ANF STEAM Curriculum Instructor's Guide

DECEMBER 11

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This curriculum is part of the "Enhancing Angels-Net Foundation's STEAM Program and Visibility" project. This project is an Interactive Qualifying Project submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the Degree of Bachelor of Science.

To view the full project:
https://wp.wpi.edu/southafrica/projects/2020-projects/anf/

Introduction

This document was created for the volunteers and teachers of the ANF afterschool STEAM program. It was created with 22 different lessons in the subtopics of STEAM. The companion document to this curriculum, the "ANF STEAM Curriculum PowerPoint," is a PowerPoint to show to the students during each lesson. This curriculum was created during the COVID-19 pandemic and as a result of this, most of the activities can be conducted virtually.

This curriculum is separated into 6 different chapters of physics, mathematics, biology, chemistry, societal science, and technology. Each activity will include an "Outline," "PowerPoint," and "Additional Materials" section. The "Outline" section for each activity will include an "Adapted From," "Lesson Objective," "Materials," "Ease of preparation," "Online Capability," and "Activity Steps" subsection. The "PowerPoint" section includes an image of each PowerPoint slide along with a guide which includes a "Script," "Questions," and "Expectations" subsection. The "Additional Materials" section includes links to different items such as worksheets, videos, or online activities.

Each lesson is constructed to take around an hour to complete. The lessons do not need to be completed in the order in which they are presented. The lesson should be conducted by first going through the PowerPoint material and then the activity as outlined in the "Activity Steps" section. The majority of this information will not be new topics for the students but is important material to review to help ensure the students have a complete understanding of the subject matter. It is suggested to review the entire lesson before conducting it with the students. The scripts and steps for each activity are illustrative so it is encouraged to make this guide your own to have fun with the students!

Table of Contents

1.0 Physics

1.1 Lego Car Build

Outline:

Adapted From: CTPC ANF Team

Lesson Objectives:

- Following instructions
- Organizations
- Planning ahead

Materials:

- Lego car kit

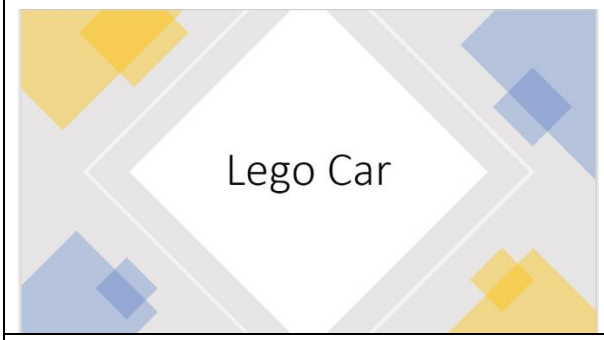
Ease of Preparation: Easy

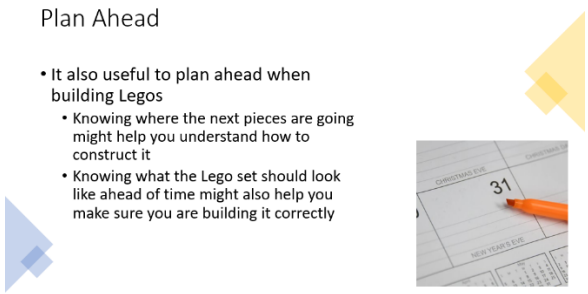
Online Capability: Yes

Activity Steps:

1. Students to open the LEGO car kit and set the instructions aside.
2. Students attempt to build the car without the instructions for a few minutes.
3. Students attempt to build the LEGO car with the instructions.

PowerPoint:

Slide 1:  	- *Script:* Hello everyone! For today's activity we will be building a LEGO car!
Slide 2:  	- *Questions:* Before we begin building today, I was wondering, who here has ever built a LEGO set before? What was your favorite thing you ever built using LEGOs? - *Expectations:* Expect the students to say they have used LEGOs before since ANF has used them in their afterschool activities for a while. When a student answers yes, ask them what their favorite thing was they have ever built. This should get the students excited to build more LEGOs, since they will remember all the fun they had last time they used them.
Slide 3:  	- *Script:* Three main steps to help build LEGOs include following instructions, organization, and planning. LEGO sets can become frustrating or difficult to complete, but these steps will help make it easier. These three steps are key when building or testing something in the scientific world too. - *Questions:* Can you think of a time in your life when it was important to follow instructions? - *Expectations*: The student might be shy at first to answer this question. If no one volunteers give an example from your life and then maybe the students will be more open to sharing.

Slide 4:  	- *Script:* It is important to follow detailed instructions in the scientific world so that you can repeat the same procedure as before. If the instructions are not followed than the result will be different. In this case the car will not be built correctly so it might fall apart or not work properly. In the scientific world, you may be working with dangerous chemicals or equipment and if instructions are not followed, then you could be putting yourself and others in danger.
Slide 5:  	- *Script:* It is important to stay organized when building LEGOs. Keeping the pieces organized will help you find the correct pieces and using a large flat surface will help ensure you do no lose pieces. Keep the pieces separate from other LEGOs so you do not end up mixing different LEGO kits.
Slide 6:  	- *Script:* It can also be beneficial to plan ahead when building LEGOs. Knowing where the next set of pieces go or what they are used for may help you understand how to construct the set. In addition, knowing what the final product of the LEGO set should look like can help ensure that you are on the right track and have not made any big mistakes.

Slide 7:	
	- Go over the activity steps with the students. - *Questions:* After 5 minutes of building the car without instructions ask the students: How difficult was it to build the LEGO car without instructions? After 15 minutes of building with instructions ask the students: Was it easier to build the LEGO car with instructions? Why? - *Expectations:* Expect the students to say that it was difficult to build the LEGO cars without the instructions. Once they can use the instructions expect the students to say it was easier to build it properly using them. Also, the students might not finish the car in the time slot provided. Tell them to finish the car outside of the class before the next activity.

Additional Materials:

In order to help the students build the LEGO set over Zoom or even in a class, you may want to show them a bigger version of the instructions, so it is easier to read for both the instructor and student. This is the link to the LEGO Car Set Instructions:

https://www.lego.com/cdn/product-assets/product.bi.core.pdf/6267103.pdf

1.2 LEGO Car Ramp

Do this activity after completing 1.1. The LEGO car from that lesson is required for this lesson.

Outline:

Adapted From: N/A

Lesson Objective:

Kinematics:

- Velocity
- Acceleration
- Law of Conservation of Energy
    - Potential Energy vs. Kinetic Energy
- Bonus: Friction

Materials:

- Stopwatch
- Ramp
- Pencil and paper
- Lego car
- Bonus: T-shirt

Ease of Preparation: Easy

Online Capability: Yes

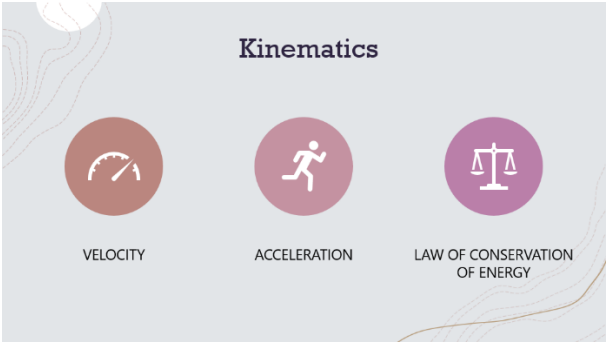
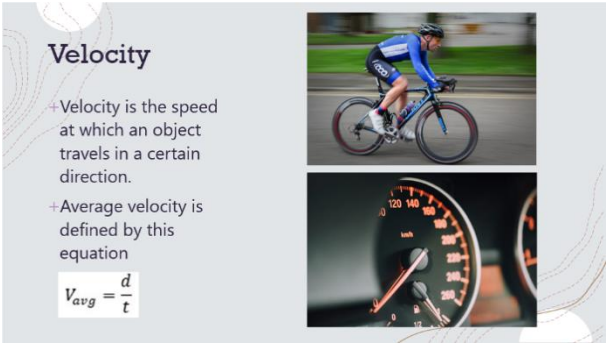
Activity Steps:

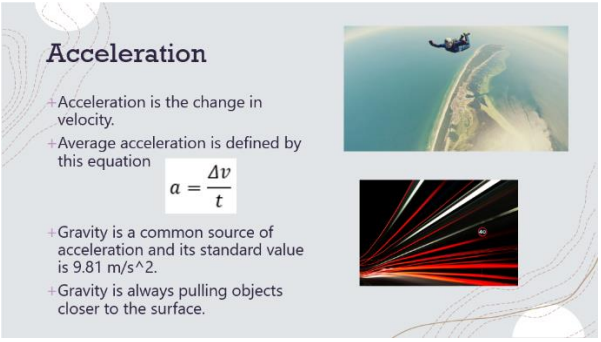
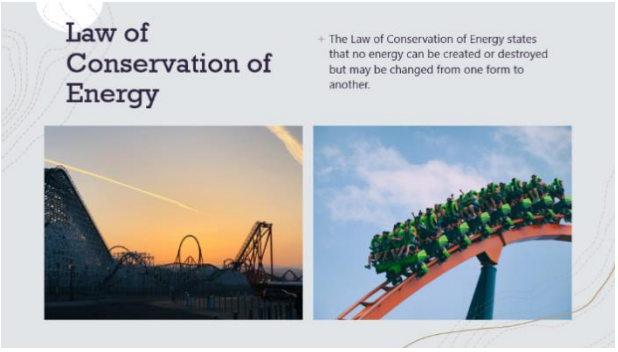
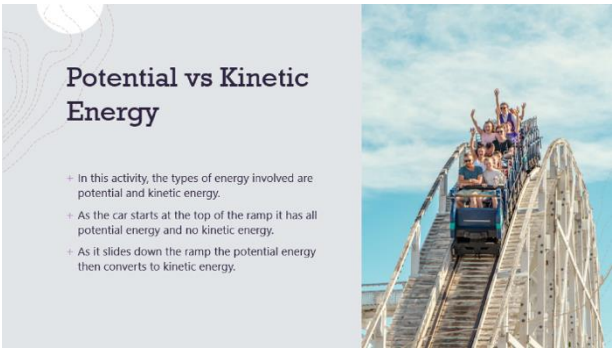
1. Students lean ramp up on a higher surface.
2. With a pencil, students mark a position on the ramp in which they will release the car from.

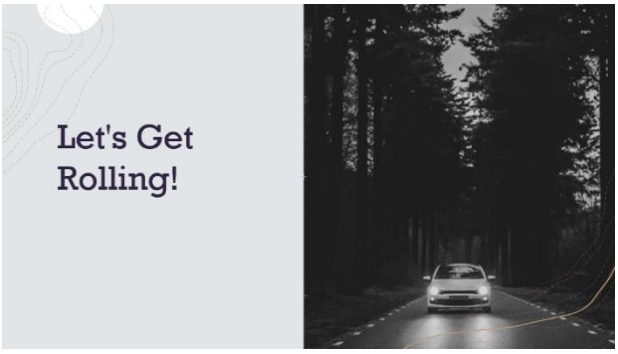
3. Students measure the distance that the car will travel along the ramp with the ruler. This distance should be from the from the pencil marking to the ground.
4. Students place the front of the car at the pencil marking and with a stopwatch measure the time it takes for the car to travel down the ramp. (Start the stopwatch when they release the car and stop the stopwatch when the car reaches the bottom of the ramp.) Students record their measurements in the corresponding worksheet table.
5. Students repeat step 4 three times and calculate the average velocity of the car as it travels down the ramp.
6. Students lean their ramp on a higher surface and repeat steps 4-5.
7. Students lean their ramp on a lower surface and repeat steps 4-5.
8. Bonus: At a lower height, students add a t-shirt or different material on the ramp. Students repeat step 4.

PowerPoint:

Slide 1:	
	- *Script:* Today we will be working on an activity that explores the LEGO car previously built and its velocity as it rolls down a ramp.

