column lists dinosaur traits such as “head size” and “tail length.” The middle column indicates all of the possible versions of those traits. For example, it is possible for a dinosaur to have a short tail or a long tail. The physical expression of traits, such as a short tail, are called phenotypes. Use your dinosaur characteristics card to figure out which phenotypes the DNA of your specific dinosaur expresses.

4. The third column in the *Dinosaur DNA Code Table* indicates the DNA nucleotide sequence that produces each phenotype. For example, if the DNA sequence for head size is ACG, then the dinosaur will have a large head. Use your dinosaur characteristics card to identify the DNA nucleotide sequence that will produce each of your dinosaur's phenotypes.
5. Let's build your dinosaur's DNA! Use the *DNA Color Key* to select which three gumdrops to use for your first trait. For example, if your dinosaur has a large head, the DNA nucleotide sequence is ACG, and your first three gumdrops should be purple-yellow-green. Connect your first three gumdrops by sliding a toothpick through them. These three nucleotides (gumdrops) represent the gene for your dinosaur's head size. A gene is a piece of DNA that codes for a specific trait.
6. Use the dinosaur characteristics card and both tables to continue to build your dinosaur's genes out of toothpicks and gumdrops. When finished, use the toothpicks to connect all of your genes into one long strand. This long strand represents one side of your dinosaur's DNA.
7. The last step is to build the opposite side of the DNA molecule. DNA is shaped like a double helix; it looks like a twisted ladder. Each nucleotide in DNA forms a bond with only one other type of nucleotide to form a base pair. There are only two possible base pairs:

   Adenine (A) – Thymine (T)
   Guanine (G) – Cytosine (C)

   Adenine (purple) will only bond with Thymine (red). Cytosine (yellow) will only bond with Guanine (green). Use this nucleotide base pairing rule to build the other strand of your DNA molecule. Use toothpicks to join each nucleotide pair in the middle of the two strands.

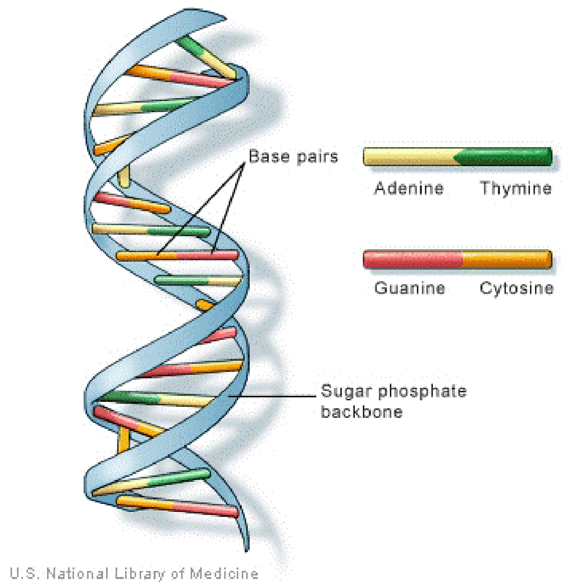




STEM Explanation:

DNA stands for Deoxyribonucleic Acid. In the same way that a blueprint is used as instructions for building a house, DNA is used by cells as instructions for life. DNA contains the instructions for an organism's growth, development, and ability to stay healthy. For example, DNA contains codes to create your physical traits like hair color, height, and whether or not you can roll your tongue. Traits are characteristics that are inherited, which is why we look somewhat like our parents. A molecule of DNA can be very long. A gene is just a piece of DNA that contains the instructions for a specific trait. So, the eye color gene tells you what color eyes you have! The physical characteristic that you have, like the actual color of your eyes, is called a phenotype.

DNA is a double helix. This means that it looks like a spiral staircase. One molecule of DNA is actually made up of many little pieces called nucleotides. The sequence of the nucleotides is what determines our traits. There are four types of nucleotides*: adenine (A), thymine (T), cytosine (C), and guanine (G).* Each nucleotide has a specific partner that it pairs with in the spiral staircase shape of DNA. For example, A always pairs with T and C always pairs with G. Different combinations of these four nucleotides create the codes for the approximately 20,000 different genes that make you who you are. No one else has the exact same sequence of DNA as you—unless you have an identical twin!



http://www.chemguide.co.uk/organicprops/aminoacids/doublehelix.gif

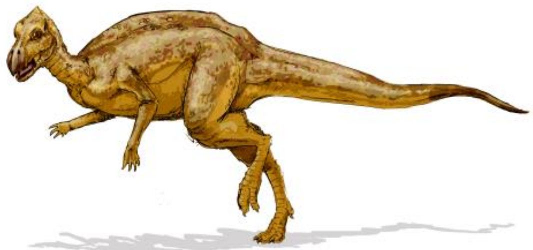
Career Connection:

Biomedical engineers study which specific DNA sequences code for certain characteristics as they investigate genetic disorders, such as color blindness, Down syndrome, cystic fibrosis, and hemophilia. Biomedical engineers also work to develop technologies that can identify DNA mutations and manipulate or replace genes that are damaged or missing.

Resource:

https://www.teachengineering.org/activities/view/cub_biomed_lesson09_activity2

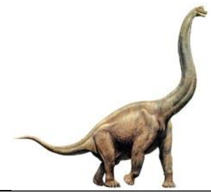
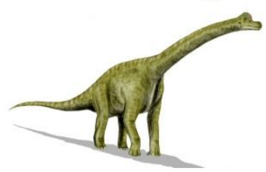
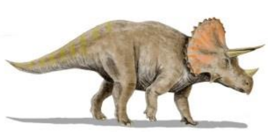
Dino DNA Resource



DNA Color Key	
Candy Color	***DNA Nucleotides***
Purple Yellow Green Red	A C G T

Dinosaur DNA Code Table		
Trait	***Phenotype***	***DNA Nucleotide Sequence***
Head size	Large Wide Small	ACG AGC AGT
Tail length	Short Long	CGT CTG
Neck length	Short Long	TGG TGC
Arms and legs	Two arms, long legs Longer back legs Shorter back legs	TAA TTA TAT
Teeth	Sharp Leaf-shaped Cheek Peg	GCC GTG GCT GTC
Feet	Three-toed Four-toed Five-toed	GAA GGG GTT

Dinosaur Characteristics Cards

Allosaurus Large head Long tail Short neck Two arms, long legs Sharp teeth Three-toed feet 	**Ankylosaurus** Wide head Club tail Short neck Longer back legs Leaf-shaped teeth Five-toed feet 	**Brachiosaurus** Small head Long tail Long neck Shorter back legs Sharp teeth Five-toed feet 
Deinonychus Large head Long tail Short neck Two arms, long legs Sharp teeth Four-toed feet 	**Diplodocus** Small head Long whip tail Long neck Longer back legs Peg teeth Five-toed feet 	**Stegosaurus** Small head Long spiked tail Short neck Longer back legs Cheek teeth Three-toed feet 
Triceratops Large head Short tail Short neck Longer back legs Cheek teeth Five-toed feet 	**Tyrannosaurus Rex** Large head Long tail Short neck Two arms, long legs Sharp teeth Three-toed feet 	**Velociraptor** Small head Long tail Short neck Two arms, long legs Sharp teeth Four-toed feet 

Optical Illusion

Now you see it, now you don't! Make your own optical illusion to see how your brain reacts. Our brain often uses shortcuts to process the information we come in contact with every day. Test your optical illusion and see if it "tricks" your eyes and brain into thinking images on two separate pieces of paper are on a single page!

TEKS:

4.2: Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and outdoor investigations.
4.3: The student uses critical thinking and scientific problem solving to make informed decisions.
4.4: The student knows how to use a variety of tools, materials, equipment, and models to conduct science inquiry.

Materials:

- Colored pencils, markers, or crayons
- Dowel, wooden skewer, or pencil
- Glue or tape
- Scissors
- White cardboard (or heavy paper, like cardstock)

How To:

1. Cut out two squares from the white cardboard or cardstock. Make sure they are the exact same size.
2. Draw an image on each square, but before you do so, choose images that pair well together. You are going to make the images seem like they are actually on the same side of one piece of paper! In our example, we drew a fish tank on one square and some fish on the other.
3. Glue or tape the dowel, skewer, or pencil in between the two pictures. The pictures should be facing outward.
4. Hold the dowel, skewer, or pencil between your palms. Rub your hands together to make the picture spin. You want it to spin pretty fast. Do your two pictures look like they are on the same piece of paper?

STEM Explanation:

Have you ever seen an optical illusion before? There are many different types of optical illusions. They use color, light, and patterns to deceive our brains! Our eyes collect information, and the brain processes it in a way that creates a perception that doesn't match what is really there. Understanding why optical illusions work has to do with understanding how the eye works with the brain to tell us what we are seeing. Our eyes act as lenses, like a camera. They focus light and then use the light to create an image that is then transmitted to our brain. The spinning pictures optical illusion works the same way as a cartoon movie or TV show you might watch. Cartoonists draw several still images that differ slightly with each rendering; then the still pictures are moved very quickly to create the illusion that characters and objects are moving on screen.

Career Connection:

Optical engineers design components of optical instruments such as lenses, microscopes, telescopes, and other equipment that use properties of light. They must have knowledge about the physics of light and how light reacts to the outside world and materials in order to control, direct, and manipulate light to behave in a certain way. Optical engineers can work in research or product development. They may make an existing product better or invent something new. Optical engineers may work at electronics companies, computer manufacturers, and medical equipment companies.

Resources:

http://www.science-sparks.com/2013/10/18/make-an-optical-illusion/
http://www.optics4kids.org/home/content/illusions/

Tea Bag Rocket

Turn an everyday tea bag into an exciting rocket! Heat makes the air inside the tea bag less dense than the air outside of it. This creates a convection current that lifts the ash from your burning tea bag and sends it flying upward.

TEKS:

3.4A: Students recognize that patterns, relationships, and cycles exist in matter. Students will investigate the physical properties of matter and will learn that changes occur. They explore mixtures and investigate light, sound, and heat/thermal energy in everyday life. Students manipulate objects by pushing and pulling to demonstrate changes in motion and position.
3.6A: The student is expected to explore different forms of energy, including mechanical, light, sound, and heat/thermal in everyday life.

Materials:

- Lighter
- Plate or pan (metal or ceramic; NOT paper or plastic)
- Scissors
- Tea bag

How To:

1. Cut off the top of the tea bag, removing the staple and string.
2. Empty the tea leaves into the trash can.
3. Unfold and straighten the tea bag. It should look like a hollow cylinder. It doesn’t need to be perfect, but it does need to be opened up. Your tea bag should be hollow inside—like a tube.
4. Stand the straightened tea bag up on the plate or pan with the tube opening facing upward.
5. Before you can launch your tea bag rocket, move to an open area with no wind to make sure that your rocket launches safely. A garage is a great place to do this activity, or outside if there is no wind. Do not launch your rocket inside as it may start a fire!
6. **Adult supervision is necessary to launch the tea bag rocket.** With an adult helping you, light the top edge of the tea bag (you want it to catch fire). Let it burn all the way down and then watch it lift off and soar into the air! It will float gently back down. What remains?

STEM Explanation:

Why does your tea bag rocket fly up into the air? When you set fire to the tea bag, the heat from the fire causes the air molecules inside the tea bag to become energized and move around quickly. The air molecules inside the tea bag are moving so fast that they spread up and out of the tea bag. This makes the air inside the tea bag less dense, or less tightly packed together, than the colder (more tightly packed together) air outside of the tea bag. Density is the measurement of how compact (or tightly packed together) something is. For example, a bag of feathers is less dense than a bag of cement of equal volume. Can you think of other objects' densities you can compare?

It is the density difference between the warm and cool air that causes your tea bag rocket to fly. As the diagram below shows, the warmer, less dense air inside the tea bag rises up above the cooler, denser air. As warmer air moves up, colder air moves in to replace it. This causes a thermal convection current to form that lifts up the tea bag.

Red represents warm air and blue represents cool air. This diagram shows that the warm air inside of the tea bag rises up above the cool air surrounding it on the outside.

http://www.popsci.com/sites/popsci.com/files/styles/large_1x_/public/import/2014/MANUAL_tea%20bag.jpg?itok=MisAd5mj

As the tea bag burns, it turns into very lightweight ash. The ash is easily lifted up by the force of rising hot air. When the ash cools, it falls back down, hopefully landing right back on the plate!

Career Connection:

Thermal engineers specialize in thermodynamics. Thermodynamics is the study of heat energy changing into other forms of energy like chemical, mechanical, and electrical. Thermal engineers can work with heating/cooling equipment or at power companies such as gas, electric, and nuclear.

Aerospace engineers are responsible for the design, construction, and application of the science behind the forces and physical properties of aircrafts, rockets, and spacecraft. This field also covers the aerodynamic characteristics and behaviors of aircraft, such as airfoil, control surfaces, lift, drag, and other properties.

Resource:

http://www.stevespanglerscience.com/lab/experiments/tea-bag-liftoff/

Fog Chamber

Have you ever looked out your bedroom window and couldn't see the neighbor's house? Or wondered why the clouds were so low in the sky? Create fog in a jar and discover how these low-lying clouds are made up of water molecules suspended in air!

TEKS:

3.8A: The student is expected to observe, measure, record, and compare day-to-day weather changes in different locations at the same time that include air temperature, wind direction, and precipitation.
4.8B: The student is expected to describe and illustrate the continuous movement of water above and on the surface of the Earth through the water cycle and explain the role of the Sun as a major source of energy in this process.

Materials:

- 1-gallon clear glass or plastic jar with a wide mouth (for example, a pickle jar)
- Matches
- Rubber glove
- Tap water

How To:

1. Pour just enough water into the jar to barely cover the bottom.
2. Hang the glove inside the jar with its fingers pointing down and stretch the open end around the mouth of the jar to seal it.
3. Place your hand halfway into the glove, and pull the glove quickly outward without disturbing the seal. Does anything happen?
4. **An adult's supervision is required for this next step.** Now, remove the glove and drop a lit match into the jar. Quickly replace the glove. Pull outward on the glove again, being careful to keep the seal intact. Does fog form?
5. Let the glove snap back. Does the fog disappear?

STEM Explanation:

The match causes the water to heat up and evaporate into water vapor molecules, which are an invisible gas. When you pull the glove outward, the air in the jar expands and loses some of its thermal (heat) energy. This means that the molecules slow down slightly and the air becomes cooler. When the water vapor molecules slow down, they stick to each other and form tiny water droplets. This causes fog to form. The smoke particles from the match give the water droplets something to join on to. When the glove goes back inside the jar, the air is warmed back up and the fog goes away.

Career Connection:

Meteorologists study the Earth's atmosphere by observing temperature, air pressure, water vapor, and their interactions and changes over time. They use simulations to help them predict the weather and to understand weather patterns so they can piece together climatic schemes, or focus on more complex weather such as hurricanes, tornados, etc. Meteorologists need an in-depth knowledge of physics, geology, chemistry, and other sub-disciplines of atmospheric sciences including climatology, hydrology, and even oceanography. These scientists are important to the fields of energy production, transportation, agriculture, and more!

Resource:

http://www.exploratorium.edu/snacks/fog-chamber

deSTEMber
SCIENCE ★ TECHNOLOGY ★ ENGINEERING ★ MATH
PRESENTED BY: girlstart

Tightrope Walker

Have you ever tried to walk on a balance beam or even a sidewalk crack? Discover how tightrope walkers are able to lower their center of gravity, increase their moment of inertia, and exert torque in order to stay balanced and perform stunts at great heights. Create your own tightrope walker to explore the best way to keep them balanced.

TEKS:

3.6C: The student is expected to observe forces, such as magnetism and gravity, acting on objects.
8.6: Force, motion, and energy. The student knows that there is a relationship between force, motion, and energy. Investigate and describe applications of Newton’s law of inertia, law of force and acceleration, and law of action-reaction, such as in vehicle restraints, sports activities, amusement park rides, Earth’s tectonic activities, and rocket launches.

Materials:

- 1 clothespin (one-piece wooden one, not the spring type)
- 5 feet of fishing wire
- 2 full water bottles of different heights
- 2 pieces of 9” long beading wire (skinny enough to bend easily)
- 1 pipe cleaner
- 1 straw (not bendy)
- 2 washers
- Optional: markers and googly eyes for decorating

How To:

1. Wrap one 9” piece of beading wire around each “leg” of the clothespin (so each leg has its own wire). Bend each wire so that they point out at a downward angle from each leg of the clothespin.
2. Wrap the other end of each wire through the hole in a washer. If needed, use tape to hold the wires in place.
3. Wrap a pipe cleaner around the clothespin near the top and curve the edges up to make arms.

4. Place a straw in the pipe cleaner arms. The straw will serve as your tightrope walker's pole.
5. Tie each end of fishing line to a water bottle to make a sloped tightrope for your tightrope walker. Make sure that the string is taut between the two water bottles!
6. Test your tightrope walker along the string by placing one "leg" over each side of the fishing line. Make modifications as needed until your tightrope walker can balance on the string on its own.
7. Decorate your tightrope walker!

STEM Explanation:

When we think of tightrope walkers, we usually picture them holding a long pole to help them balance. Why do they hold this pole? When a tightrope walker is walking across the rope, gravity is pulling her down. Each time she takes a step, she must shift her weight, making it very difficult to balance on the skinny wire. Balancing is also difficult because torque, a rotational force, acts on the tightrope walker and is rotating her sideways off the wire with every unbalanced step. By using a pole weighted at the ends, the tightrope walker is able to counter the torque and keep balanced on the wire. The weighted pole increases the walker's moment of inertia, or resistance to rotating and falling off the wire, allowing the walker time to correct her position and stay balanced. In addition, holding the pole low helps to keep her center of gravity low, and this further increases her ability to balance. On the example that you made, your clothespin tightrope walker is able to balance because the washers lower its center of gravity, and the straw increases its moment of inertia. Does a clothespin with nothing attached to it balance on the string? Try experimenting with the way your wire is bent or where your straw is placed. What works best?

Career Connection:

Physicists are scientists who study matter and its motion through space and time, along with related concepts such as energy and force. More broadly, the field of physics analyzes the world around us in order to understand how the universe behaves.

Resource:

http://familyfun.go.com/crafts/crafts-by-material/pipe-cleaner-crafts/amazing-acrobats-670033/

Solar Eclipse

What is a solar eclipse? Have you ever wondered what it would be like for the sky to suddenly go dark in the middle of the day? On August 21, 2017, everyone in the United States will get to witness an eclipse and experience how it turns the day temporarily into night. Create a model to observe how a solar eclipse occurs, and you will be ready to share your knowledge next August!

TEKS:

K.8C: Observe, describe, and illustrate objects in the sky such as the clouds, Moon, and stars, including the Sun.
1.8B: Observe and record changes in the appearance of objects in the sky such as clouds, the Moon, and stars, including the Sun.
2.8D: Observe, describe, and record patterns of objects in the sky, including the appearance of the Moon.
3.8C: Construct models that demonstrate the relationship of the Sun, Earth, and Moon, including orbits and positions.

Materials:

- Flashlight
- Grape
- Orange
- 2 packing peanuts
- Ruler
- Toothpick

How To:

1. Stack the two packing peanuts on top of each other. Stick the toothpick through both of the packing peanuts so that the packing peanuts are both located at one end of the toothpick. Your packing peanuts should form a base that lets your toothpick stick straight up into the air. Stand your packing peanut base up on a table (or other flat surface).
2. Stick the grape on top of the toothpick so that the grape is about 2 inches up in the air.
3. Place the orange on the table about three inches behind the grape.

4. Place the flashlight about 1 foot in front of the grape. Turn the room lights off and then turn the flashlight on. The beam of light should shine directly on the grape and then the orange.
5. Look at the orange. You should be able to see a shadow that is darker in the middle and lighter on the outside.

STEM Explanation:

An eclipse occurs when the moon and Earth form a line with the sun. There are two types of eclipses: lunar and solar. A lunar eclipse takes place when Earth is located directly between the sun and the moon. As Earth passes between the sun and the moon, the sun shines on Earth, and this causes Earth to cast a shadow that blocks out the moon. A solar eclipse happens when the moon passes between Earth and the sun. The moon appears to block out the sun and the moon's shadow pitches Earth into darkness. In this activity, you are simulating a solar eclipse. The flashlight represents the sun. The grape represents the moon and the orange represents Earth. When the grape is between the flashlight and the orange, the grape's (moon's) shadow falls onto the orange (Earth). If you lived in an area on Earth that was in the shadow of the moon during a solar eclipse, the sky would get dark even if it was the middle of the day!

Safety Warning: Do not look at the sun, even when it is only a partial eclipse! Special eye protection is required to observe any solar eclipse. Looking directly at the sun can seriously damage your eyes! Check out NASA's 'Eye Safety During a Total Solar Eclipse' tips.

Career Connection:

Astronomers study planets, moons, stars, galaxies, meteors, comets, and their interactions with each other. They must have an in depth knowledge of physics in order to understand how forces such as gravity change throughout space. Astronomers work together sharing their knowledge in order to better understand how the universe works at microscopic and macroscopic levels.

Resources:

http://www.kidseclipse.com/pages/a1b3c1d0.htm
https://www.nasa.gov/content/eye-safety-during-a-total-solar-eclipse
http://eclipse2017.nasa.gov/

Thread the Needle

Did you know you are able to perceive depth because your left eye and right eye see things slightly differently? What type of adjustments would you have to make if you only had vision in one eye? Explore how your brain creates a three-dimensional image of the world in this eye opening activity.

TEKS:

4.3A: Scientific investigation and reasoning. The student uses scientific problem solving to make informed decisions. The student is expected to, in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student.
7.3B: The student is expected to use models to represent aspects of the natural world, such as human body systems and plant and animal cells.

Materials:

- A pencil (or dowel)
- A washer with a hole that is a little larger than the pencil's diameter (so the pencil can fit through it)
- Lump of modeling clay

How To:

1. Use the modeling clay to stand the washer on its edge.
2. Hold the clay with the washer in one hand and the pencil in the other. Hold the washer so that the edge is facing you (NOT the hole) and extend your arm in front of you.
3. Close one eye and try to put the pencil through the hole in the washer. Were you able to do it?
4. Switch eyes and try again. Were you able to put the pencil through the hole this time?
5. Now try to put the pencil through the hole in the washer with both eyes open. Was it easier?

STEM Explanation:

In order to judge distance and depth, your brain uses the differences between what your left eye sees and what your right eye sees. Pick an object to stare at. Cover up your left eye and look at it, then switch to covering up your right eye. Did the object seem to shift? Your brain combines these different views to create a three-dimensional picture of the world. Take this experiment further. Close one eye and, at the same time, move your head from side to side as you try to put the pencil through the washer. Does this change anything? Your eyes work as lenses to focus light and then create an image that is sent to your brain. When a person only has vision in one eye, they aren't able to see depth in the same way as someone with vision in both eyes because they do not receive two inputs at one time (one from the left eye and one from the right). Instead, they perceive depth by comparing the different views they get from one eye at two separate times. Because people with vision in only one eye don't receive two image inputs at once, they cannot perceive depth as well as a person with vision in both eyes.

Career Connection:

Optical engineers design components of optical instruments such as lenses, microscopes, telescopes, and other equipment that uses properties of light. They must have knowledge about the physics of light and how light reacts to the outside world and materials in order to control, direct, and manipulate light to behave in a certain way. Optical engineers can work in research or product development. They may make an existing product better or invent something new. Optical engineers may work at electronics, computer manufacturing, and medical equipment companies.

Resources:

http://www.exploratorium.edu/snacks/thread-needle
https://www.youtube.com/watch?v=syaQgmxb5i0

Laser Show

Have you ever seen a laser show and wanted to create one of your own? Use some fairly common items to learn about how sound waves travel to create your own laser show!

TEKS:

5.6A: Explore the uses of energy, including mechanical, light, thermal, electrical, and sound energy.
5.6C: Demonstrate that light travels in a straight line until it strikes an object or travels through one medium to another, and demonstrate that light can be reflected, such as the use of mirrors or other shiny surfaces, and refracted, such as the appearance of an object when observed through water.

Materials:

- Coffee can, or similar container, with approximately 4-6” round opening
- Laser pointer (WARNING: Lasers can be very dangerous. Do not point them into anyone’s eyes!)
- Latex glove
- Old CD (or other small reflective material)
- Rubber band
- Stand-alone speaker that fits inside the coffee can
- Super glue
- Metal straight edge
- Permanent marker
- Ruler
- Scissors
- X-Acto knife or box cutter

How To:

1. Remove the lid of the coffee can.
2. Clean and dry out your coffee can to make sure nothing will damage the speaker.
3. If your speaker requires a cable, cut a small hole in the side of the coffee can as close to the bottom as possible. Try to make the hole only big enough to allow the cable to pass through.