Slide 2:  	- *Script:* Today's lesson will be centered around Kinematics. The three topics covered in kinematics for today will be velocity, acceleration, and law of conservation of energy. - *Questions:* Ask the students if they know anything about each of the three topics. For example, "Have you heard of velocity before? If so, can you explain to me what velocity is?." - *Expectations:* You should expect some students to have heard of It and they might be able to tell you what velocity is. However, if no students answer or do not know what velocity is, then that is okay. Continue going onto the next slide and talk about velocity.
Slide 3:  	- *Script:* Velocity is very similar to speed. As you might know, speed is how fast something travels. In a car, this is often recorded in miles per hour. Velocity and speed have the same number; however, velocity also includes the direction the object is moving. One way to calculate the numerical value for velocity and speed is to take the distance something travels and divide it by the time it takes the object to get there. - *Question:* In your own way, how would you define velocity and speed? Can you give an example on how they are different? - *Expectations:* The students should be able to understand the difference after you go over the slide. However, if they are still having trouble give them another example such as comparing the speed and velocity of an airplane flying from here to Africa.

Slide 4:  	- *Script:* Acceleration is the change in velocity. Average acceleration is the change in velocity over a certain period and is defined by the equation in the slide. - *Question:* Without looking at the slide, can anyone tell me something that causes an object to accelerate? - *Expectations:* Some students may know that gravity is a form of acceleration, but if not, that is okay. Explain that gravity is a common source of acceleration and its standard value is 9.81m/s^2. Gravity is always pulling objects closer to Earth.
Slide 5:  	- *Script:* The Law of Conservation of Energy states that no energy can be created or destroyed but may be changed from one form to another.
Slide 6:  	- *Script:* The two types of energy in this activity are potential and kinetic energy. Potential energy is the energy ready to be transferred into kinetic energy. Kinetic energy is the energy of motion. This concept can be pictured with a simple roller coaster. At the top of the coaster where the car is barely moving over the hump, there is a lot of potential energy and little kinetic energy. As the car is speeding down the coaster, the potential energy is being transferred into kinetic energy because it is moving faster.

Slide 7:  	- Go over the activity steps with the students. - *Questions:* At the end of the activity ask: "As you changed the height of the top of the ramp, did the average velocity increase or decrease? What force do you think caused this change in velocity? " - *Expectations:* Expect the students to answer as the height increased so did the velocity; and as the height decrease, so did the velocity. They might not remember that acceleration causes this change, so just explain that to them if they don't remember.
Slide 8:  	- If time allows, have students work on the bonus activity and explore the concept of friction. - *Question*: Who knows what friction is? - *Expectations*: The students may not understand the concept of friction for which you will have to cover the material in the next slide.

Slide 9:	
	- Depending on the time, you can choose to talk about this slide. However, we suggest that is better to just focus on the previous slides because you do not want to overload the students with new information. - *Script:* Friction is the resistance of motion from one object moving relative to another. Have the students rub their hands together and then have them move their hands freely through the air. Explain that friction is what makes it harder to move their hands when they rub them together rather than just moving freely through the air. - Go over the bonus step with them. - *Question:* Did the velocity change when you added the t-shirt on the ramp? Why? - *Expectation:* The students should be able to understand that friction from the other material slowed down the car.

Additional Materials:

Here is the link to the worksheet, https://www.angelsnetfoundation.org/kids-corner

1.3 Buoyancy Tests

Outline:

Adapted From: CTPC ANF Team

Lesson Objective:

- Buoyancy
- Mass & weight
- Density
- How different concentrations of salt affect the density of water

Materials:

- 4 glasses
- Water
- Salt
- 3 eggs
- 3 plastic cups
- 1/2 cup of Salt
- 2-3 handfuls of different-sized rocks

Ease of Preparation: Medium

Online Capability: Yes

Activity Steps:

1. Students label the four glasses 1-4 then fill each with water and salt accordingly
    a. Glass 1: Stir in 6 tablespoons of salt
    b. Glass 2: No salt
    c. Glasses 3 and 4:
        i. Fill halfway with water, then stir in 3 tablespoons of salt.

ii. Then gently fill up the rest of the glass with regular water.

2. For the first activity, students:
   a. Place 3 plastic cups facing upwards in each of the glasses (Glasses 1-3)
   b. Place one rock into each cup.
   c. Continue placing rocks into each cup until they sink or float.
   d. Write, on the worksheet, the number of rocks in each cup and whether they sank.
3. For the second activity, students:
   a. Remove the rocks, reuse Glass 1 and 2 from the first activity and grab Glass 4.
   b. Gently place an egg into each glass.
   c. Write, on the worksheet, to what level each of the eggs sank.

PowerPoint:

Slide 1:  BUOYANCY TESTS	- *Script:* This activity will explore the concept of buoyancy.
Slide 2:  INTRO QUESTION Have you heard of the Salt Sea?	- *Questions:* Have you heard of the Salt Sea? - *Expectation:* Students may or may not have heard of the Salt Sea (otherwise known as the Dead Sea). If they don't know tell them the water in the Salt Sea is saltier than any other body of water on Earth. Because of this there is no fish in the sea and everything in it floats. The large amount salt in the Salt Sea causes the water to be denser than a normal sea would be. The students may ask what density means. If they do, tell them it's a surprise and they will learn soon.

Slide 3:

WHAT IS BUOYANCY?

- The ability or tendency to float in water, air or another fluid.
- But why do some objects float while others sink?

- *Script:* Buoyancy is the ability or tendency to float in water, air, or another fluid. In the Salt Sea many objects float in water because they are buoyant enough.
- *Question:* Why do some objects float while others sink?
- *Expectations:* Students are not expected to know the answer to this question which is why the material is covered in the following slides.

Slide 4:

MASS & WEIGHT

Mass
- Mass is a measure of the quantity of matter contained in an object.
- It is a property of matter and does not change.

Weight
- *Everyday definition:* a measure of how heavy a person or object is
- *Scientific definition:* the force exerted on an object due to the acceleration of gravity

$$W = mg$$

Weight of object = mass of object x acceleration of gravity

Mass vs Weight
- The same mass can have a different weight depending on the acceleration.
  - For example, a person has the same mass on the Earth and on Mars, yet weighs only about one-third as much on Mars.

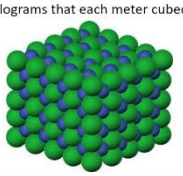
Source: ThoughtCo.com

- *Script:* Mass is a measure of the quantity of matter contained in an object. It is a property of matter and does not change. The everyday definition of weight is the measure of how heavy a person or object is. The scientific definition of weight is the force exerted on an object due to the acceleration of gravity. The same mass can have a different weight depending on acceleration. For example, a person has the same mass on the Earth and on Mars but weighs only about one-third on Mars as they do on Earth.
- *Expectations*: The students may not fully understand the scientific definition of the word weight. Therefore, the everyday definition is also included.

Slide 5:

DENSITY

- **Density** is how tightly packed the mass is in an object
  - It is the number of kilograms that each meter cubed of the material weighs.



- *Script:* Density is how tightly packed the mass is in an object. For example, it is the number of kilograms that each meter cubed of material weighs. As you can see on the slide, the object's molecules are densely packed. This means the object will have a high density.

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Slide 6:

	Density	Weight
Definition	A measure of the amount of matter available in a unit volume.	The amount of matter in an object.
Unit	Kilogram/cubic meter	Newton
Effect of Gravity	No relation to gravity	Directly affected by gravity

DENSITY VS WEIGHT

- The ***key difference*** between density and weight is that weight is a measure of the amount of *matter* in an object, whereas density measures the amount of matter in a unit *volume*.

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- *Script:* The key difference between density and weight is that weight is a measure of the amount of matter in an object, whereas density measures the amount of matter in a unit volume. Other differences can be seen on the left.

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Slide 7:


ACTIVITY 1 – PLASTIC CUP

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- Go over the activity steps for the first activity.

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Slide 8:


ACTIVITY 2 - EGGS

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- Go over the activity steps for the second activity.
- *Questions:* Did you find the object to float or sink in the water with more salt? Why do you think this is?
- *Expectations:* The students may need help and guidance with the activity and for answering the worksheet questions. Expect the students to say that the objects floated in the water with more salt. They should answer that this is because the water is denser than the object, but if they don't figure it out explain it to them.

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Additional Materials:

Example Worksheet: https://www.ccmr.cornell.edu/wp-content/uploads/sites/2/2015/11/Buoyancy-Activity-Sheets.pdf

1.4 Paper Airplanes

Outline:

Adapted From: CTPC ANF Team

Lesson Objectives:

Four main components of aerodynamics:

- Drag
- Gravity
- Thrust
- Lift

Materials:

- 4 sheets of paper
- Pencil and/or Crayons

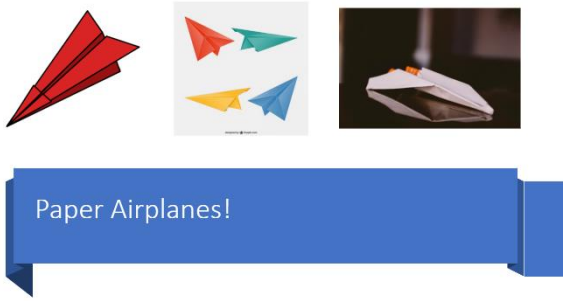
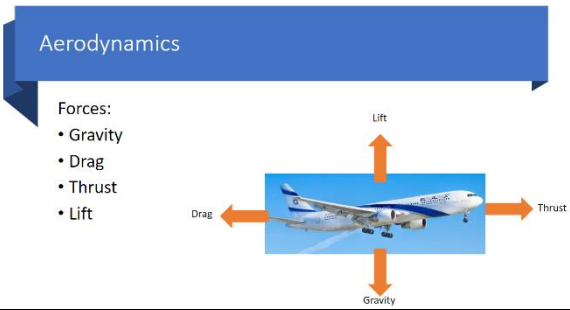
Ease of Preparation: Easy

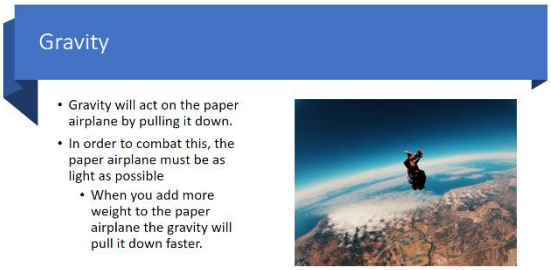
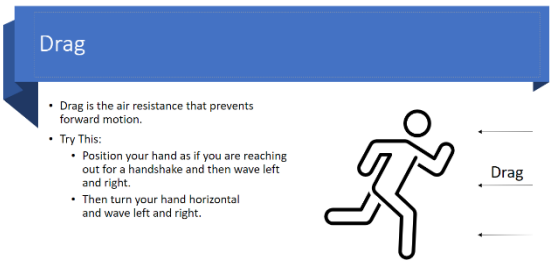
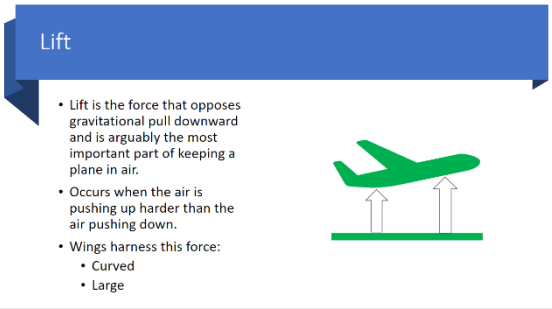
Online Capability: Yes

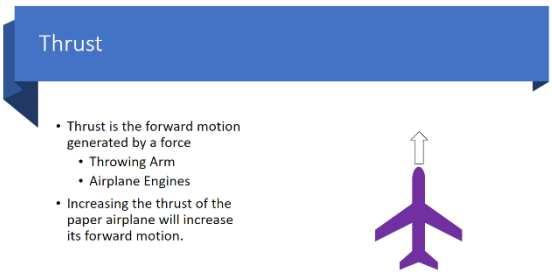
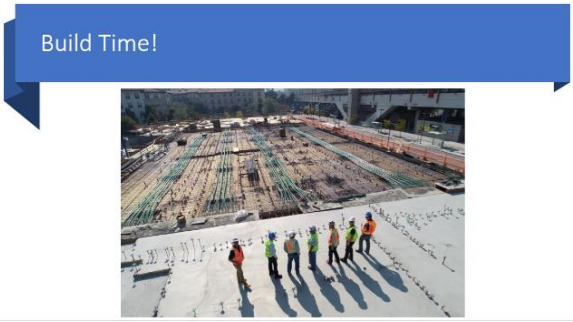
Activity Steps:

1. With the four pieces of paper, students make four <u>different</u> types of paper airplanes.
2. Students draw and make fun designs on the planes. For their best plane, students draw their country's flag on it.
3. Students test out the four paper airplanes.
4. Students modify their planes based off the design of the one that went the furthest.
5. Students test the planes out again.