4. Place your speaker, facing up, inside the coffee can. Center it on the bottom of the can. Make sure the speaker is turned on. If using a Bluetooth speaker, don't forget to pair it with your sound source.
5. If the speaker has a cable, thread the cable through the hole you made. (You can cover the hole with tape if the hole is too large.)
6. You may choose to attach your speaker to the bottom of the can using tape or other means, but be careful not to damage the working components of the speaker.
7. The glove will provide the latex needed to cover the opening of the coffee can. First, use scissors to cut off the fingers of your glove. Then, cut the glove in half along the thumb side. Finally, cut any remaining pieces that are preventing the glove from opening up into a rectangle.
8. Stretch the rectangular piece of latex (from the glove) over the opening of the coffee can. (Make sure the speaker is already inside the can before you do this!) Try to stretch the latex as evenly as possibly in all directions over the top of the can. It should be tight enough that if you flick it, it will vibrate, but not so tight that it will easily rip.
9. Use the rubber band to hold the latex in place by wrapping it around the outside of the can.
10. Trim away any large, excess pieces of latex that are hanging over the side of the can.
11. **With adult supervision**, cut an approximately 1 inch by 1 inch square out of the CD using large scissors or an X-Acto blade and a metal straight edge. This will be the reflective surface for the laser beam. Be very careful when cutting! The knife can easily slip across the smooth surface of the CD; the cut edges of the CD will be very sharp.
12. Attach the mirror (CD square) to the center of the piece of latex covering the can. To do this, use the ruler to find the exact center of the latex covering. With the permanent marker, make a small dot in the center of the latex.
13. Place 1 drop of super glue over the dot in the middle of the latex covering, and center the CD square, **reflective side up**, onto this. Let dry for approximately 1 minute.
14. Before you power up your laser show, an important warning. **Lasers can be very dangerous. Do not point them in anyone's eyes or let your laser show hit anyone in the eyes!** The safest place to display your laser show is on a wall or ceiling.
15. Choose a song for your laser show. Connect the speaker and push play.
16. Point your laser at the center of the CD square, and watch it dance to the music. Experiment with pointing the laser from different angles, but be very careful to avoid your own eyes and others' eyes. Does your laser show look best on the wall? On the ceiling? From close up or far away?
17. OPTIONAL: Build a stand for your laser by bending a wire coat hanger (or another means) to make a base and secure your laser pointer to it. Your stand should steadily aim the laser at the CD square. Be sure the laser pointer is securely fastened to prevent it from slipping and accidentally pointing into someone's eyes.

STEM Explanation:

Sound travels in waves made up of compressions (high pressure) and rarefactions (low pressure). The speaker makes sound by pulsing forwards (creating a compression) and backwards (creating a rarefaction). With the speaker inside the coffee can, the can directs all of the sound upward to the latex covering. The sound waves cause the latex covering with the attached mirror to vibrate. The small vibrations result in large differences in the laser's reflection over a distance.

Career Connection:

Lighting designers work with many people (the director, choreographer, set designer, costume designer, and sound designer) to create the lighting, atmosphere, and time of day for a theater production. When creating a lighting design, the lighting designer has to consider not just the story line, but also things like safety, visibility, and cost. In addition to theater, lighting designers can work in areas as diverse as rock and pop tours, corporate launches, art installations, and massive spectacular celebrations like the opening and closing ceremonies for the Olympics.

Resource:

Courtesy of Topher Stumreiter

deSTEMber
SCIENCE ★ TECHNOLOGY ★ ENGINEERING ★ MATH
PRESENTED BY: girlstart

Gumdrop Dome

Squares, circles, or triangles — which shape do you think makes the strongest structure? Look around the area you are in to explore all the different shapes used to make things. Use gumdrops and toothpicks to construct a dome structure that is strong and won't collapse. Follow our instructions, design your own, or do both!

TEKS:

2.5D: The student is expected to combine materials that when put together can do things that they cannot do by themselves, such as building a tower or a bridge, and justify the selection of those materials based on their physical properties.

Materials:

- 11 gumdrops
- Small plate
- 25 toothpicks

How To:

1. First, form a base for your dome. Use toothpicks to connect 5 gumdrops in a pentagon ring shape. Build your dome on a plate to avoid making a sugary mess!
2. Next, build triangles upwards from the ring base to make the sides of your dome. To do this, insert a toothpick into the top of a gumdrop in the ring base, then insert another toothpick into the top of a gumdrop next to it. Angle the tops of the toothpicks together to make a triangle shape and connect the tops of the toothpicks with a gumdrop. Work your way around the ring base; you should make 5 triangles.
3. Connect the gumdrops at the tops of the triangles with toothpicks. Put the toothpicks into the sides of the gumdrops to connect them in a ring shape, much like you did with the base.
4. To complete your dome, insert a toothpick into each top gumdrop. Angle them upwards and towards the center. Use another gumdrop to connect all 5 toothpicks at the top center of your dome.
5. Would you be able to make a dome using half as many toothpicks or half as many gumdrops?

STEM Explanation:

Architectural engineers often use triangles when they design buildings. Did you notice that your dome is made up of lots of triangles? That's because triangles are stable shapes. That means they don't bend, twist, or collapse easily when you push on them. A square is not as stable as a triangle. Test it! Make a gumdrop square and triangle out of toothpicks and gumdrops; then stand each one up. Press down on one corner of each shape. How do the two shapes compare? Does one bend, twist, or collapse more easily than the other? Think about the materials that real buildings are made out of. Do you think architects use the same structures that we used in our activity when designing buildings?

Career Connection:

Architects plan and design buildings for various uses. They use their scientific and mathematical knowledge of physics to understand building construction as well as their artistic abilities to design visually appealing structures. Architects are scientists, mathematicians, and artists. To become an architect you need a four-year degree and a professional degree from an architectural program.

Resource:

http://www-tc.pbskids.org/zoom/printables/activities/pdfs/gumdropdome.pdf

Marble Mazes

Have you ever thought about what it takes to design your own maze? Don't let your marble get lost in this fun activity! Explore how the Law of Conservation of Energy and Newton's 3 Laws of Motion will help you design a challenging maze.

TEKS:

4.6A: Differentiate among forms of energy, including mechanical, sound, electrical, light, and heat/thermal.
6.8A: The student knows force and motion are related to potential and kinetic energy. The student is expected to compare and contrast potential and kinetic energy.
8.6C: Investigate and describe applications of Newton's law of inertia, law of force and acceleration, and law of action-reaction, such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches.

Materials:

- 1 marble
- Pencil
- 9" x 7" piece of cardboard
- Ruler
- Scissors
- Sharpie
- Tacky glue
- 20 tongue depressors

How To:

1. Draw a perimeter line (about 6.5" x 8.5") with a Sharpie around the inside of the cardboard's edge to create a boundary for your maze. Don't forget to leave spaces to mark where your marble will enter and exit the maze!
2. Use a pencil and a ruler to map out the maze design. Remember, the goal is to create a challenging path for the marble. Be sure to add a few dead ends. Also make sure your paths are wide enough for the marble to move through.

3. Lay out the tongue depressors along the design, including your outer perimeter. Use scissors to adjust the length of the tongue depressors as needed. **Adult supervision may be needed.**
4. Use tacky glue to adhere the tongue depressor maze walls in place. (Hold each tongue depressor in place for a few seconds to let the glue dry.)
5. Continue the gluing process until all of the maze walls are in place.
6. Test your maze. If needed, gently remove a maze wall to relocate.
7. Your marble's movement through the maze illustrates Newton's 3 Laws of Motion. Newton's 1st Law of Motion states that an object at rest will remain at rest unless a force acts on it. Similarly, an object in motion will stay in motion unless a force acts on it. What force acted on your marble to make it begin moving through the maze? Once the marble was moving in your maze, what force acted on it to prevent it from moving continuously in the same direction?
8. Newton's 2nd Law of Motion states that Force = Mass x Acceleration. In other words, the bigger the mass of an object, the greater the force needed to make it move and accelerate. Did you need to exert a large force or a small force on your marble to get it to move?
9. The 3rd Law of Motion states that for every action, there is an equal and opposite reaction. Think about what happens when you run into somebody. Your force will push that person away from you, while, at the same time, you bounce back off that person; this is Newton's 3rd law. How does the marble in your maze illustrate this 3rd law?

STEM Explanation:

Energy can come in many different forms, such as potential or kinetic. Potential energy is the stored energy an object has because of its position. If you hold the marble just at the edge of the maze, the marble has potential energy. This potential energy can be released and transformed into other forms of energy.

When you release the marble, it begins to move through the maze as you tilt the cardboard base. Releasing the marble into the maze transforms the marble's potential energy into kinetic energy. Kinetic energy is the energy of motion. Any object that has mass and is moving has kinetic energy.

Important laws of physics are demonstrated by your marble maze. Newton's Law of Conservation of Energy says that energy may be transformed from one kind to another, but energy cannot be created or destroyed. That means the marble in the maze has a total amount of energy. The energy changes between potential and kinetic, but it never disappears completely.

The maze also illustrates Newton's 3 Laws of Motion. When you drop the marble into the maze to make it begin moving, you are exerting a force on it and demonstrating the 1st law. Also according to the 1st law, the marble would continue to go in a straight line if the walls weren't there to exert a force on it. Your marble has little mass and doesn't require a lot of force to start moving it through the maze. This is Newton's 2nd law. Finally, when the marble hits the walls of your maze, it bounces off the walls. This is a demonstration of Newton's 3rd law as it shows that every action has an equal and opposite reaction.

Career Connection:

Architects plan and design buildings for various uses. They use their scientific and mathematical knowledge of physics to understand building construction combined with their artistic abilities to design visually appealing structures. Architects are scientists, mathematicians, and artists. To become an architect you need a four year degree and a professional degree from an architectural program.

Resources:

http://www.fabdiy.com/make-your-own-marble-maze/

http://www.tackyliving.com/cheap-n-easy-marble-mazes/

http://teachertech.rice.edu/Participants/louviere/Newton/law1.html

Moving Hand

Do you know how many bones are in your hand? Create a moveable model to discover the many parts of your hand. Use your model to explore how your bones, tendons, and muscles all work together to move your hand and fingers.

TEKS:

7.3B: The student is expected to use models to represent aspects of the natural world, such as human body systems and plant and animal cells.
7.12B: The student is expected to identify the main functions of the systems of the human organism, including the circulatory, respiratory, skeletal, muscular, digestive, excretory, reproductive, integumentary, nervous, and endocrine systems.

Materials:

- Beads
- Chopsticks
- Craft foam
- Double sided tape or glue
- Paper straws
- Pen
- Scissors
- Twine or yarn

How To:

1. Trace your hand on a piece of craft foam. Then cut your hand outline out of the foam.
2. The bones in your fingers are called phalanges. Feel your fingers to figure out where the phalanges are—can you feel three bones in each finger and two bones in your thumb? Cut the paper straws into small pieces to represent the bones in your fingers. Using double sided tape or glue, stick the pieces of straw (3 for your finger bones; 2 for your thumb bones) onto the fingers of your foam hand. Leave a large gap between the pieces of straw so that your foam fingers can bend later!

3. Then, cut 5 longer pieces of straw to represent the bones in your palm (called metacarpals). The metacarpals attach to the phalanges. Stick the metacarpals to your foam hand with double sided tape or glue. Don't forget to leave a large gap between each piece of straw so that your foam fingers can move!
4. Cut five pieces of twine, each about a foot long. Tie a bead to one end of each piece of twine. Thread a piece of twine through the straws of each finger (be sure to thread it through the metacarpals on your palm, too!).
5. Once your twine has been threaded through the straws, tie another bead to the opposite end of each piece of twine to prevent it from falling out of the straws. Each piece of twine should now have a bead at both ends.
6. Tape a chopstick to the palm of the foam hand so that you can hold it. Then pull gently on the twine to make your fingers move!

https://gosciencegirls.com/articulated-hand-movable-fingers-joints-tendons/

STEM Explanation:

The hand has many bones. The three bones in each finger and two bones in each thumb are called phalanges. The phalanges connect to the metacarpals which are the five bones in the palm of your hand. Altogether, you have 19 bones in each hand! Your fingers and thumbs are moved by tendons which are moved by muscles. In most other bones in your body, tendons attach muscles to bone, and then the muscles move the bone. However, your fingers are special because there are no muscles in your fingers. Instead, the muscles that control your fingers are located in your palm and forearm. The muscles move the tendons in your fingers, and it's the tendons that make your fingers move. The tendons slide through a tendon sheath, which is connected to your finger bones. Look at both sides of your actual hand as you open and close your fingers, and you will see the tendons that are moving your fingers! In this experiment, we used straws to represent the tendon sheaths and twine to represent the tendons.

Career Connection:

Orthopedic surgeons treat a number of conditions that affect the bones, joints, muscles, ligaments, tendons, and nerves. These doctors work closely with other health care providers and often serve as consultants to other physicians. Before going to medical school, future orthopedic surgeons must have a deep understanding of all sciences including chemistry, biology, and physics.

Resource:

https://gosciencegirls.com/articulated-hand-movable-fingers-joints-tendons/

Bumper Cars

If you love amusement park rides, you've probably experienced the thrill of crashing, bouncing, bone rattling bumper cars! Bumper cars are a perfect example of Newton's three laws of motion. Program and play your own bumper car game and learn the science behind the crashing fun!

TEKS:

8.6C: Force, motion, and energy. The student knows that there is a relationship between force, motion, and energy. The student is expected to investigate and describe applications of Newton's law of inertia, law of force and acceleration, and law of action-reaction, such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches.

Materials:

For building cars:

- Bumper Car Assembly Instructions (links provided below)
- Bumper Car Programming Guide (attached)
- Lego Mindstorms NXT Brick Base Set (can be found here: https://education.lego.com/en-au/lego-education-product-database/mindstorms/9797-lego-mindstorms-education-base-set)

For decorating cars:

- Blue or Scotch tape (avoid duct tape, masking tape, or glue – too sticky)
- Felt to cut out shapes/designs to attach to car
- Foam to cut out shapes/designs to attach to car
- Markers to draw on foam/felt
- Random Lego pieces (can be added on to base)
- Scissors

For building/decorating the ride arena:

- Glue/tape to attach pool noodle pieces around poster board
- Markers to decorate
- 4 pool noodle pieces cut to the same length as each side of the poster board (they will border the poster board to contain the ride and protect the car)
- 1 poster board (this will be the floor of the ride area)

How To:

How to Build the Bumper Car:

1. Use this link to create your NXT bumper car. (http://www.nxtprograms.com/castor_bot/steps.html)
2. Next, use this link to design the bumper car attachment. (http://www.nxtprograms.com/bumper_car/steps.html)
3. Decorate your car using felt, foam, and other Lego pieces. Be careful that decorations do not interfere with the functionality of the car.

How to Program the Bumper Car:

1. Refer to attached NXT Step by Step programming instructions (provided at end of write up).
2. Make sure to test your programming and troubleshoot any issues your car may have. You want your car to collide with the obstacle (pool noodle border), move backward, turn away from the obstacle, and then keep moving forward in the new direction. Note: Your bumper is designed to trigger the touch sensor when any part of the robot hits something as it moves forward, but there are certain kinds of obstacles that it might not react to. It's also possible that the bumper will get hung up and stuck when the robot tries to back up and turn. Can you improve the design of the bumper to solve any problems you encounter?

How to Create the Bumper Car Arena:

1. Use markers to decorate one side of the poster board. This is the floor of your bumper car arena and the bumper car will move on top of it. Does your amusement park have a specific theme? Feel free to get creative with your design!
2. Using tape, attach the 4 pieces of cut pool noodle to the outside of the poster board. This will create a barrier to keep the car inside the ride arena.
3. Once your car is built, programmed, and in the decorated arena, play with your bumper car.

STEM Explanation:

All three of Newton's laws of motion are in action during the bumper car game.

Newton's 1st Law of Motion – Every object in motion continues in motion and every object at rest continues to be at rest unless an outside force acts upon it. This is called inertia. When you are riding in a bumper car and end up in a collision with another bumper car, you feel a jolt. Your body's inertia causes your body to keep moving, even though your bumper car has now suddenly stopped. The security bar or safety harness provides the force that jolts your body to a stop. Newton's 1st law of motion is the reason why it is so important to wear seat belts when riding in cars!

Newton's 2nd Law of Motion – The greater the mass of an object, the greater the force needed to change the object's motion. When riding in bumper cars, you may have noticed that people who weigh less tend to get bumped around more than people who weigh more. That's because it takes a greater force to move the cars with heavier (more mass) riders than it does to move the cars with lighter (less mass) riders.

Newton's 3rd Law of Motion – For every action, there is an equal and opposite reaction.

If two bumper cars traveling at the same speed and carrying the same amount of weight run into each other, they will bounce off and move an equal distance away from each other. However, if there is a difference in the amount of weight being carried in the two cars, the car with less weight will get bumped farther away from the point of impact than the car carrying more weight.

Did you have trouble getting your bumper car to do what you wanted at first? If only one small detail is incorrectly programmed the car will not be able to do what you want. The computer only knows as much information as you tell it, so you must be very specific when programming your bumper car. If you could program your car to react a certain way after each collision, what would it do? Spin? Reverse? Turn? Make sounds? Flash lights? Now that you have successfully programmed your bumper car, try modifying your bumper car program to add your own ideas of what to do when the robot hits something.

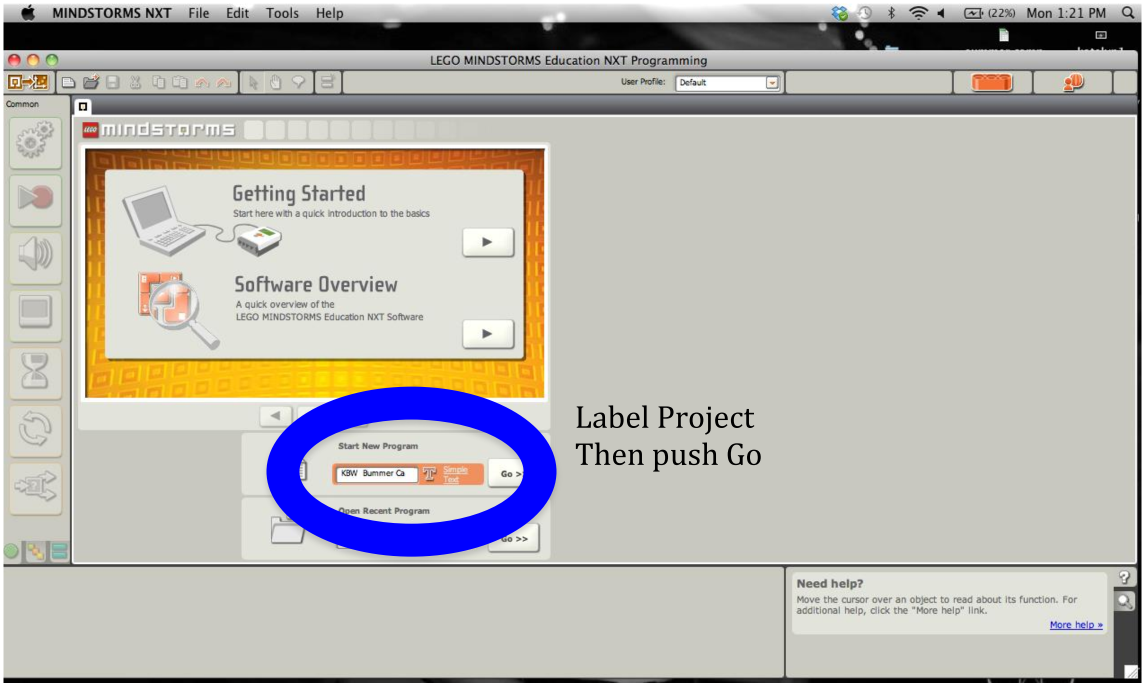
Career Connection:

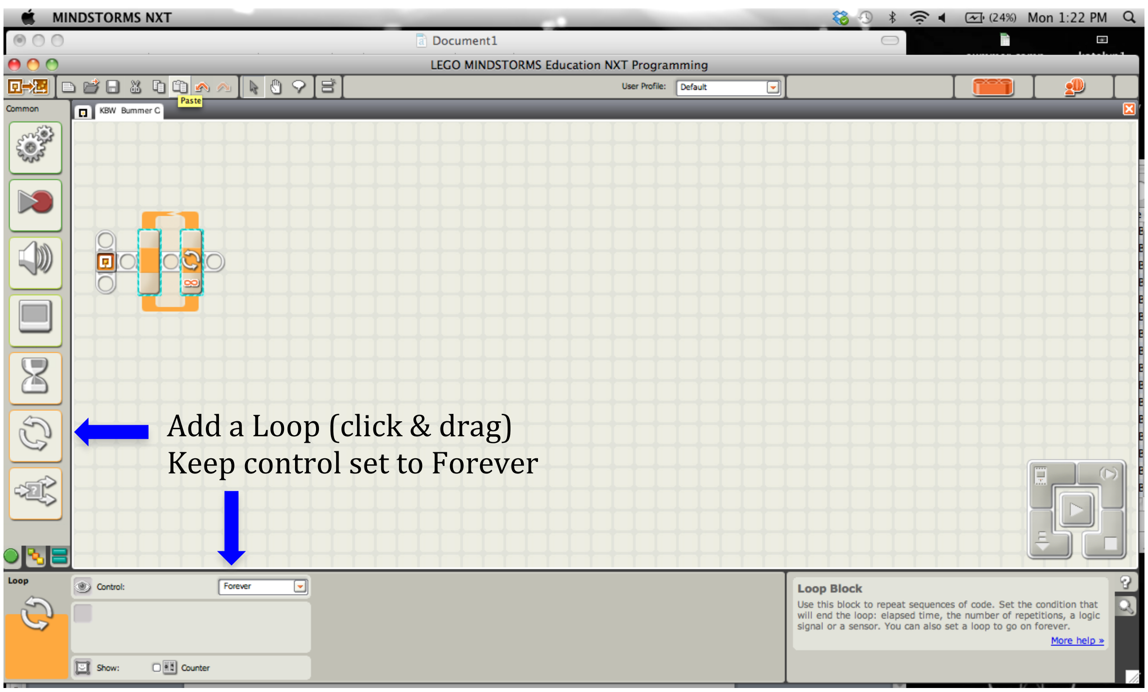
Physicists are scientists who research and apply the principles of physics. They study a wide range of naturally occurring physical phenomena, from the structure of tiny atomic particles to the movement of all objects within the universe, and observe patterns and develop theories that explain them. Physicists frequently combine their knowledge and skills with other disciplines like engineering, technology, and medicine.