PowerPoint:

Slide 1:  	- *Script:* This activity will explore the concept aerodynamics and what it takes it fly!
Slide 2:  	- *Questions:* Have you ever built a paper airplane? What do you think makes airplanes fly? - *Expectations:* These questions will help you figure out if you need to explain to the students how to make a paper airplane during the activity. Most of the students should know how to make a paper airplane. If they don't, it is suggested to go through the process of making a paper airplane all together as a class later. The second question is one the student probably won't know in detail, but that okay because it is covered in the lesson.
Slide 3:  	- *Script:* The four forces that affect aerodynamics are gravity, drag, thrust, and lift. When building a plane these 4 forces must be accounted for.

Slide 4:  	- *Script:* Gravity will act on the paper airplane by pulling it down. In order to combat this, the airplane must be as light as possible. When you add more weight to the paper airplane the gravity will pull it down faster.
Slide 5:  	- *Script:* Drag is the air resistance that prevents forward motion. Try this exercise with the students. Position your hand as if you are reaching out for a handshake and then wave left and right. When you do this, you should feel a significant amount of air resistance against your hand. Next, turn your hand horizontal and wave left and right. When you do this, you should feel much less air resistance against your hand. - *Question:* Why do you feel more air resistance when your hand is turned vertically? - *Expectations:* You should expect some students to know this, but there might not be a student that answers so explain the reasoning to the class. Explain, this is because there is much less surface area in the direction of motion and therefore less drag that encounters your hand.
Slide 6:  	- *Script:* Lift is the force that opposes gravitational pull downward and is arguably the most important part of keeping a plane in air. This occurs when the air is pushing up harder than the air pushing down. Wings are designed to be curved so that air can move down the wing more easily than moving up the wing. Therefore, more force is required for the air to move up. In addition, the wings are very large, so they experience the maximum amount of air resistance.

Slide 7:  	- *Script*: Thrust is the forward motion generated by a force. A real plane generates this force with its airplane engines. This force is generated for a paper airplane by the arm of the person throwing it. Throwing the plane harder will increase its forward motion.
Slide 8:  	- Go through the activity steps with the students.

Additional Materials:

Here is the link to the worksheet, https://www.angelsnetfoundation.org/kids-corner

1.5 Recyclable Race

Do this activity after lesson 5.3. The recyclable car from that activity will be used in this one.

Outline:

Adapted From: WPI Engineering Ambassadors

Lesson Objective:

- Newton's laws of motion
  - Newton's 1st law of motion
  - Newton's 2nd law of motion
  - Newton's 3rd law of motion
- Friction

Materials:

- Recyclable Cars
- Tape
- Ruler/Measuring Tape

Ease of Preparation: Easy

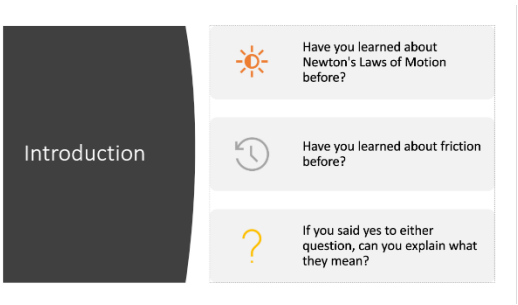
Online Capability: Yes

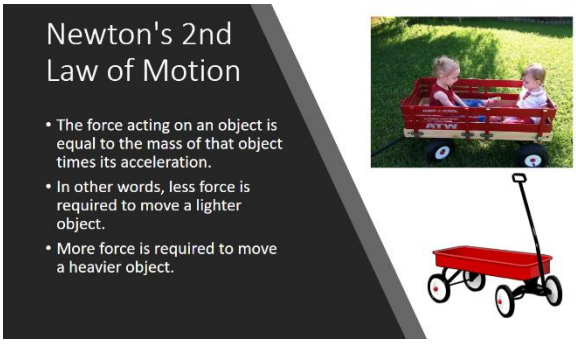
Activity Steps:

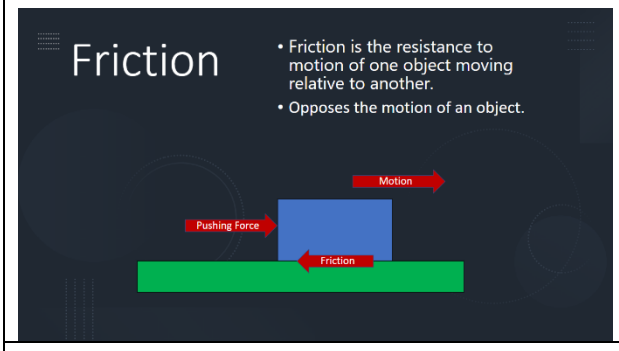
1. Students place a piece of tape on the floor, table or other large flat surface to represent a marker for the starting line.
2. Students blow air into the balloon attached to their car

3. Without letting air leave the balloon, students place the racecar on next to the marker.
4. Let the car go and see how far it goes!
5. Students measure the distance between the starting marker and the front of the car wherever it stops with a ruler or measuring tape.
6. Students repeat steps 5-6 three more times.
7. Whoever gets the farthest distance out of their three trials, wins.
8. Every student shows their car for the whole class to see and compare.

PowerPoint:

Slide 1:  	- *Script:* For this activity will create recyclable cars to race!
Slide 2:  	- *Questions:* Have you learned about Newton's Laws of Motion before? Have you learned about friction before? If you said yes to either question, can you explain what they mean? - *Expectations:* Try and get at least a few students to answer. However, if they don't respond, then just explain that you will be going over that information throughout this lesson. You should expect most students to not understand these concepts, which is why you will be explaining these concepts to them. It is okay if they do not fully understand the concepts as they are a bit advanced for their age. However, it is good to get them familiar with the concepts before they go to high school.

Slide 3:  	- *Script*: Newton's 1st law can be described by this statement: A body at rest will remain at rest, and a body in motion will remain in motion unless acted upon by an external force. A real-life example is that a car will remain at rest until acted upon by the force of an engine. A car will remain in motion until acted upon by the force of the brakes and eventually friction. - *Questions:* How does this law relate to the recyclable racecar and balloon? - *Expectations:* After reading through the slide, some students might know the answer to the question, but if not, then go over the answer with them so that they know how this relates to real-life. The answer to this question is that the recyclable car will remain at rest until acted upon by the balloon force and will remain in motion until eventually stopped by friction force.
Slide 4:  	- *Script:* Newton's 2nd law is that the force acting on an object is equal to the mass of that object times its acceleration. In other words, less force is required to move a lighter object. More force is required to move a heavier object. - *Question:* For which of the two-pictures would the wagon be harder to pull? - *Expectation:* They should say the top one because there are two students in the wagon, whereas the bottom wagon has nothing in it.

Slide 5:  	- *Script*: "Newton's 3rd law is that for every action, there is an equal and opposite reaction. When you swim you apply a force in the direction behind as you are paddling. The water provides an equal and opposite force that pushes you forward. "Then have them look at the pictures of the swimmers on the right so they can once again, understand this concept in real-life. - *Question*: What part of the recyclable cars relates to this? - *Expectations*: You can expect some students to understand this question after going over the example with swimming. However, if nobody answers then explain that balloon force deals with this concept. As the balloon force pushes behind the car, the air pushes back on the car to push it forward.
Slide 6:  	- *Script*: Friction is the resistance to motion of one object moving relative to another. Friction also opposes the motion of an object. Because of friction, more surface on the wheels of a car will cause more friction, since the wheels will encounter the flat surface.
Slide 7:  	- *Script:* Go through the activity steps of the activity with the students. - *Questions:* Did the lighter or heavier cars travel further in the race? If so, why? Name one way you could improve your recyclable racecar. - *Expectations:* Expect the students to understand these questions and now the answers. However, they might be shy to answer so start off by answering the questions yourself.

2.0 Math

2.1 Fractions with LEGOs

Outline:

Adapted From:

http://www.bambinis.net/learn-through-play/teach-kids-fractions-lego/

Lesson Objective:

Fraction equations involving:

- Addition
- Subtraction
- Multiplication
- Division

Materials:

- 2 x 4 LEGO blocks
- 2 x 2 LEGO blocks
- 2 x 1 LEGO blocks
- 1 x 1 LEGO blocks

Ease of Preparation: Medium

Online Capability: Yes

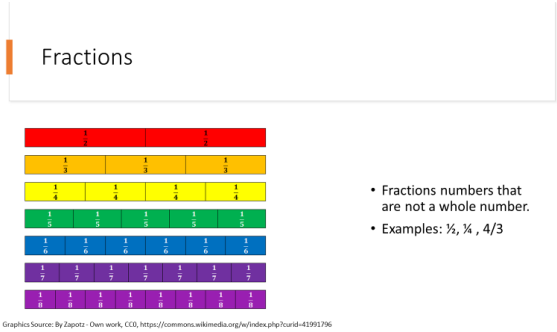
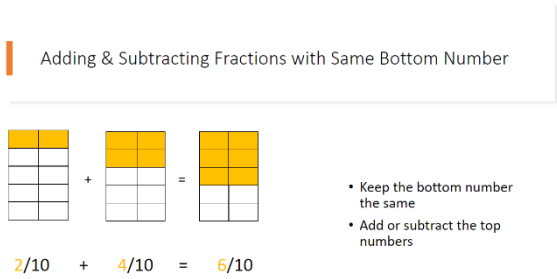
Activity Steps:

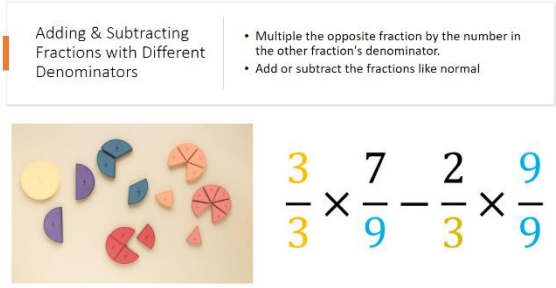
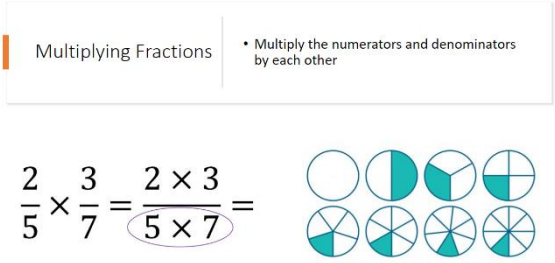
1. Students start off with worksheet and LEGOs.

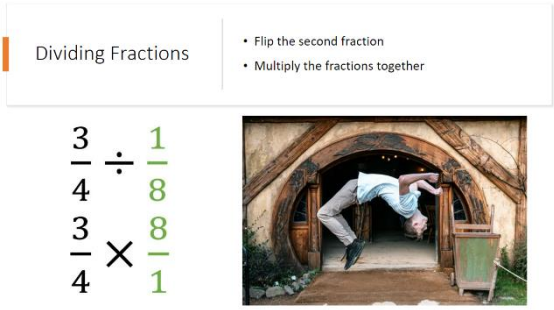
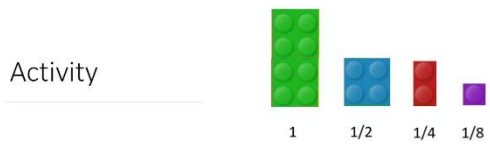
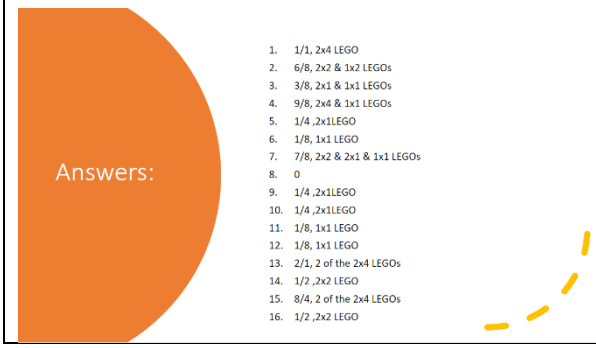
2. For each equation on the sheet, students put the two LEGOs representing the fractions next to each other.
3. Then based on the operation, students determine what the fraction answer would be and what LEGO piece or pieces represent that fraction. Have the students write down the fraction and LEGO piece on the worksheet.