Resources:

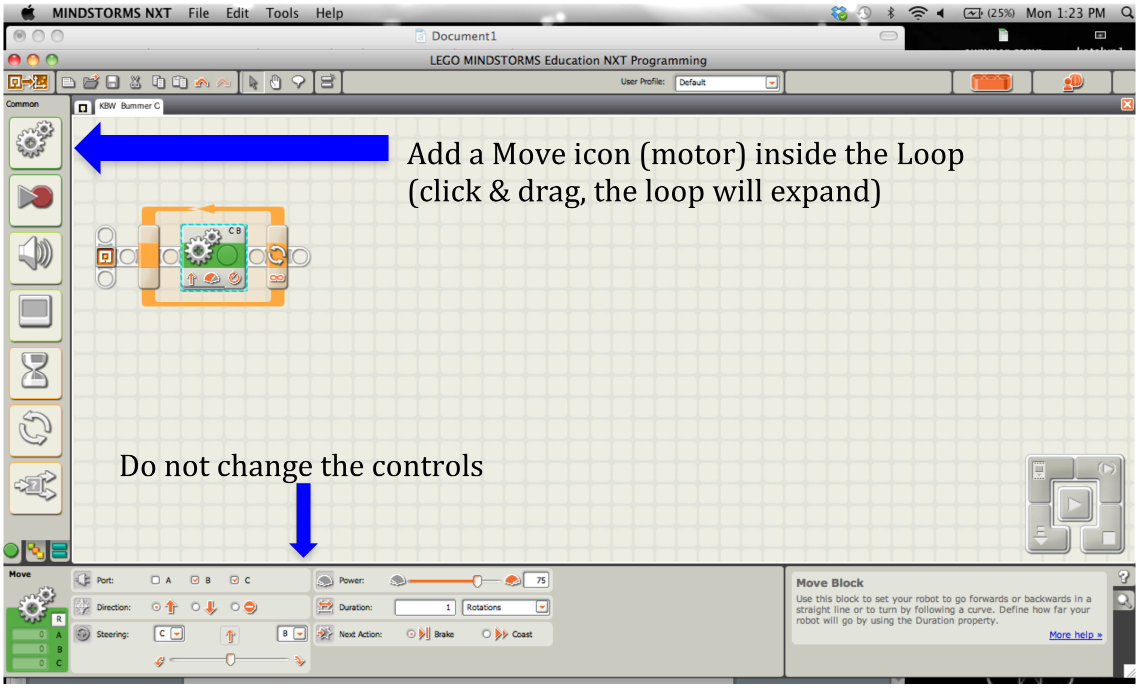
http://www.hometrainingtools.com/a/amusement-park-science
http://www.amusementproducts.com/index.html

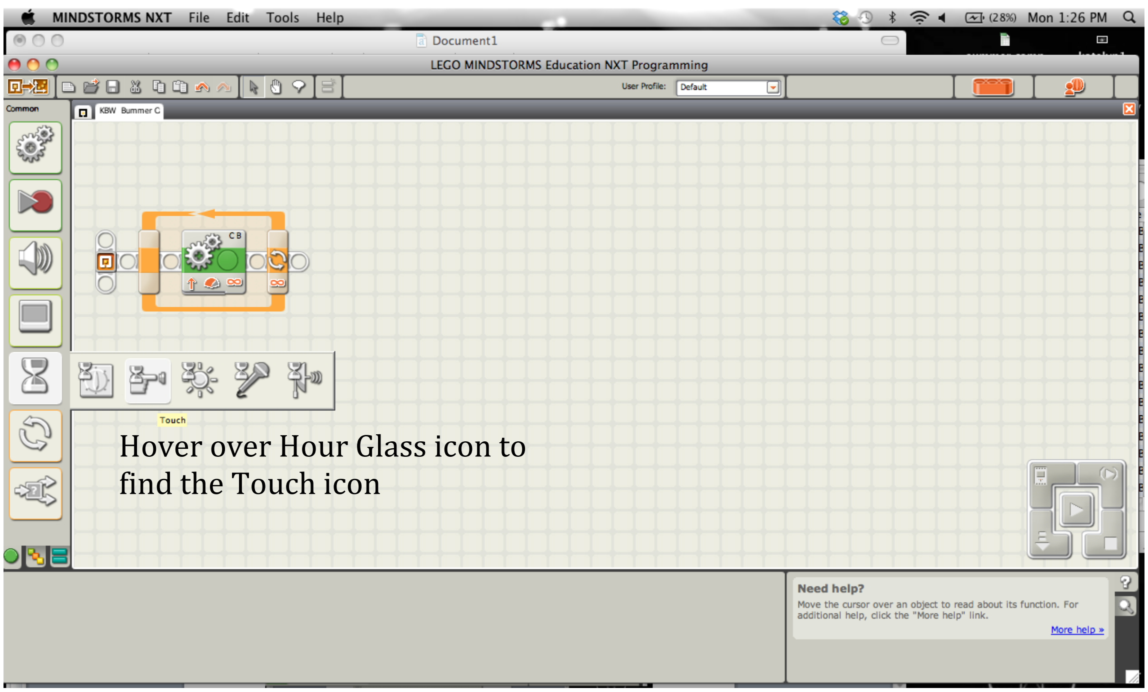
NXT Bumper Car Programming Guide

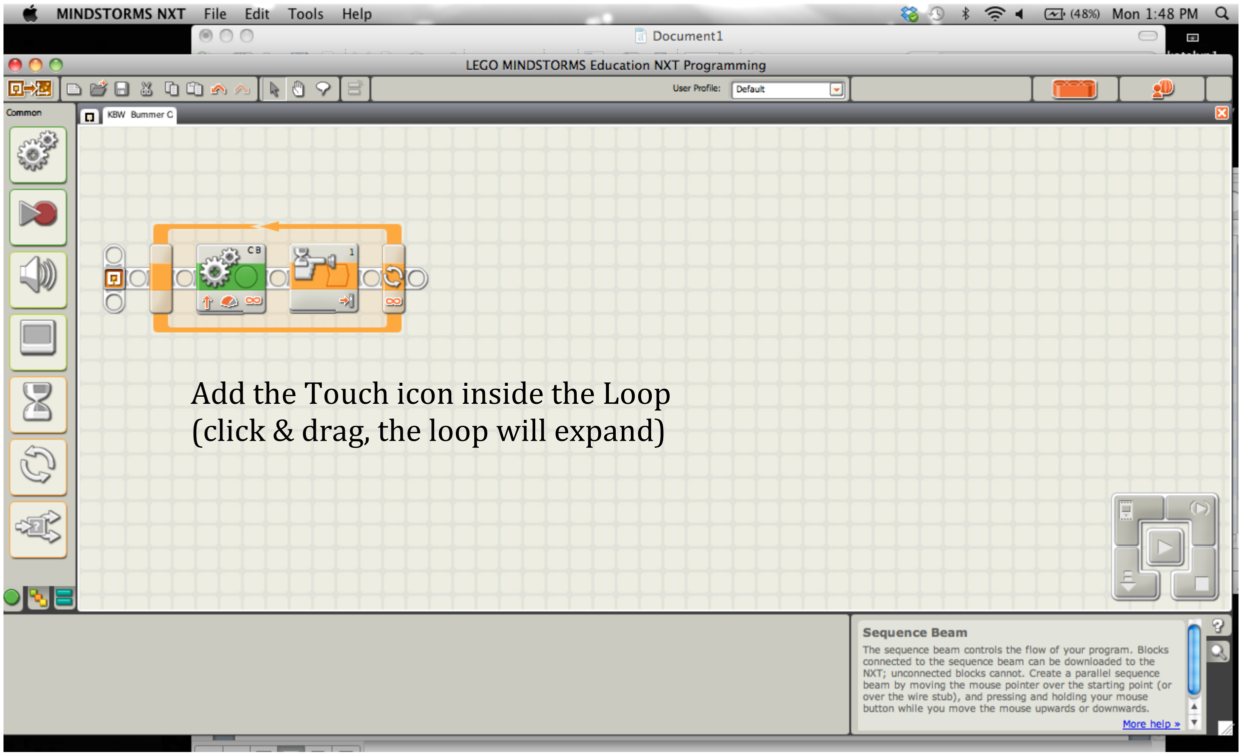


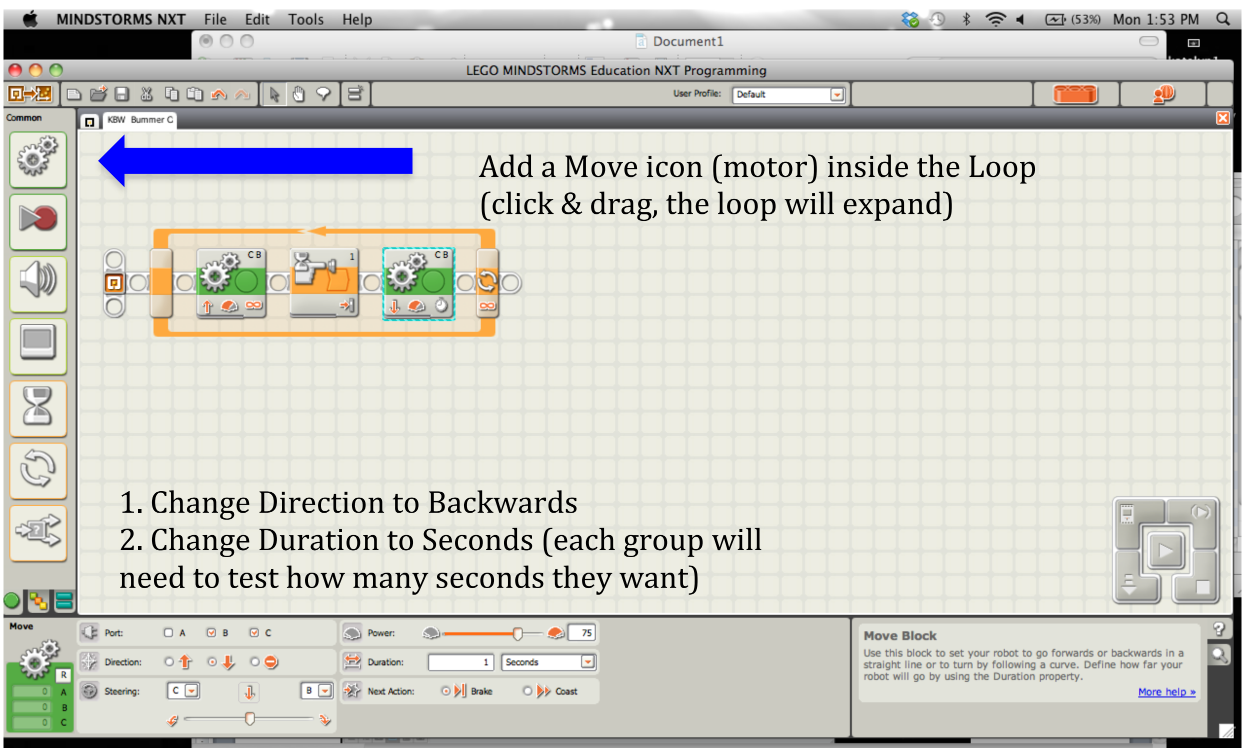


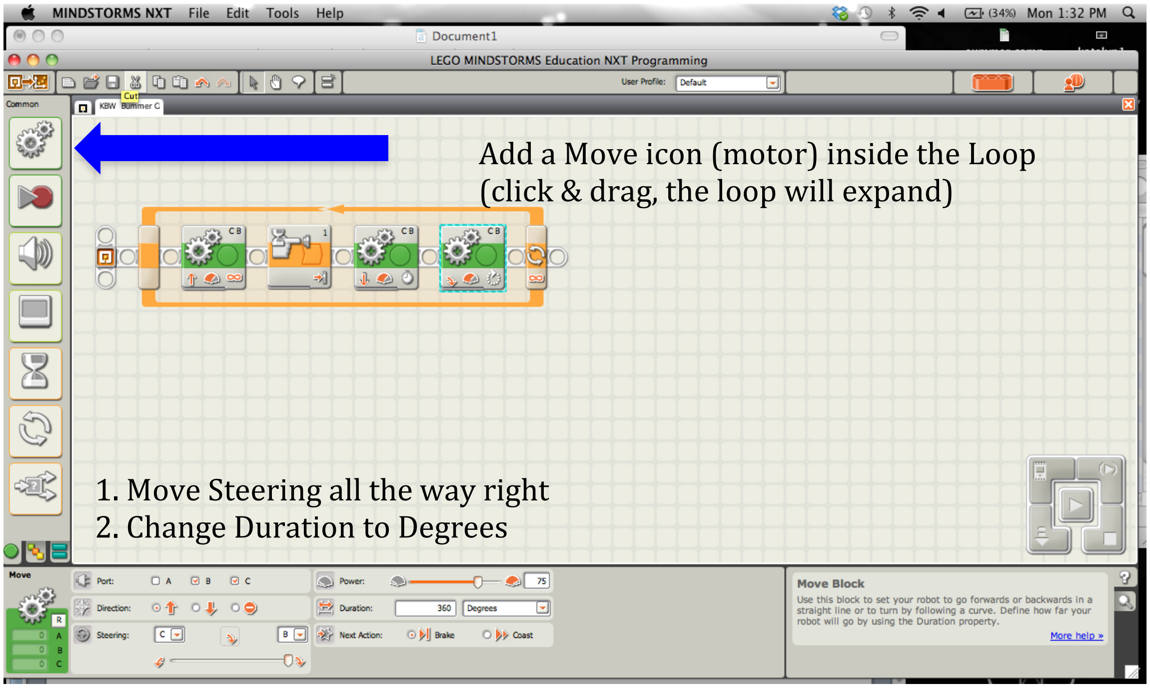
31 Days of STEM FuN!

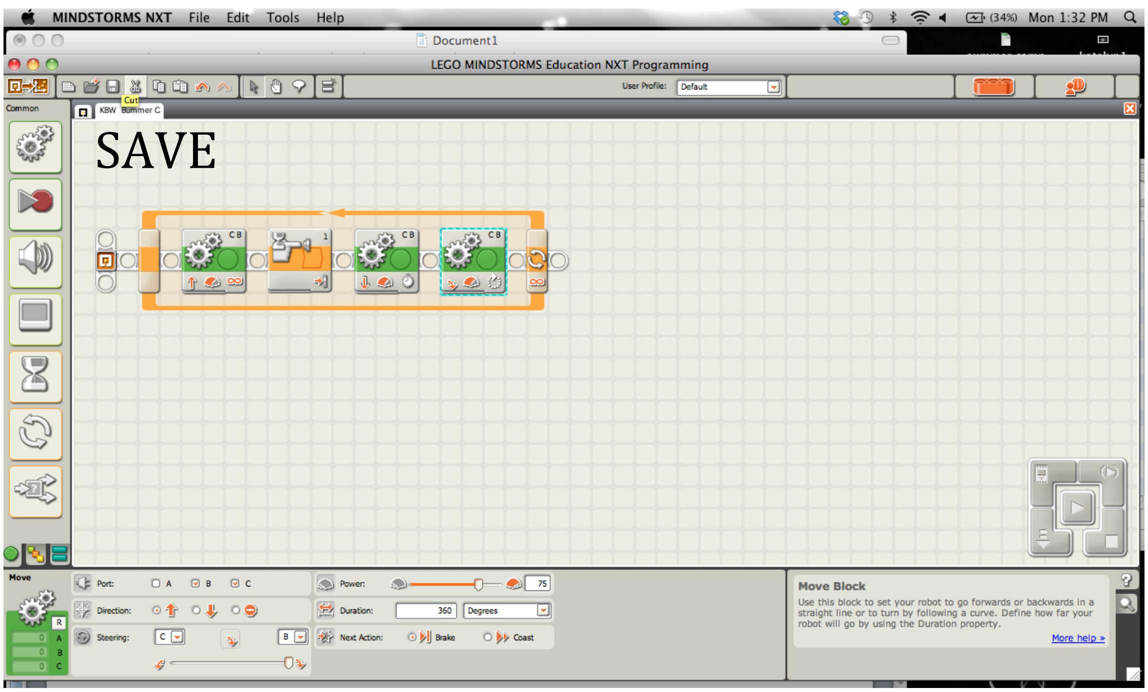

MINDSTORMS NXT File Edit Tools Help
LEGO MINDSTORMS Education NXT Programming
Add a Move icon (motor) inside the Loop
(click & drag, the loop will expand)
Do not change the controls
Move Block
Use this block to set your robot to go forwards or backwards in a straight line or to turn by following a curve. Define how far your robot will go by using the Duration property.
More help »

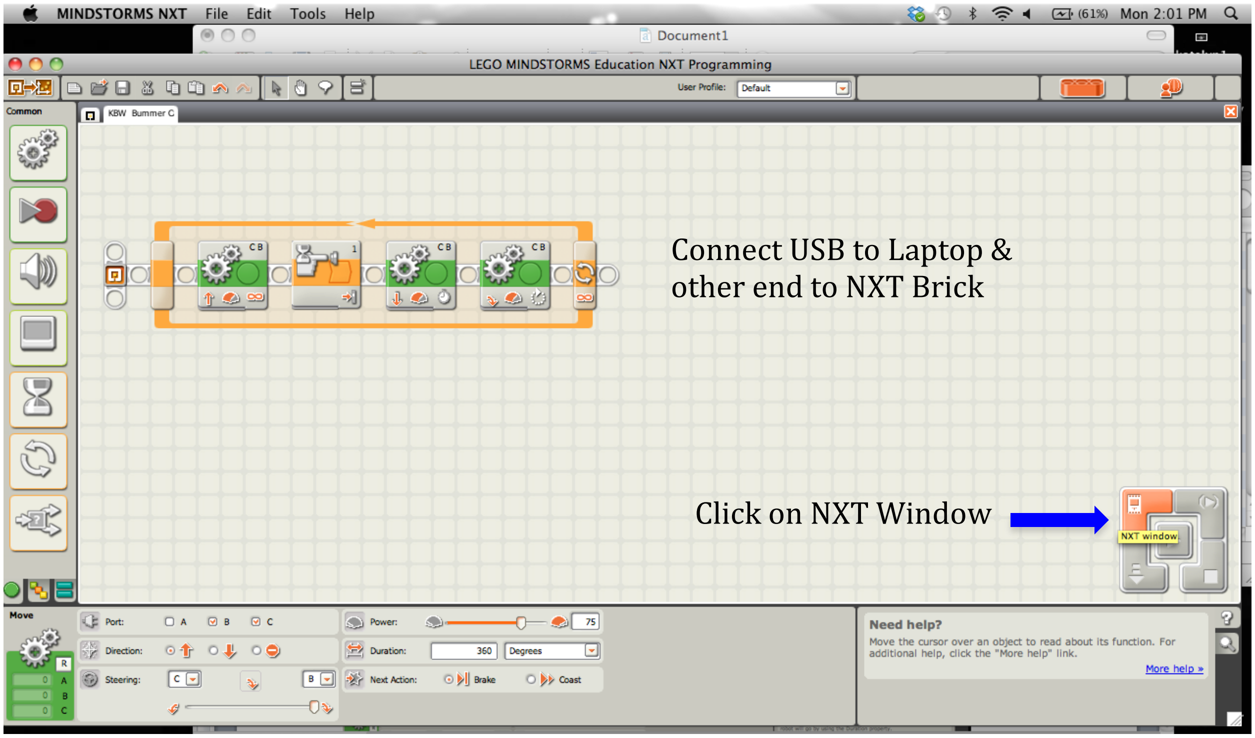

MINDSTORMS NXT File Edit Tools Help
LEGO MINDSTORMS Education NXT Programming
Touch
Hover over Hour Glass icon to
find the Touch icon
Need help?
Move the cursor over an object to read about its function. For additional help, click the "More help" link.
More help »

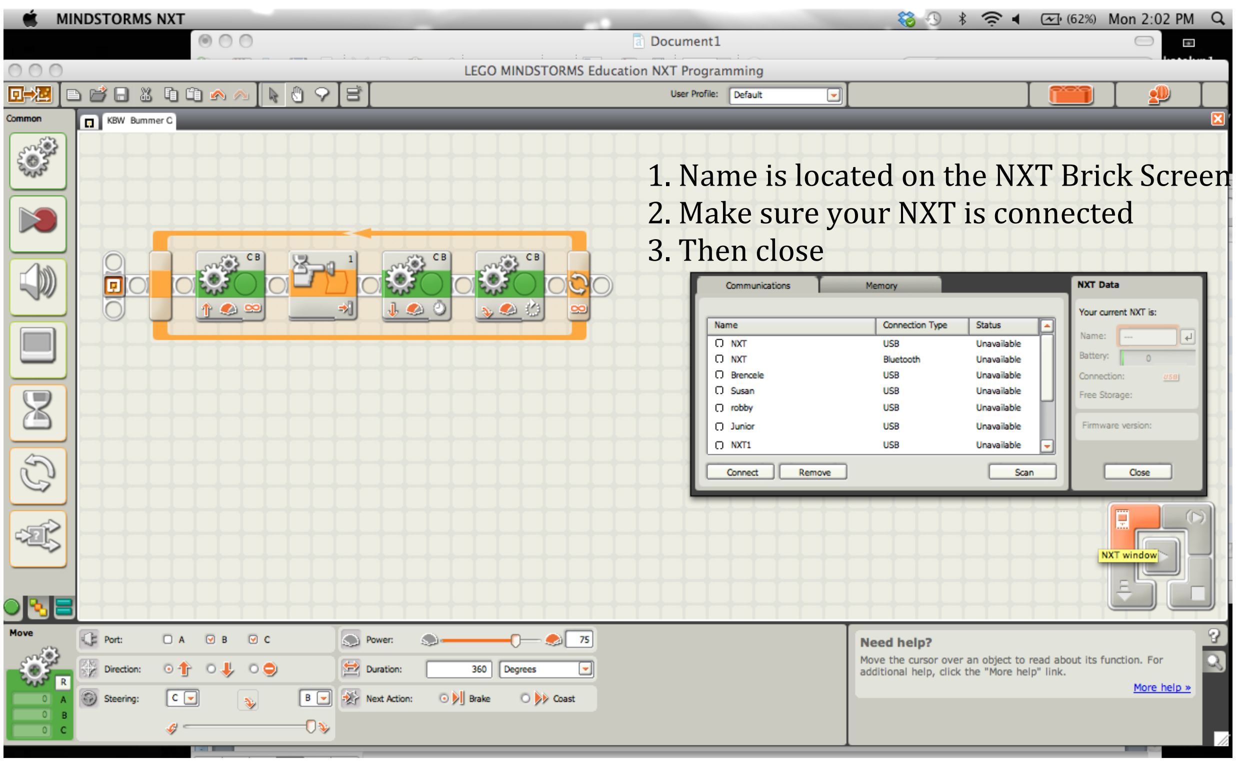

MINDSTORMS NXT File Edit Tools Help
Mon 1:48 PM
Document1
LEGO MINDSTORMS Education NXT Programming
Add the Touch icon inside the Loop
(click & drag, the loop will expand)
Sequence Beam
The sequence beam controls the flow of your program. Blocks connected to the sequence beam can be downloaded to the NXT; unconnected blocks cannot. Create a parallel sequence beam by moving the mouse pointer over the starting point (or over the wire stub), and pressing and holding your mouse button while you move the mouse upwards or downwards.
More help »

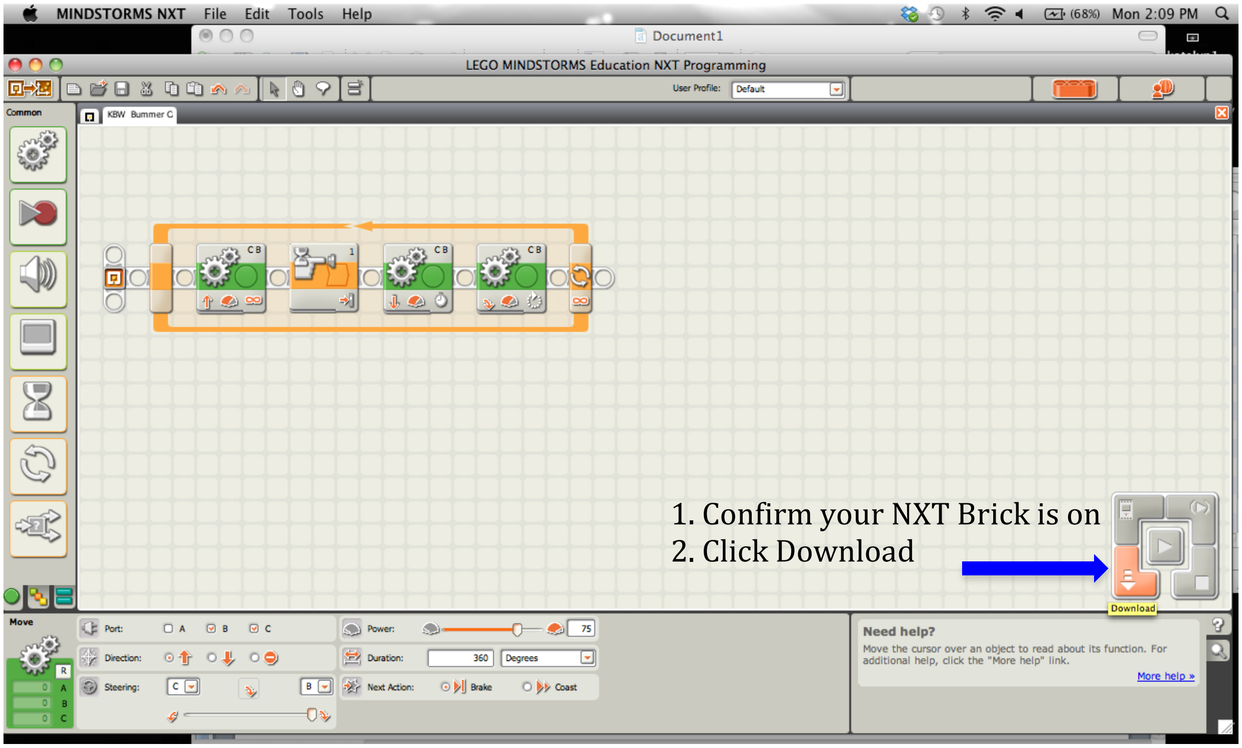

MINDSTORMS NXT File Edit Tools Help
Mon 1:53 PM
Document1
LEGO MINDSTORMS Education NXT Programming
Add a Move icon (motor) inside the Loop
(click & drag, the loop will expand)
1. Change Direction to Backwards
2. Change Duration to Seconds (each group will need to test how many seconds they want)
Port:
Direction:
Steering:
Power:
Duration:
Seconds
Next Action:
Brake
Coast
Move Block
Use this block to set your robot to go forwards or backwards in a straight line or to turn by following a curve. Define how far your robot will go by using the Duration property.
More help »