PowerPoint:

Slide 1:  	- *Script:* Today we are going to be going over fractions and how to solve equations using them, but we are going to be using LEGOs to do it!
Slide 2:  	- *Question:* For the pile of red LEGOs, all of them have 8 bumps. For picture "a.)" all the LEGOs in the pile have 4 bumps, for picture "b.)" all the LEGOs in the pile have 2 bumps, for picture "c.)" all the LEGOs in the pile have 12 bumps. Which pile of LEGOs contains the LEGO type that is half the size of the red LEGOs? - *Expectations:* The students should be able to guess that a is the correct answer. If they do guess it correct, ask why "a.)" is the correct answer. They should say because the red LEGO has 8 bumps and "a.)" has 4 bumps: 4 is ½ of 8. If they don't that's okay, the following slides will refresh them about fractions since they should all have learned about them by 6th grade.

Slide 3:  	- *Script:* Fractions are a numerical value that is not a whole number such as 1 or 2. You can also think of them of numbers in-between the main numbers. One way to have a better understanding of fractions is to stick out your hand. You have 5 fingers on your hand. If you put down 4 fingers you only have 1 out of your five fingers sticking up. Therefore, you 1/5 of your fingers are up right now. One final note is that fractions are often though off as numbers less than 1 such as ½ and ¼. However, fractions can also be non-whole numbers greater that 1, such as 4/3.
Slide 4:  	- *Script:* To be able to fully understand how fractions work it's important to know how to add and subtract them when they have the same bottom number. Luckily, when fractions have the same bottom number all you do is add the top two numbers. As you can see from the picture, 2/10 + 4/10 = 6/10. - *Question:* Before we move onto the next slide do you know what the bottom and top numbers of fractions are called? - *Expectation:* The students should have learned that the top number is called the numerator and the bottom number is called the denominator. However, these words can be hard to remember so if they can't figure it out just tell them.

Slide 5: 	- *Script*: To add and subtract fractions with different denominators multiply the numerator and denominator by the denominator of the other fraction. Then you add or subtract the fraction like normal. - *Question:* For the equation shown on the slide, 7/9 - 2/3, what is the answer? - *Expectation:* Since this is just multiplication and subtraction the students should be able to get that answer is 3/27. Some students might know how to simplify and 1/9 would also be correct but, in this lesson, we won't go over simplifying fractions since it doesn't pertain to the LEGO activity and we don't want to overload them with information. If the students can't figure it out, go through how to do it with them step by step.
Slide 6: 	- *Script:* Multiplying fractions is nice and simple. All you do it multiply the numerators together and then you multiply the denominators together. - *Question:* For the equation shown on the slide, 2/5 x 3/7, what is the answer? - *Expectations:* Since this is just multiplication, the students should be able to get that answer is 6/35. If the students can't figure it out, go through how to do it with them step by step.

Slide 7: 	- *Script:* Finally, we are going to go over how to divide fractions. In order to divide fractions, you take the second one and flip it upside down. This is shown in the equation on the slide since 1/8 becomes 8/1. After that, you just multiply the fractions like you normally would. - *Question:* For the equation shown on the slide, (¾) ÷ (1/8), what is the answer? - *Expectation*: Since this is just multiplication the students should be able to get that answer is 24/4. If a student says the simplified version, 6, that is also correct. If the students can't figure it out, go through how to do it with them step by step.
Slide 8: 	- Hand out materials and go over activity steps on worksheet.
Slide 9: 	- At the end of the activity go over the answers with the students and answer any questions they have about fractions.

Additional Materials:

Here is the link to the worksheet, https://www.angelsnetfoundation.org/kids-corner

2.2 Origami Pyramid

Outline:

Adapted From: http://www.origami-instructions.com/origami-modular-pyramid.html

Lesson Objectives:

- Patterns
- Surface Area
- Area of Triangles

Materials:

- 4 sheets of paper
- Tape
- Ruler

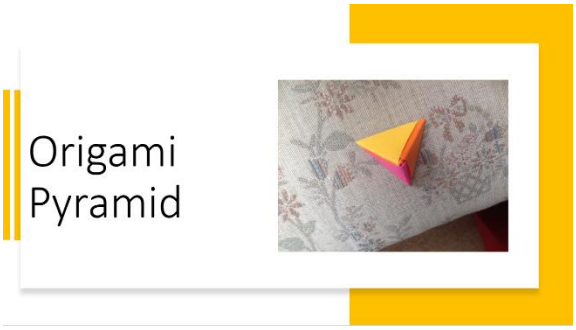
Ease of Preparation: Easy

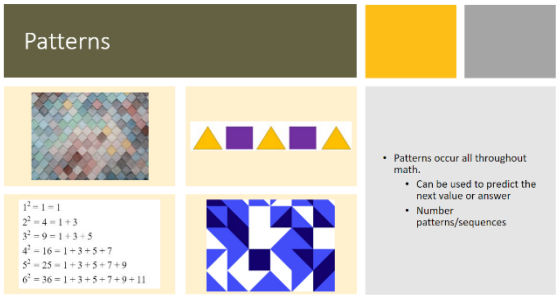
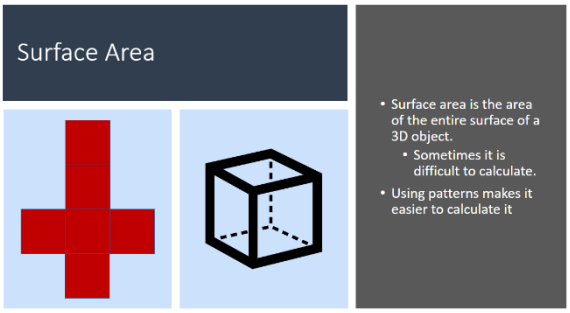
Online Capability: Yes

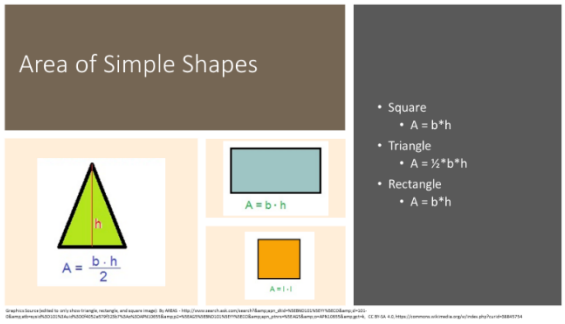
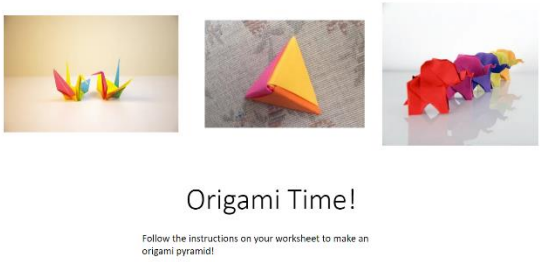
Activity Steps:

1. Students construct the origami pyramid using the steps from the website.
2. Students measure the height and base of one of the triangles.
3. Students use the area of triangle formula to solve for the area of that triangle.
4. Because the pyramid is uniform with each side, students will multiply the area of the triangle by four.
5. This will result in the surface area of the pyramid.

PowerPoint:

Slide 1:  	- *Script:* Today we will be learning about surface area and patterns using origami.
Slide 2:  Introduction • Have you ever done origami before? • Have you ever learned about surface area before? • Have you ever combined the two?	- *Questions:* Have you ever done origami before? Have you ever learned about surface area before? Have you ever combined the two? - *Expectations:* If the students respond make sure to acknowledge their responses, but if they do not respond that is okay. You will be explaining and helping them understand the material.
Slide 3:  	- *Question:* How does origami relate to Math? - *Expectations:* Explain that the three answers are patterns, surface area, and area of simple shapes.

Slide 4:  	- *Script:* "Patterns occur all throughout math because they can be used to predict the next value or answer and number patterns/sequences." Go over the various types of patterns shown on the images on the slide.
Slide 5:  	– *Script:* Surface area is the area of the entire surface of a 3D object. Sometimes it is difficult to calculate. Using patterns makes it easier to calculate it. The image on the right is a cube and the image on the left is the same cube folded apart. In the left image you can see all of the different sides laid out. - *Question:* Ask the class if they know how they could solve for the surface area of the cube. - *Expectations:* The answer to the question is the area of one of those squares multiplied by 6. You should expect the majority of the students to know this answer, but if they are shy and do not respond then tell them the answer and process in how you would solve for the surface area.

Slide 6:  	- *Script:* "For a square, the area is A = b*h. For a triangle the area is A = ½*b*h. For a rectangle the area is A = b*h." As you go through each shape on the bullet points, make sure to guide the class's attention to the corresponding image of the shape so they can visualize the formula rather than just look at the formula. - *Questions:* If you wanted to engage with the students more, you can even give some simple values for the different shapes and have them answer the area of the given shape. - *Expectations:* All the students should know how to solve for the area of these simple shapes so hopefully they respond. However, if they do not respond, then you can answer your own scenarios and explain the process to them.
Slide 7:  	- Go over the activity steps with the students.

Additional Materials:

This is the link to the website with instructions: http://www.origami-instructions.com/origami-modular-pyramid.html

2.3 Math with Skittles

Outline:

Adapted From:

https://www.target.k12.mt.us/cms/lib7/MT01000812/Centricity/Domain/68/Isnt_math_yummy.pdf

Lesson Objective:

- Percentages
- Probability
- Variables
- Math signs: <, >, =

Materials:

- Bag of Skittles
- Napkin

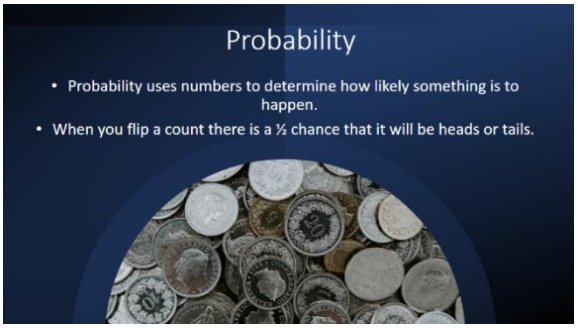
Ease of Preparation: Easy

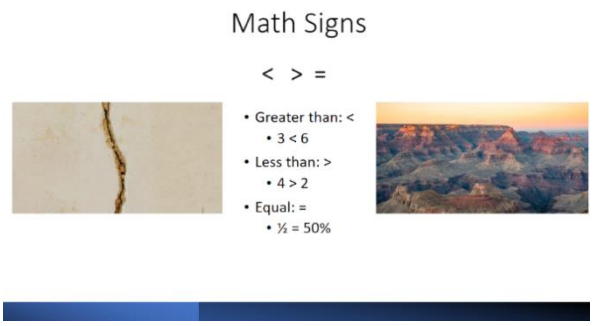
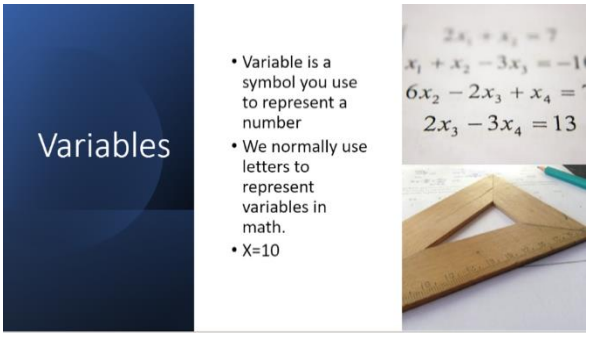
Online Capability: Yes

Activity Steps:

1. Students begin the activity with a napkin and an un-opened bag of Skittles.
2. Students follow instructions on worksheet.
3. Once the activity is up, students may eat the Skittles!

PowerPoint:

Slide 1:  	- *Script:* Hello everyone! For today's activity we will review key math topics and information, but with Skittles!
Slide2:  	- *Questions:* Who likes Skittles? Who knows what Probability, Percent, or Variables are? - *Expectations:* The first question is just to break the ice with the students and to get them excited to do the activity with Skittles. The second question is more related to what they will be learning. It should be expected that the students will have knowledge of all these topics at some level.
Slide 3:  	- *Script:* Probability is a branch of math that uses numbers to determine how likely something is to happen. For example, when you flip a coin there is a ½ chance it will be heads or tails. In probability the top number of a fraction is called the favorable outcome, this is because this is the number of times that the outcome could be in your favor. The bottom number is the number of all the possible outcomes. If I flip a coin and want it to land on heads, there is only 1 side it can land on for me to be happy. But, in total there are 2 possible sides it could land on. - *Question:* Does anyone know another way of saying there is a ½ chance? - *Expectation*: It should be expected that the students have been taught ½ is the same as 50%. However, they might not remember so if no one answers go onto the next slide and explain percentages.

Slide 4:  	- *Script:* A percent is a fraction expressed out of 100. Calculating percentages are used to make math and fractions easier to understand. To calculate a percentage, you take the top number of a fraction and divide it by the bottom number. For ½ you do 1 divided by 2 and you get 0.5. From there you multiple that number by 100. 0.5 x 100 is 50. That final number is your percentage, so ½= 50%.
Slide 5:  	- *Script:* Math signs are something that are simple, but it's always good to review them. The first sign on the left is the greater than sign. This sign it used when the number on the right is greater than the number on the left. For example, 3 < 6, also the canyon on the right is greater than the crack on the left, so we could also use the greater than sign for this very slide. The less than sign is similar, but it is the reverse. It is used when the number on the left is greater than the number on the right. For example, 4 > 2. We all know the equal sign means that the 2 numbers on both sides are the same. Just like how ½ equals 50%.
Slide 6:  	- *Script:* Finally, we are going to go over variables. A variable is a symbol you use to represent a number. The symbol can be anything, but in the math world we normally use letters as variables. - *Question*: For the mathematical statement, X=10, what is the variable? - *Expectation:* The students should know the variable is x.

Slide 7:  	- Go through the Activity Steps with the students.

Additional Materials:

Here is the link to the worksheet, https://www.angelsnetfoundation.org/kids-corner

3.0 Biology

3.1 The Anatomy of a High-Five

Outline:

Adapted From: https://www.sciencekids.co.nz/projects/modelhand.html

Lesson Objectives:

- The structure of a living system
- The systems of a Human Body
- What nerves, tendons, and arteries are
- The bones in a hand

Materials:

- Paper or card paper
- Scissors
- 5 straws
- 24 inches of string
- Tape or glue
- Stapler
- Pen or pencil

Ease of Preparation: Medium

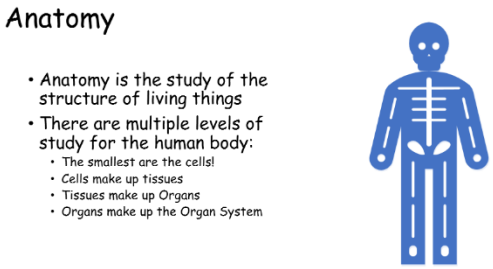
Online Capability: Yes

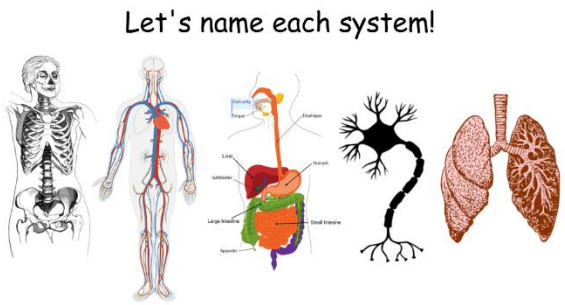
Activity Steps:

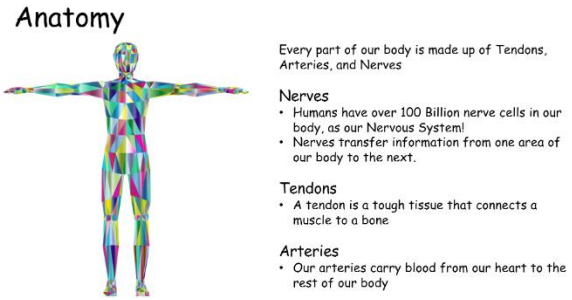
1. Students trace an outline of their hand on the paper or card paper
2. Students cut the outline out with scissors

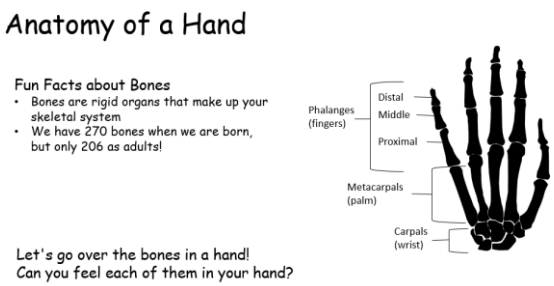
3. Students cut the string into 5 pieces, about the length of each of your fingers
4. Students tape or glue one end of each string to the tip of each finger
5. Students stretch the string and attach (with tape or glue) the other end at the base of the palm
6. Students staple the string to the paper where you have joints in your fingers

PowerPoint:

Slide 1:  	- *Script*: Today we will be doing an introduction of Anatomy, and we will be focusing on the anatomy of our hands!
Slide 2:  	- *Questions:* Ask the students some intro questions, such as "Have you ever seen an x-ray?", "Does anyone know what 'Anatomy' means?", or "Have you ever seen Dinosaur skeletons at a museum?" - *Expectations:* These are simple fun questions so expect the students to answer. If not, share your own answers to the questions.
Slide 3:  	- *Script:* Anatomy is the study of the structure of living things! Scientists study the anatomy of humans, fish, birds, and even dinosaurs! For the human body, there are multiple levels of study. First, the smallest level, are the cells! These cells then make up tissues, which in turn then make up our Organs! These Organs then make up our Organ systems!

Slide 4:
 
 	
	- *Script:* Start by asking the students what they think each of these systems is called, and what it is. Start on the left and move to the right.
	- *Expectations:* Expect the students to have some background knowledge of this material, but not a full understanding. The answers are:
	  o First: Skeletal System (bones)
	  o Second: Circulatory System (blood – arteries and veins)
	  o Third: Nervous System (nerves)
	  o Fourth: Digestive System (stomach, big & small intestines, etc...)
	  o Fifth: Respiratory System (Nose, lungs, bronchi, etc...)

Slide 5:  	- *Script:* The anatomy of the human body is super complicated, so let's take a look at the general view of a hand. Every part of our body is made up of tendons, arteries, and nerves, among other things. Let's start with the Nerves! Did you know the human body has over 100 Billion nerve cells?? These nerve cells make up our nervous systems. Tendons are tough tissues that connects our muscles to a bone. Arteries carry blood from our heart to the rest of our body!

Slide 6:  	- *Script*: In addition to the nerves, tendons, and arteries, our human body also has A LOT of bones! Bones are considered rigid organs, and they make up our skeletal system. As babies, we have over 270 bones in our body, but as adults, we only have 206! - *Questions:* Can anyone guess what happens to some of these bones? Can you feel any of these bones in your own hand? - *Expectations:* Expect the students to guess but not know the answer to the first question so explain it to them. For the second question, expect the students to be engaged and give answers. If not, then maybe start of by answering the question yourself.
Slide 7:  	- Go over the activity steps with the students. - *Questions:* What happens when you pull the string from the base of your palm? Which systems are at work in your hand when you move your fingers? - *Expectations:* Expect the students to answer and know the questions since they aren't too complicated. If they don't just explain the answers to them.

Additional Materials: N/A

3.2 The Systems of the Human Body

Outline:

Adapted From: CTPC ANF Team

Lesson Objectives:

- What the five systems of the human body are
- How each system functions and their parts
- Where each part is found in the body
- Where each parts are in relation to other parts of other systems

Materials:

- Paper
- Pen or pencil
- Tape or stapler
- Colored pencils or markers
- Scissors

Ease of Preparation: Easy

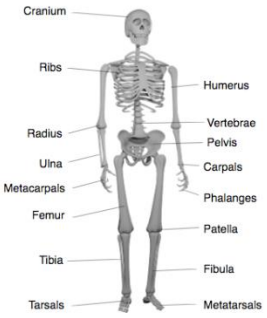
Online Capability: Yes

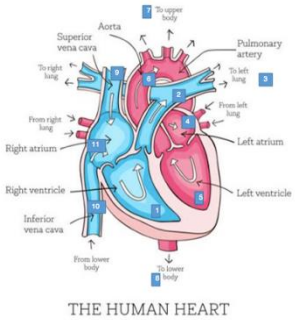
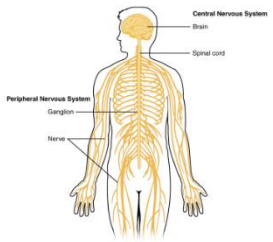
Activity Steps:

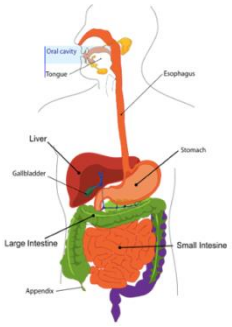
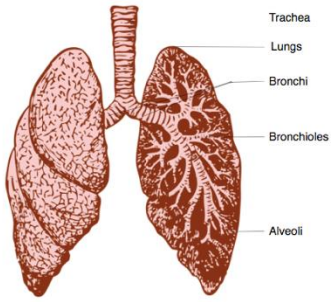
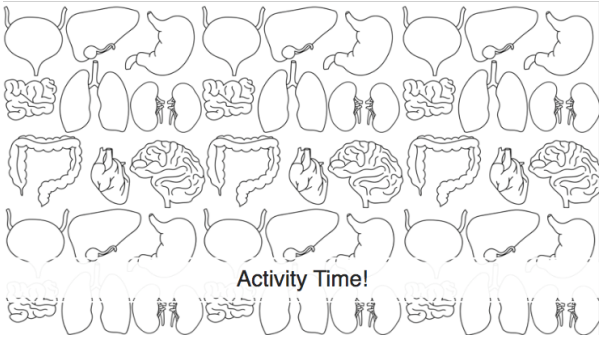
1. Students pick two of the systems
2. With their first paper, students will draw an outline of the human body
    a. They will then fill in this outline with their first system of choice
3. Then, using separate sheet(s) of paper, students will outline then cut out the parts of their second system of choice

4. Students will then tape or staple these parts onto the correct area of the body, on the first paper (with the first system of choice)
5. Students are encouraged to color everything in but should wait until the end.

PowerPoint:

Slide 1:  	- *Script:* Today, we will be learning about 5 systems of the human body! We are just going to go over the parts of each system and how they interact, but since each system is so complicated, we will not be going over the functions of each part today.
Slide 2: Have you ever broken a bone or gotten sick?  	- *Questions:* Have you ever broken a bone? Have you ever gotten sick? - *Expectations:* Expect every student to have been sick at one point and hopefully they can raise their hands. There will most likely be at least one or two student that have broken bones. Explain to them that we will be going over the human body so they can see the effects of these questions.
Slide 3:  Skeletal System	- *Script:* "This is our Skeletal System! It is made up of all the bones in our body. When we are born, we have approximately 270 bones, and when we are adults, there are only about 206. Let's go over some of the major ones." You can then explain the diagram, indicating where each of the bones are.