Add a Move icon (motor) inside the Loop
(click & drag, the loop will expand)
1. Move Steering all the way right
2. Change Duration to Degrees


SAVE


MINDSTORMS NXT
File
Edit
Tools
Help
Document1
LEGO MINDSTORMS Education NXT Programming
User Profile:
Default
Connect USB to Laptop &
other end to NXT Brick
Click on NXT Window
NXT window
Move
Port:
Direction:
Steering:
Power:
Duration:
Degrees
Next Action:
Brake
Coast
Need help?
Move the cursor over an object to read about its function. For additional help, click the "More help" link.
More help »


MINDSTORMS NXT
Document1
LEGO MINDSTORMS Education NXT Programming
1. Name is located on the NXT Brick Screen
2. Make sure your NXT is connected
3. Then close
Communications
Memory
NXT Data
Name
Connection Type
Status
NXT
USB
Unavailable
NXT
Bluetooth
Unavailable
Brencele
USB
Unavailable
Susan
USB
Unavailable
robby
USB
Unavailable
Junior
USB
Unavailable
NXT1
USB
Unavailable
Connect
Remove
Scan
Close
Your current NXT is:
Name:
Battery:
Connection:
Free Storage:
Firmware version:
NXT window
Need help?
Move the cursor over an object to read about its function. For additional help, click the "More help" link.
More help »



MINDSTORMS NXT File Edit Tools Help
Document1
LEGO MINDSTORMS Education NXT Programming
1. Confirm your NXT Brick is on
2. Click Download
Download
Need help?
Move the cursor over an object to read about its function. For additional help, click the "More help" link.
More help »

Vibrating Dinosaur

Harness the power of the sun to create a vibrating dinosaur! Learn how to solder, connect a circuit, and discover how solar panels absorb the sun's rays to make your dinosaur move.

TEKS:

5.7C: The student is expected to identify alternative energy resources, such as wind, solar, hydroelectric, geothermal, and biofuels.
6.7: Matter and energy. The student knows that some of Earth's energy resources are available on a nearly perpetual basis, while others can be renewed over a relatively short period of time. Some energy resources, once depleted, are essentially nonrenewable.

Materials:

- Dinosaur template (attached)
- Googly eyes
- Heat gloves
- Heat goggles
- Hot glue
- Pipe cleaners
- 2V solar cell (can be purchased here)
- Solder
- Soldering iron
- Soldering safety tips (attached)
- Tape
- Vibrating motor (can be purchased here)
- Wet sponge (to clean soldering iron)

How To:

Soldering Instructions:

1. Peel off the adhesive backing from the motor, align the wires on the motor with the leads (gold colored squares) on the sides of the solar cell, and stick the motor on to the cell. Make sure the motor is attached to the bottom of the solar cell (the non-solar panel side)!
2. Read over the attached soldering safety tips with an adult.
3. With adult supervision, turn the soldering iron on and let it heat up. To check if the iron is ready to use, touch the tip of the solder to the soldering iron and the solder should begin to melt.
4. The part that requires solder is the connection between the wires and the leads on the solar cell.
5. Once the iron is hot enough, unroll part of the solder, and hold the solder in your gloved hand. Touch the tip of the solder to the tip of the soldering iron. Once the solder becomes liquid, be sure the liquid drop stays on the iron, and then gently wipe the liquid drop onto the wires touching the leads on the solar cell. Be very careful that the liquid solder does not touch your skin, as it will cause serious burns!
6. Let the solder dry and cool before making sure the connection is secure. (Touching the solder while it's still hot can burn you!) If needed, add more solder to fully attach and connect the motor's wires to the solar cell's leads.

Decorating Instructions:

1. Color and cut out the pterodactyl template (both sides of the paper should be colored).
2. Hot glue the wings to the bottom of the solar cell (the same side the motor is on). Be sure not to glue the motor.
3. Cut a slit on the back end of the dinosaur head along the black line, slip the solar cell through the slit, and glue the head to the bottom side of the solar cell.
4. Cut 4 pieces of pipe cleaner into 2-3 inch sections to create the legs.
5. Hot glue or tape the legs to the bottoms of the solar cell, 2 on each long side of the solar cell.
6. Attach the googly eyes to each side of the dinosaur head.
7. Take your finished dinosaur outside, let the solar cell absorb the sun's energy, and watch your dinosaur move!

STEM Explanation:

Solar panels/cells absorb the sun's rays to provide energy to create electricity or heat. They can serve as the battery for electrical circuits. In this activity, the solar cell and the sun are the battery of the circuit, and the motor is the object being powered. The wires that were soldered allow the electricity to flow from the solar cell to the motor. Soldering is the process of joining two metal pieces together by melting another metal, solder. Essentially, the liquid solder acts as "glue" to attach the metal pieces to one another. Solder is used because it is a metal, and metals are good conductors. Conductors allow electricity to flow from the battery to the object. By soldering two metal pieces together, connections between electrical parts become permanent.

Career Connection:

Solar energy engineers plan, design, and create solar energy projects. They suggest ways to use more passive solar design techniques to lower costs and energy use, minimize maintenance, reduce greenhouse gas emissions, and provide comfortable indoor environments for people.

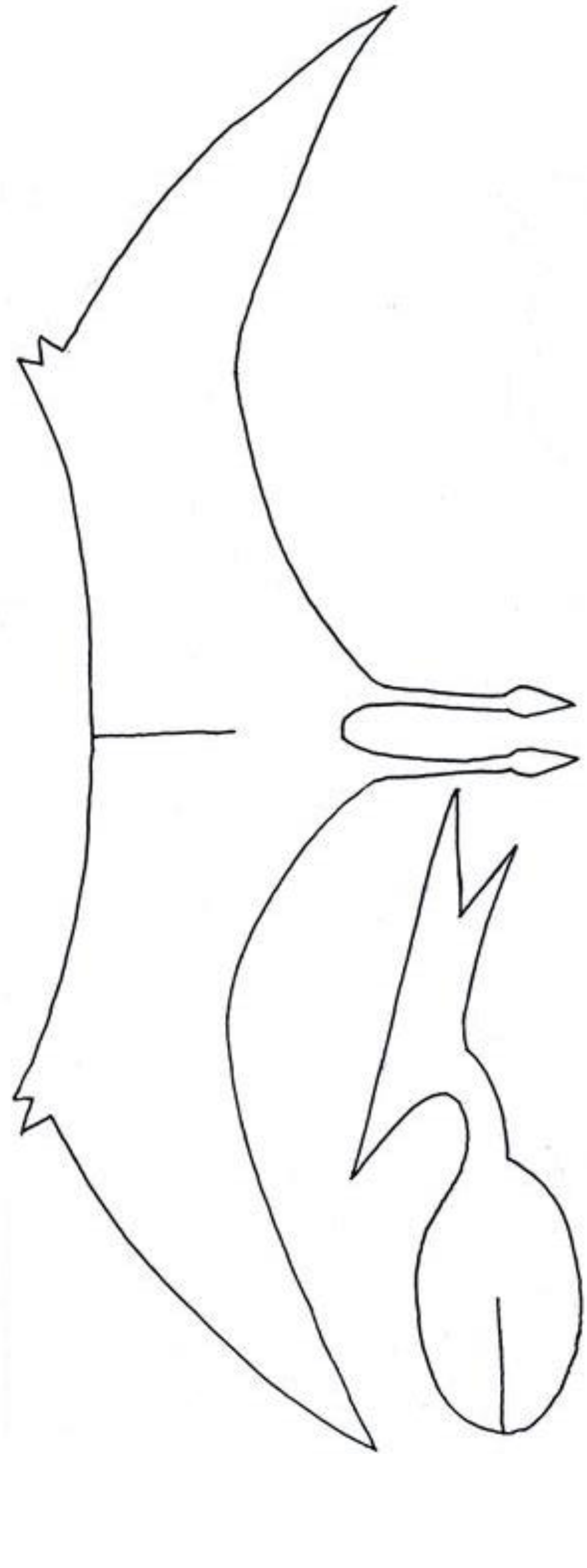
Resources:

https://s-media-cache-ak0.pinimg.com/736x/8e/40/b5/8e40b507407b0f1722513a3bb4d5da06.jpg
http://www.browndoggadgets.com/products/2v-50ma-solar-cell

Soldering Safety Tips:

- Wear safety goggles and gloves when working with or near solder. Hot metal or water can splash while soldering.
- ‘Tin’ the solder tip by coating it with a thin layer of solder. This helps the heat transfer between the tip and the components.
- Wipe off excess solder on a wet sponge. Make sure to keep the cleaning sponge wet during use.
- Be careful when you wipe the iron on the sponge so hot water does not splash, but do not touch the iron to the sponge for too long.
- Avoid breathing in the smoke by keeping your head to the side of your work, not right above it.
- Apply solder directly to the metal/copper wires (not to the soldering iron) – hold the iron to one side of the components you are trying to join and feed the solder from the other side.
- Hold the flat edge of the iron’s tip to the joint, not just the point of the iron.
- Don’t put a blob of solder on to the iron and try to transfer it to your joint – it causes the flux to burn away which helps the solder to stick.
- DO NOT TOUCH THE IRON – it’s around 700°F!
- Don’t grab your joint while it’s hot. It can take about a minute to cool down.
- Avoid holding the metal part of a component with your fingers. Metal is a conductor so the heat will transfer from the solder.
- Hold wires in place with tweezers, clamps, or play-doh.
- Always return the soldering iron to its stand when not in use. Do not just set it down on the work surface.
- Turn off unit and unplug when not in use.
- Wash your hands after using solder because the solder contains lead.
- Used solder sponges must be disposed of as hazardous waste.

Dinosaur Template



Robot Prototype

Robots build cars, clean houses, help soldiers and doctors, are played with by kids, and explore other planets. Use your creativity and some common craft materials to design your own robot prototype. What will your robot do to help the world?

TEKS:

3.2A: The student is expected to plan and implement descriptive investigations, including asking and answering questions, making inferences, and selecting and using equipment or technology needed to solve a specific problem in the natural world.
6.2B: The student is expected to design and implement experimental investigations by making observations, asking well-defined questions, formulating testable hypotheses, and using appropriate equipment and technology.

Materials:

- 1 3 oz. Dixie cup
- Foam shapes
- Glue or tape
- 2 googly eyes
- 2 index cards
- Jewels
- 4 Life Savers candies
- Piece of cardstock
- 3 pipe cleaners
- 2 pom poms
- 1 rubber band
- 2 small paperclips
- 2 straws
- 4 toothpicks

How To:

1. Before you design your robot prototype, brainstorm what function or purpose you would like the robot to have. Your robot should have a specific task that will help make the world a better place. It can be anything you want!
2. Sketch a design of your robot prototype. Think about the materials you would use and why. Can your robot move around easily? Is it durable enough to accomplish its purpose? What types of conditions does it need to withstand?
3. Using some or all of the materials above, build your robot prototype!

STEM Explanation:

A robot is a machine that senses the world, processes the sensors' information with a computer, and then does something in response to that information. Robots are used to perform many different jobs that help people. Building cars, cleaning houses, helping soldiers and doctors, entertaining kids, and exploring other planets are just some of the jobs robots do today. Robots may not look like the ones we see in the movies, but they are still doing important jobs. Before a robot can be built and sent out to do an important job, it must first be researched and designed. A **prototype** is the first version of any machine, including robots. After the prototype has been made, it is tested and then improved again and again until the final product has been perfected! The robot you are creating is a prototype because it is the very first time it will be made.

Career Connection:

Robotic engineers design robots, maintain them, and develop new applications for them. They use their in-depth knowledge of computer programming and technology to create high functioning robots to aid humans in many activities. There are robots we send into space, and even robots we use in our homes. Have you ever seen a vacuum that moves around the room without help? That's a robot, and it was designed by robotic engineers!

Resource:

Courtesy of Shelby Schaefer

Color Mixing

Have you ever been to a show and seen colored lighting? Make your own colored gel lighting overlays to explore what happens when you add or subtract a particular color gel. Determine the best colors to make your very own light show!