Slide 4:  Circulatory System	- *Script:* Next, we have our circulatory system. This is how our blood can move around from our heart to every part of our body! The circulatory system has a specific order, and we're going to begin from the right ventricle, labeled #1 on the diagram. The blood is then pumped upwards through the pulmonary arteries to the lungs, then through the lung's capillaries. The lungs oxygenate the blood, meaning they add oxygen molecules, and then send it through the pulmonary vein back to the heart for distribution. This now oxygenated blood reaches the left atrium of the heart, labeled #4, then the left ventricle, #5. The Aorta sends the blood either upwards to the brain, through the capillaries of the head and forelimbs, #7, or down to #8, the capillaries of the abdominal organs and hind limbs (legs, feet). From the head to the heart, the blood goes down the anterior vena cava. And from the legs to the heart, the blood goes through the posterior vena cava. These vena cavas meet at #11, the right atrium. The right atrium then feeds into the right ventricle, thus completing the loop.
Slide 5:  Nervous System Graphics Source: By OpenStax - https://cnx.org/contents/FPK1zmh@8.25:fEU3COK@10/Preface, CC BY 4.0, https://commons.wikimedia.org/w/index.php?curid=30147907	- *Script:* The nervous system is made up of two major parts: The Central Nervous System, and the Peripheral Nervous System. The Central Nervous System, in pink, is primarily made up of the brain and spinal cord. And the peripheral nervous system, in blue, consists of the billions of nerves throughout the rest of our body.

Slide 6:  Digestive System	- *Script:* For most people, the food we eat gets ingested through our mouth, then gets swallowed, and goes through our esophagus. It then reaches our stomach, where it first gets digested. But the stomach is only the first step in making sure that our body absorbs all the nutrients. After the stomach, the food is processed by the liver, then the gallbladder, followed by the pancreas. It then finally reaches the small intestine, which then feeds into the large intestine! The large intestine is the final step in the digestive system, and any waste left over (meaning, the content that is now empty of nutrients) gets disposed of!
Slide 7:  Respiratory System	- *Script:* The respiratory system allows us to breathe, and thus brings oxygen into our bodies. The nose breathes in air through the nasal cavity, and sends it down through the pharynx, larynx, and trachea. The air then reaches the bronchi, where it splits towards the two lungs. As it moves through the two lungs, the bronchi split into smaller bronchioles, which then split into even smaller alveoli. Then, we have the diaphragm!
Slide 8:  	- Go through the activity steps with the students. - *Questions*: Which system do you think is the coolest or most interesting? Which system do you think is the hardest? - *Expectations:* If the students do not respond, then you can share your own opinions to spark their interest and make them feel more comfortable responding.

Slide 9:  Bonus: The Bone Dance! YouTube video link: https://youtu.be/CMV8y2b4whl	- If the students are working well and engaging in the activity, this Bone Dance from Hannah Montana (the TV show) might be a good bonus!

Additional Materials: YouTube video link: https://youtu.be/CMV8y2b4whl

3.3 Bubble Cell

Outline:

Adapted From: http://lmacs.org/chen/wp-content/uploads/2014/03/Bubble-Lab.pdf

Lesson Objectives:

Cell Parts

- Cell membrane
- Ribosomes
- Cytoplasm
- DNA

Cell Functions

- Flexibility
- Repairing
- Channel proteins

Materials:

- Straws
- Tray
- Paper Towels
- Bubble solution, can be bought or made from 900ml water, 100ml dish soap, 25ml corn syrup
- String tied in a loop
- Pencil

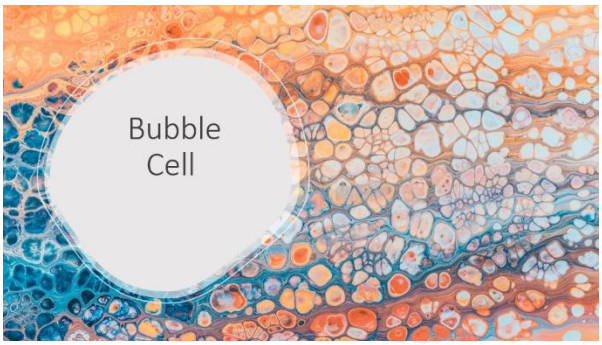
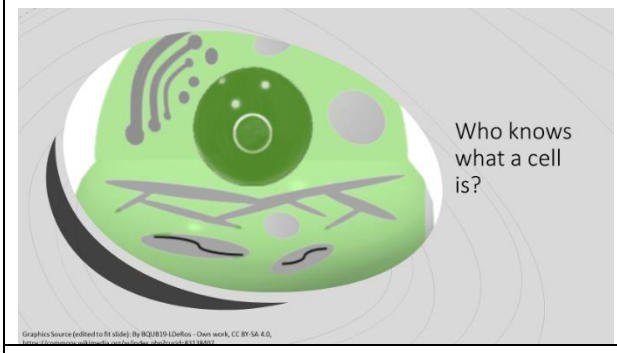
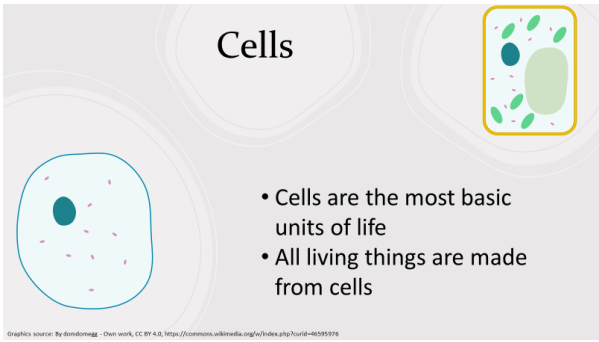
Ease of Preparation: Hard

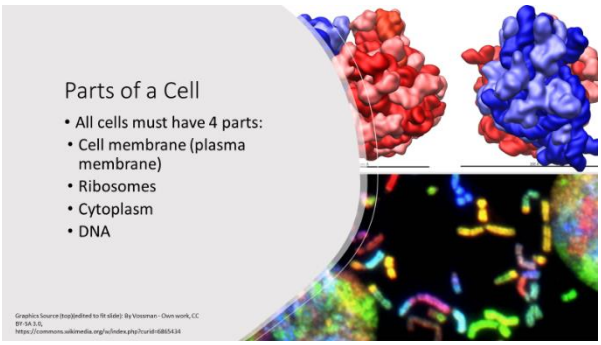
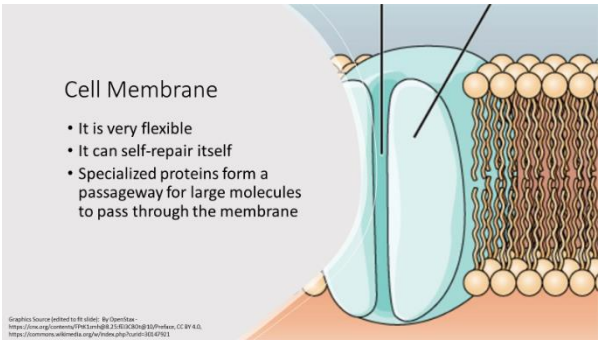
Online Capability: No

Activity Steps:

1. Students pair into groups of two and for each group place a tray of bubble solution, a string tied in a loop, and 4 straws on top of a paper towel.
2. Students use the four straws to make a square bubble frame, as shown on the last slide of the PowerPoint.
3. Students dip the bubble frame into the solution so that when you lift it a thin layer of bubble film spans across it.
4. Students tilt and lightly twist and shake the bubble frame to show that the bubble layer won't break easily.
5. Students dip one finger into the bubble solution.
6. Students slowly push the finger they dipped into the solution through the bubble layer, so it doesn't pop.
7. Students remove finger from the bubble layer and it will go back to normal.
8. Students hold the bubble frame parallel to the floor and gently lay string loop onto the bubble layer.
9. Students use a pencil to break the bubble layer inside the loop of thread. Notice how the rest of the bubble layer doesn't break.

PowerPoint:

Slide 1:  	- *Script:* Today we are going to be taking a brief look at what a cell is and more specifically what the cell membrane is and how it works.
Slide 2:  	- *Question:* Who knows what a cell is? - *Expectations:* Expect most of the older middle schoolers to know a what a cell is and some of the parts of it; however, expect some of the younger students to not know too much about cells. Some students may say cells are what make up our bodies, which is correct!
Slide 3:  	- *Script:* Cells are the most basic unit of life. They are the smallest living thing, and they are the building blocks of other living things such as you and me. Everything that is living is made from cells, people, plants, animals, and bugs. Animals have cells such as the one shown in the lower left hand corner of the slide and plants have a slightly different type of cell which is shown in the top right of the slide. The cells are both very similar however they have some small differences because plants and animals are very different lifeforms. - *Question:* All cells must have 4 things in common, does anyone know what they are? - *Expectations:* Expect the students to guess different parts of the cell. Encourage them to answer even if they are not correct. Explain to them that you will go over the answers with them on the next slide.

Slide 4:  	- *Script*: The 4 parts of a cell all cells must have are the cell membrane, ribosomes, cytoplasm and DNA. The cell membrane is what holds the cell together. It's like a very flexible wall that allows some molecules to enter and leave the cell. Ribosomes do a lot of very complicated work in the cell but the main goal the accomplish to make protein for the cell to survive. Cytoplasm is a jelly like liquid that fills up all the empty parts inside the cell. DNA is the genetic code inside the cells that make every living thing unique and different.
Slide 5:  	- *Script:* For this activity we are going to be learning a bit more on how the cell membrane works. Some important facts about the cell membrane to know for this activity is that it is very flexible, if it gets a tear in it can self-repair itself, it is semi-permeable which means small object can move through it, and there are special proteins that form a passageway for molecules to pass through the membrane, as shown by the big blue tube on the slide.
Slide 6:  	- *Script:* Its time do to do the activity now! As we go through the steps keep in mind how this bubble layer might be like a cell membrane. - Go through the Activity Steps with the students. - *Questions:* 1. After step 4: How is the bubble layer similar to the cell membrane? 2. After step 6: How putting your finger through the bubble layer and then taking it out without the bubble popping relate to the cell membrane? 3. After step 9: How is the hole the string made related to the cell membrane? - *Expectations:* 1. Since it was very recently explained the students should be expected to say that it is flexible like the cell

	membrane. However, if the students don't figure it out, explain to them that they are both flexible and they won't break easily. 2. This question might be a bit harder to figure out so the students might not understand it. The answer is that even though you finger breaks through the bubble layer, it fixes itself once you take it out. This is just like how the cell membrane can fix small tears itself. Along with this, the bubble is semi-permeable just like the cell membrane. 3. This comparison is a bit simple so the students should be able to figure it out. The answer is this hole is like the protein in the cell wall that allows things to move in and out of the cell.

Additional Materials: For instructions and photos of the activity:

1. https://nittygrittyscience.com/bubble-plasma-membrane-demo/
2. https://www.pasd.com/common/pages/DisplayFile.aspx?itemId=3591060

3.4 Cloud in a Jar

Outline:

Adapted From: https://lifeovercs.com/cloud-in-a-jar-science-activity-for-kids/

Lesson Objectives:

- How a cloud is created
- What the different phases of matter are

Materials:

- Mason Jar with cover
- Blue food coloring
- Ice
- Hairspray
- Dark piece of paper

Ease of Preparation: Hard

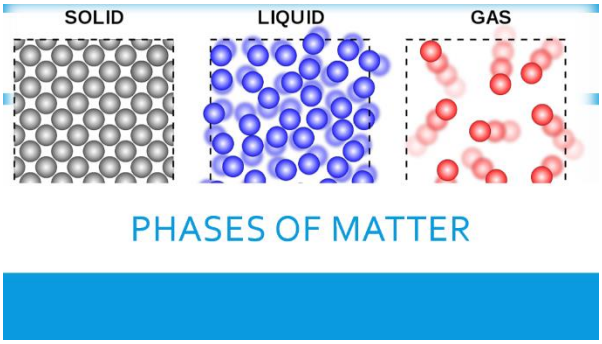
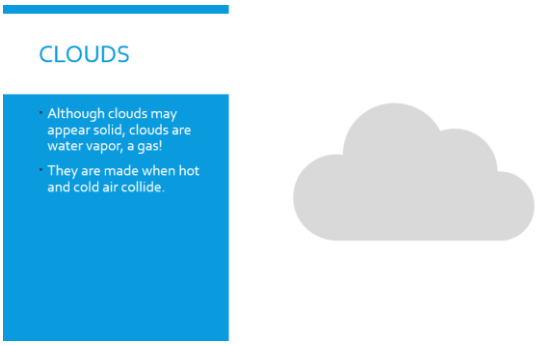
Online Capability: Yes

Activity Steps:

1. Students place ice on top of the mason jar lid.
2. Students pour ½ cup of boiling water into the mason jar. (Be careful and don't let the students touch the hot water.)
3. Students spray the surface of the water with hairspray.
4. Students put the jar in front of a dark piece of paper.
5. Students quickly put on the lid with the ice over the jar.
6. Sit back and watch the cloud form!

7. Once the cloud is formed, students lift the jar and watch it float away.

PowerPoint:

Slide 1:  	- *Script:* Today we will be making our own clouds! - *Question:* What is a cloud? What phase of matter is it? - *Expectations:* Students are not expected to know this. This question is to help engage the students. Explain to them that you will be going over this material in the following slides.
Slide 2:  	- *Script:* The three phases of matter are gas, liquid, and solid. Many substances can take numerous of these forms to produce different appearances. For example, water as a liquid looks different from water as a solid because it then becomes ice! - *Question:* Does anyone know what the gas phase of water is? - *Expectation:* You should expect some of the students to know the answer, but they might not respond. In the case that they don't, make sure to explain to them that the answer is water vapor.
Slide 3:  	- *Script:* Although clouds may appear solid, they are actually water vapor suspended in the atmosphere, a gas! They are created when hot and cold air collide.

Slide 4: 	- Follow the activity steps section and help the students pour hot water into their mason jar as they should not be touching it themselves. - *Expectations:* The students will need help with this activity when pouring the hot water in the mason jar.

Additional Materials: For photos of the activity:

1. https://lifeovercs.com/cloud-in-a-jar-science-activity-for-kids/

4.0 Chemistry

4.1 Density Testing

Outline:

Adapted From: CTPC ANF Team

Lesson Objectives:

- Density
- Mass
- Volume

Materials:

- Clear Jar/Glass
- Paper Towel
- Liquids (Choose 3-4):
  - Water
  - Cooking Oil
  - Orange juice
  - Soda
  - Syrup
  - Honey
- Solids (Choose 1-2):
  - Ice
  - Rock

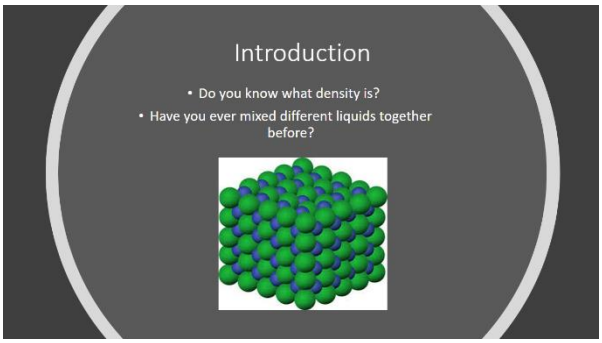
Ease of Preparation: Medium

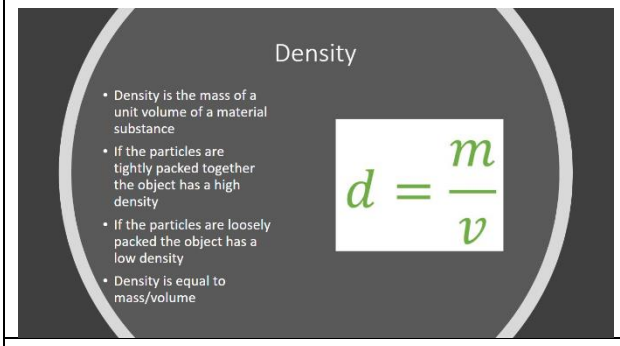
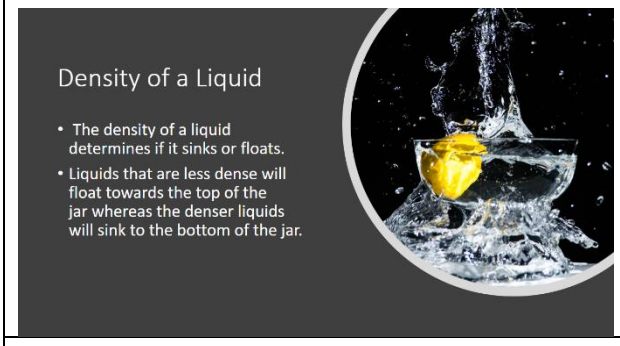
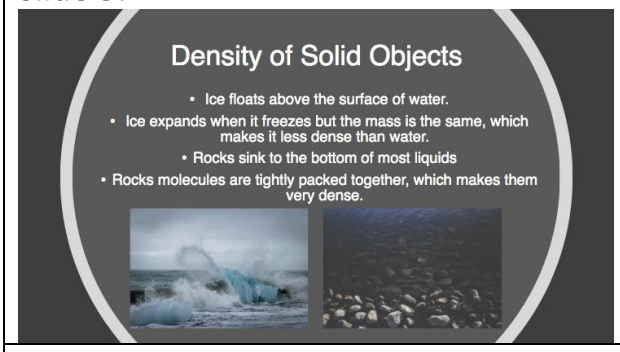
Online Capability: Yes

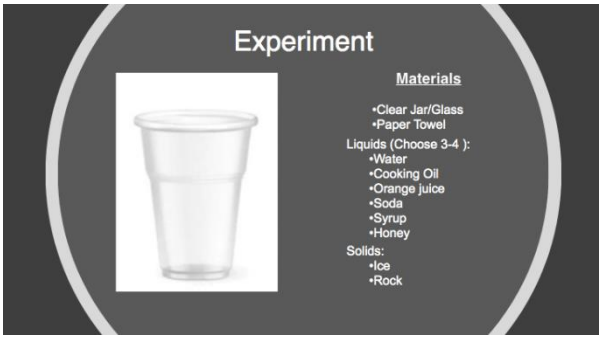
Activity Steps:

1. Students place paper towel on surface you are working on to prevent messes.
2. Students carefully pour each of the chosen liquids in one by one.
3. Students analyze what each layer is and mark it in the worksheet.
4. Students then gently shake the jar and wait for it to settle. If the layers changed, write down the new order of layers.
5. Students add the solids chosen one by one and analyze what each layer is and mark it in the worksheet.

PowerPoint:

Slide 1:  	- *Script:* Today we will be working on an activity that explores the densities of numerous solids and liquids.
Slide 2:  	- *Questions:* Do you know what density is? Have you ever mixed different liquids together before? - *Expectations:* Expect some students to know what density is, but just to make sure you will go over density in the next slide. Some students may have mixed different liquids together, but they might not have understood why they didn't mix well. Explain that this is due to differing densities.

Slide 3:  	- *Script:* Density is the mass of a unit volume of a material substance. If the particles are tightly packed together the object has a high density. If the particles are loosely packed, the object has a low density. Density is equal to mass divided by volume.
Slide 4:  	- *Script:* The density of a liquid determines if it sinks or floats. Liquids that are less dense will float towards the top of the jar whereas the denser liquids will sink to the bottom of the jar.
Slide 5:  	- *Script:* Ice floats above the surface of water because it expands when it freezes. The mass is the same, but the volume increases so it is less dense than water. Rocks sink to the bottom of most liquids because the rock molecules are tightly packed together, which makes them very dense.
Slide 6:  	- If time allows, this video can be shown to explain the science in further detail.

Slide 7:	
	- Go through activity steps with the students. Have the students rank the different liquids and solids in order from least dense to most dense. - *Questions:* Are the layers the same as they were before shaking the jar? - *Expectations:* The layers should be the same as they were before shaking the jar because the densities will force the liquids to return to their original layers. The most dense should be at the bottom and the least dense should be at the top.

Additional Materials:

Here is a link to the worksheet, https://www.angelsnetfoundation.org/kids-corner

Video Link – https://www.youtube.com/watch?v=27UeDBV9qmg

4.2 Invisible Ink

Outline:

Adapted From: https://www.sciencekids.co.nz/experiments/invisibleink.html

Lesson Objectives:

- Organic vs. Inorganic compounds
- Oxidation-reduction reaction

Materials:

- Paper towels
- Half a lemon
- Water
- Spoon
- Bowl
- Cotton bud
- White paper
- Lamp or light bulb

Ease of Preparation: Medium

Online Capability: Yes

Activity Steps:

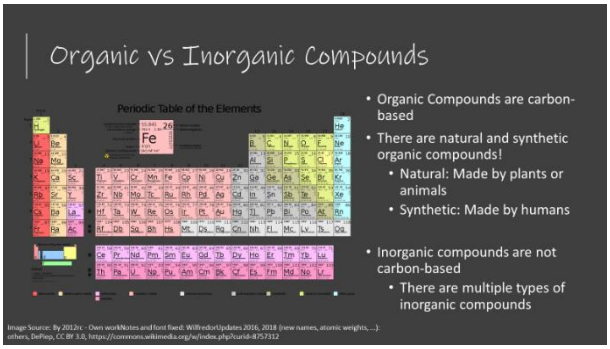
1. Students place paper towels on the surface they will be working on to prevent messes.
2. Students squeeze lemon juice into a bowl, add a few drops of water
3. Students mix the lemon juice and water with the spoon

4. Students dip cotton bud into the mixture
5. Students begin writing secret message on the white paper
6. When ready to reveal message, students hold it to a lightbulb to heat the paper

PowerPoint:

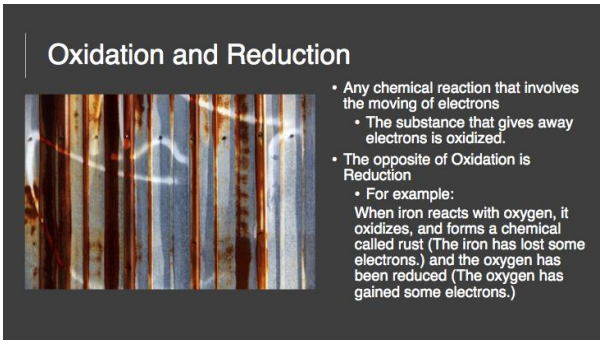
Slide 1:  	- *Script:* Today we will be exploring some chemical reactions by writing in invisible ink!
Slide 2:  	- *Question:* Have you ever wondered what it would be like to be a spy? Have you ever written in invisible ink before? - *Expectation:* These questions are to engage the students. If no one responds, explain to them that they will soon find out how to.

Slide 3:



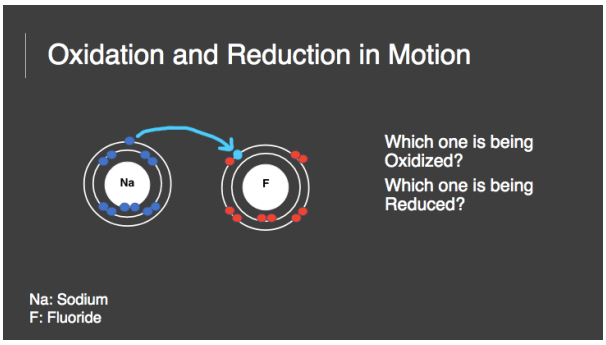
- *Script:* Chemicals are divided into various categories, and one of these divisions is between Organic and Inorganic Compounds. Organic compounds are carbon-based. Some organic compounds are made naturally, by plants or animals, and some are made synthetically, meaning they are made by humans. Meanwhile, inorganic compounds are not carbon-based. There are multiple types of inorganic compounds: Minerals (salts, silicates, etc...), Alloys (which are a combination of metals or metals combined with one or more non-metallic elements (brass, bronze, etc...)), and most compounds including non-metallic elements.