TEKS:

5.4A: Classify matter based on physical properties, including mass, magnetism, physical state (solid, liquid, and gas), relative density (sinking and floating), solubility in water, and the ability to conduct or insulate thermal energy or electric energy.
5.6A: Explore the uses of energy, including mechanical, light, thermal, electrical, and sound energy.
5.6C: Demonstrate that light travels in a straight line until it strikes an object or travels through one medium to another, and demonstrate that light can be reflected, such as the use of mirrors or other shiny surfaces, and refracted, such as the appearance of an object when observed through water.

Materials:

- At least 2 moveable light sources (3 if possible; clip on lights or lights with a goose neck work best)
- Food coloring (red, green, and blue)
- Small pot (and stove for heating up the pot)
- Smooth, flat plastic surface with a lip*
- Spoon for mixing
- Tablespoon for measuring
- Unflavored gelatin (or Knox gelatin envelopes)
- Water

* Note: The plastic surface is for pouring the liquid gel onto to make the gel molds. Some options for this are:

- A plastic lid such as a coffee can lid; however, it should be completely flat in the middle (non-imprinted).
- A petri dish

How To:

1. Add 3 tablespoons of water to the small pot.
2. While gently stirring the water, sprinkle in 1 tablespoon of unflavored gelatin (or one packet of Knox gelatin envelopes).
3. With adult supervision, place the pot on the stove and turn the heat on low. Stir *very gently* until the gelatin is melted. **Stirring too vigorously will form bubbles that will cloud your lighting gel.**
4. Once all the gelatin has melted, turn off the heat and add your desired food coloring. Be generous with the food coloring. More is better as you want a good solid color! (Note: If using *gel* food coloring, make sure it melts completely — you may need to turn the heat back on low to melt it.)
5. Tilt the pan to one side and use a spoon to skim off any foam or bubbles that have formed.
6. Before pouring the liquid gel into the plastic mold, allow it to cool slightly. You do not want it to melt the plastic!
7. Once the gel has cooled but is still liquid (hasn't begun to thicken), pour a small amount onto your plastic mold.
8. Working quickly, tilt your mold gently in all directions to spread out your liquid gelatin into a thin, even surface. Be careful not to burn yourself — the gelatin will be hot!
9. Repeat the above steps for each different colored gelatin sheet that you wish to make (red, blue, and green).
10. Before handling the gelatin sheets, you will need to let them dry overnight. If you put the sheets under (or next to) a fan turned on low, the sheets will dry faster, and you may be able to handle them in a few hours. However, the thicker the layer of gelatin that you pour, the longer it will take to dry. **Don't rush the process by putting them in a fridge or freezer, as this will make the sheets overly brittle.**
11. Clean your supplies.
12. Once dry, peel your gelatin sheets away from the plastic. Using scissors, cut them into a shape/size that can serve as a filter for your light sources.
13. Now you are ready to experiment with color mixing! Start with two colored gels and two light sources. Cover each light source with one of the colored gels. You can tape them on the lights, but be careful that the light doesn't become too hot as it will melt your gel. Once the lights are covered, turn them on and shine them both at the center of a piece of white paper or at the same spot on a white wall. You want the colored lights to overlap on the white surface. (Note: You will need to turn off all other light sources in the room to see the colors produced by your gel-covered lights.) What color is produced? Experiment with using different colored gels as filters. Record your observations in the chart below.

Colored Gel Combinations *Each gel covers a *separate* light source	**Color Light Produced**
Red + Green	
Red + Blue	
Green + Blue	
Red + Green + Blue	

14. Now try experimenting with stacking the colored gels over one single light source! Tape a red gel and a green gel over one light. Shine the light at a piece of white paper. What color do you see? Try the combinations in the chart below and record your observations.

Colored Gel Combinations *Gels *stacked* over *1* light source	Color Light Produced
Red + Green	
Red + Blue	
Green + Blue	
Red + Green + Blue	

STEM Explanation:

Red, green, and blue are the primary colors of light. Combining the three primary colors of light in different proportions can produce any color. In this lesson, when you combined the red and blue filtered light, you produced magenta light. When you combined the blue and green light, you produced cyan. When you combined the red and green light, yellow light should have been produced. Finally, when you combined red, blue, and green light, white light was produced. This is known as additive color mixing. Did you know that computers and TVs only use pixels that emit red, green, and blue light? Our electronics use additive color mixing to produce all of the colors we see on our screens. The white areas of our screens are the places where red, green, and blue light is being emitted at the same time.

Mixing colored lights is different from mixing pigments to make paint. Everything we see that isn't a source of light is actually reflected light! For example, when we look at yellow paint, the pigment is absorbing blue light and reflecting green and red light to make yellow reflected light. So when we see something that is yellow, we are actually seeing green and red reflected light. The more pigments you mix, the more light is absorbed (or subtracted), and the darker the colors that are produced. Mixing pigment colors is known as subtractive color mixing. The three primary colors of pigment are magenta, cyan, and yellow. If you mix the three primary colors of pigment, all light is absorbed and the resulting color is black. You demonstrated this when you stacked your colored gels on top of one another, and no light was allowed to pass through. If you shine a light through a red filter, the red filter allows the red wavelengths of light to pass through, but absorbs all the other colored wavelengths of light. So if you stack a red filter and a green filter together, the red filter will block all light except the red light. The red light will pass through, but then it will be absorbed by the green filter (which would only allow green light through), so no light passes through.

Career Connection:

When you go to a play, a *Lighting Designer* creates different moods by using different colored lights. Red light might make you feel anxious or scared, while blue light can create sadness or a feeling of peacefulness. When creating a lighting design, the lightning designer has to consider not just the story line, but also things like safety, visibility, and cost. In addition to theater, lighting designers can work in areas as diverse as rock and pop tours, corporate launches, art installations, and massive spectacular celebrations like the opening and closing ceremonies for the Olympics. Lighting Designers need to have a strong background not only in art, but also science and math.

Resources:

Courtesy of Topher Stumreiter
Making clear Gelatin sheets: http://www.howtocakethat.com/edible-gelatin-plastic.html
CMYK vs RGB Diagram: http://imulus.com/our-thoughts/additive-color-vs-subtractive-color/

SCIENCE ★ TECHNOLOGY ★ ENGINEERING ★ MATH

PRESENTED BY: girlstart

Dream Big

Wrap up the last day of DeSTEMber and launch into the New Year by thinking about your goals. When you set goals, it is important to think big about the goals you want to achieve and how you are going to achieve them. Decorate a bookmark with your goals. Write a letter to your future self as a reminder to dream big and stay motivated to reach your goals.

Materials:

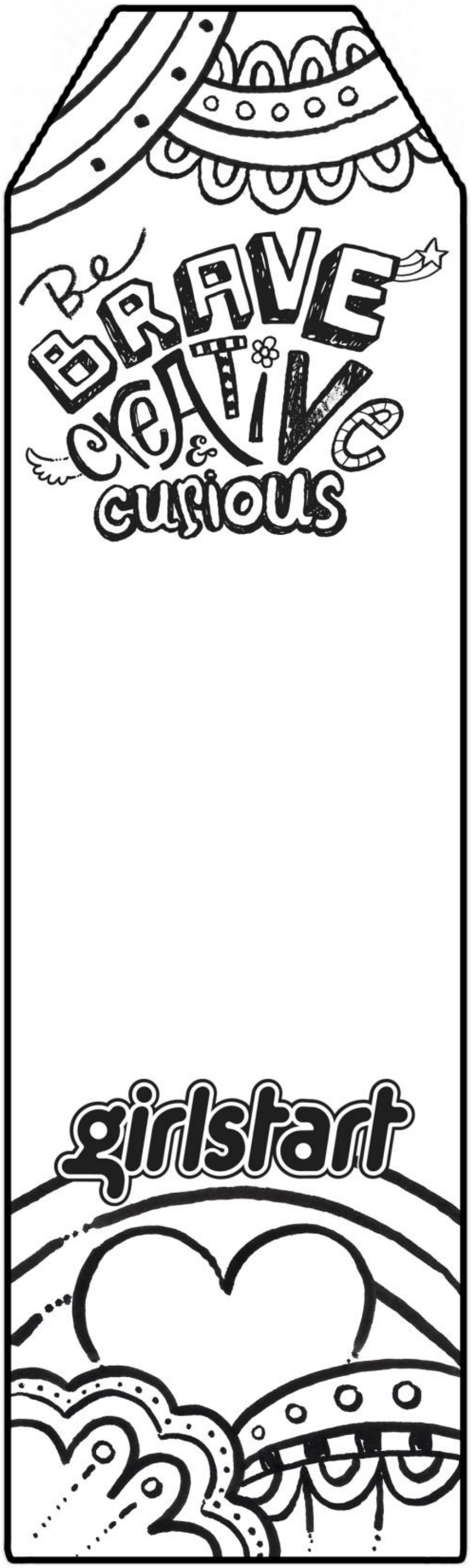
- Girlstart bookmark (attached)
- Hole puncher
- Markers, colored pencils, or crayons
- Paper
- Pencil
- Ribbon
- Scissors

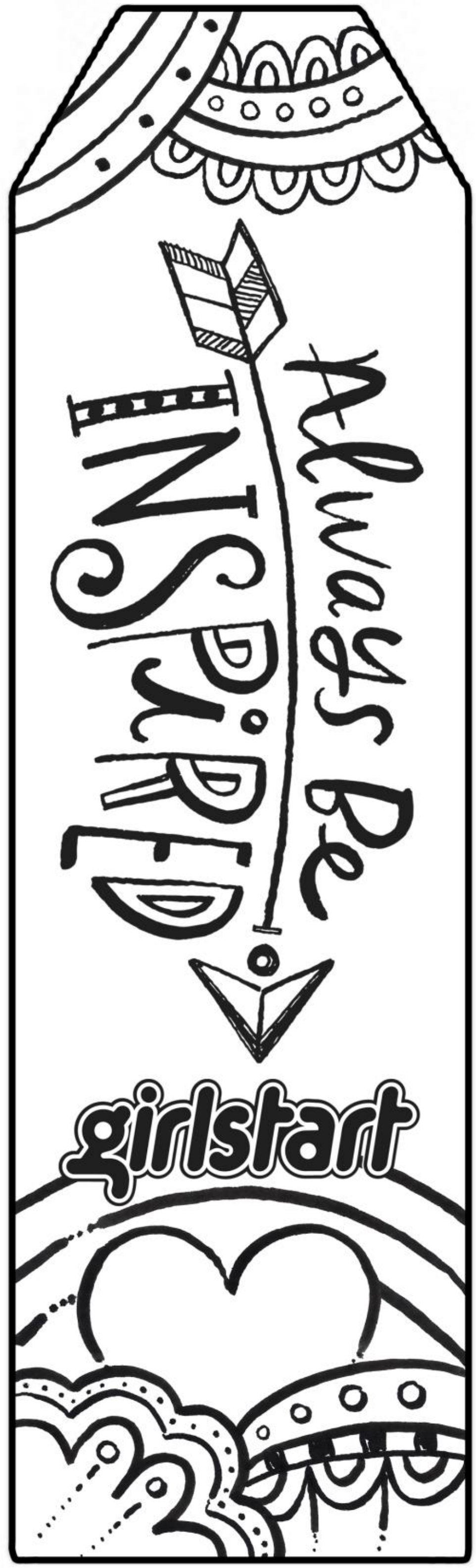
How To:

1. Think about the type of career you would like to have when you grow up. What do you need to do to get there? Do you need good grades? Do you need to go to college? Attend graduate school? Have an internship? Write a letter to your future self that outlines your goals and how you will achieve them.
2. Choose a bookmark design below and print. Printing on cardstock makes for a sturdier bookmark.
3. Cut out your bookmark. On either the front or the back of your bookmark, write down your goals or draw them in pictures. Color and decorate your bookmark.
4. If you would like, punch a hole in the top of your bookmark and tie a ribbon or bow through it.
5. Put your bookmark somewhere you will see it, or use it in the book you are reading right now! It will remind you of your goals and help keep you motivated to achieve them.

STEM Explanation:

Did you know that you are more likely to accomplish your goals if you write them down? It's true! Writing down your goals can help you plan what you need to do to reach them and also keep you motivated to achieve them. Remember, if you dream big and work hard to make the right choices, you will have the power to accomplish all your goals!





31 Days of STEM FUN!