Slide 4:



- *Script:* Oxidation describes a chemical reaction that involves the moving of electrons. The substance that gives away electrons is oxidized, and the substance that received the electrons is reduced. The opposite of oxidation is reduction. An example of an oxidation-reduction reaction is when a piece of Iron rusts. The iron reacts with oxygen in the air. Thus, the iron is oxidized and gives away electrons, and the oxygen is reduced, meaning it gains electrons.

Slide 5:



- *Script:* This is another example of an oxidation-reduction reaction. Sodium, whose chemical symbol is "Na" and Fluoride, whose chemical symbol is "F."
- *Questions*: Which element is being oxidized? Which one is being reduced?
- *Expectations:* The students should identify that the sodium is losing an electron and the Fluoride is gaining an electron. Thus, the sodium is being oxidized, and the Fluoride is being reduced. If they are having trouble figuring this out, talk them through the diagram. (The arrow is a clue!)

Slide 6: Activity Time! 	- Have the students begin the activity! - Questions: Is the lemon juice oxidizing or reducing? What is causing the lemon juice to oxidize? - *Expectations:* The lemon juice is oxidizing and the heat from the lightbulb is causing it to oxidize

Additional Materials: N/A

4.3 Paper Chromatography

Outline:

Adapted From: CTPC ANF Team

Lesson Objectives:

- How chromatography works
- How to separate different types of ink

Materials:

- Two or three different colored pens
- Piece of paper or tissue
- Small cup
- Water

Ease of Preparation: Medium

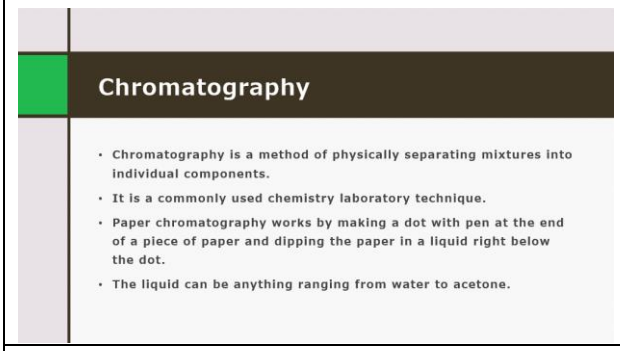
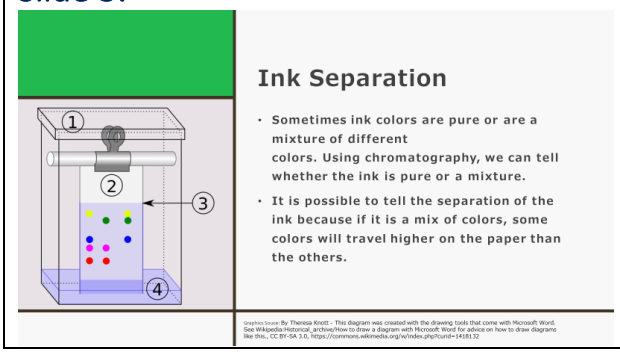
Online Capability: Yes

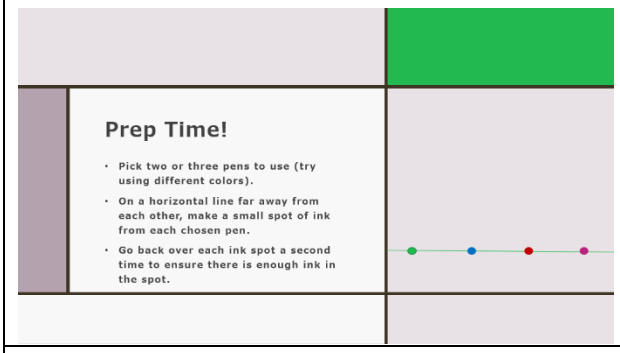
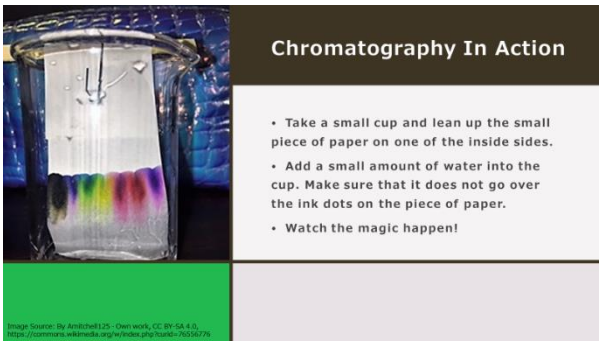
Activity Steps:

1. Students pick two or three pens to use (try using different colors).
2. On a horizontal line far away from each other, students make a small spot of ink from each chosen pen.
3. Students go back over each ink spot a second time to ensure there is enough ink in the spot.
4. Students take a small cup and lean up the small piece of paper on one of the inside sides.

5. Students add a small amount of water into the cup. Make sure that it does not go over the ink dots on the piece of paper.
6. Watch the magic happen!

PowerPoint:

Slide 1: 	- *Script:* Today we will be exploring paper chromatography! - *Question:* What is chromatography? - *Expectation*: The students may know from prior chemistry classes but are not expected to know the answer to the question. The answer is explained in the next slide.
Slide 2: 	- *Script:* Chromatography is a method of physically separating mixtures into individual components. It is a commonly used chemistry laboratory technique. Paper chromatography works by making a dot with pen at the end of a piece of paper and dipping the paper in a liquid right below the dot. The liquid can be anything ranging from water to acetone.
Slide 3: 	- *Script*: Sometimes ink colors are pure or are a mixture of different colors. Using chromatography, we can tell whether the ink is pure or a mixture. It is possible to tell the separation of the ink because if it is a mix of colors, some colors will travel higher on the paper than the others.

Slide 4:  	- *Script:* Now we are going to go into the activity prep time! We will choose our colors and make the dots on the paper. - Have the students follow the activity steps listed above and on the slide. The slide image on the right is a great example of how to make it.
Slide 5:  	- Have the students follow the activity steps listed above and on the slide. Students may need help with the chromatography set up and may accidentally drop the whole paper in the water. If this happens, they will have to make new dots on a new piece of paper. - *Questions:* Did you find that any of your pens separated into different colors? What were the colors? - *Expectations:* If done correctly, the colors will separate. If not, students can figure out why this is happening.

Additional Materials: N/A

5.0 Societal Science

5.1 What's on Your Plate... Tectonics; A game of Geology and Geography

Outline:

Adapted From: CTPC Group ANF

Lesson Objectives:

- Geology
- Plate tectonics
- The formation of mountains, volcanoes, and earthquakes
- The geography of tectonic plates, continents

Materials:

- Paper
- Scissors
- Tape
- Glue
- The worksheet, printed
- Pen or pencil
- Coloring pencils or markers (optional)

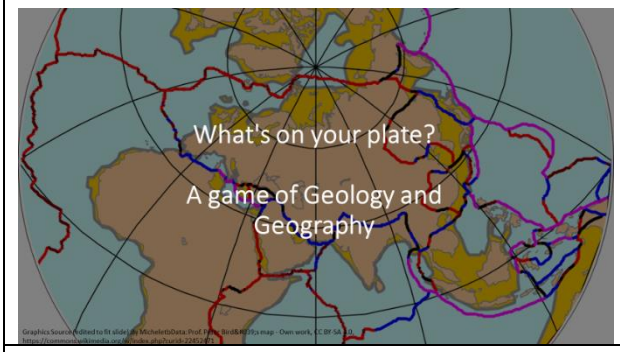
Ease of Preparation: Medium

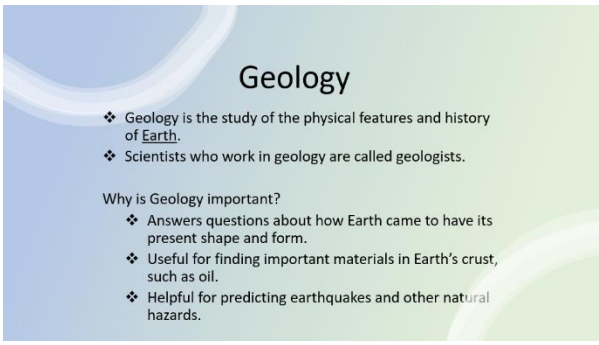
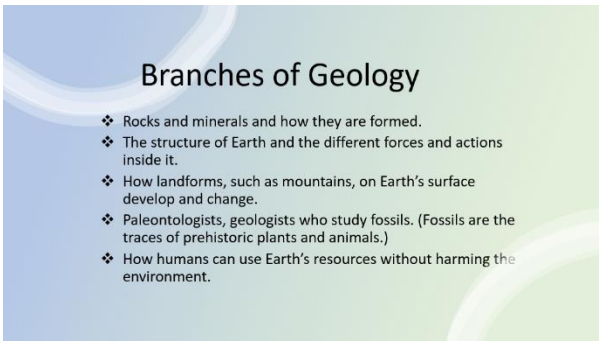
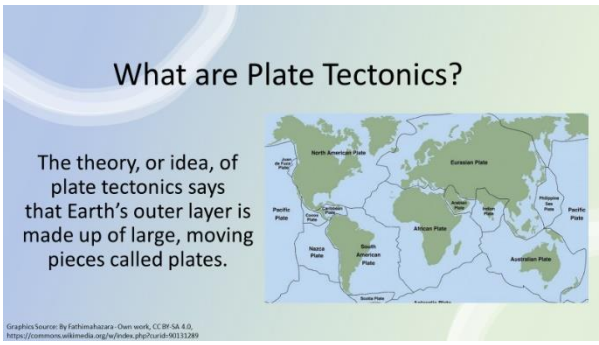
Online Capability: Yes

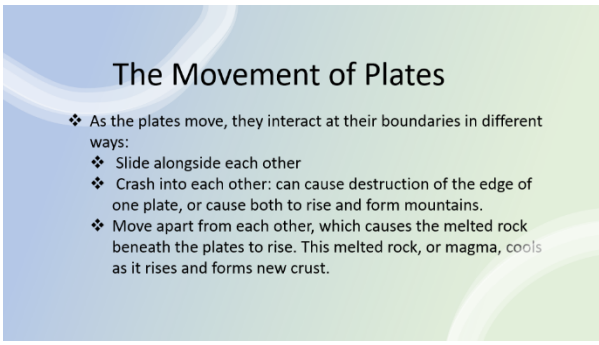
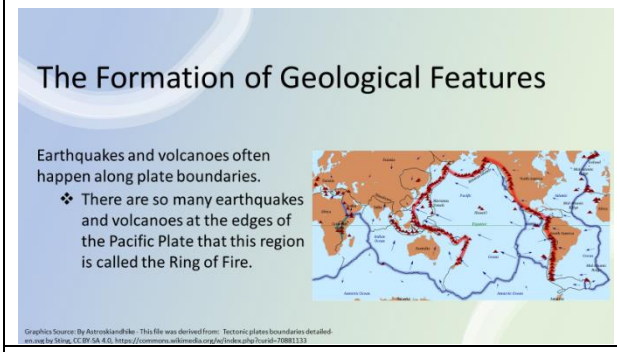
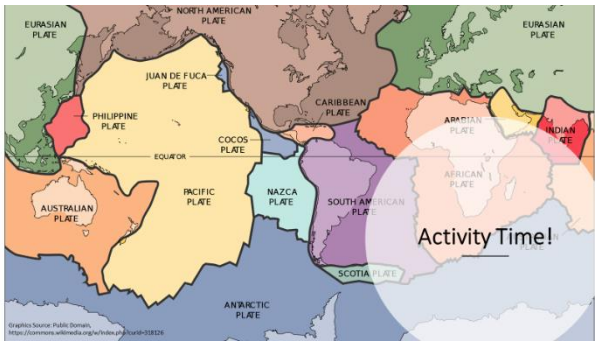
Activity Steps:

1. Students cut out the continents, then the countries. Label each.
2. Students glue the continents onto their respective tectonic plates.
3. Students tape the countries onto their respective continent, in the appropriate geographical position.
4. If they are done early, students can color and label in the continents and countries.

PowerPoint:

Slide 1: 	- *Script:* Today we will be learning about Geology and Geography, through plate tectonics!
Slide 2: 	- *Questions:* Have you ever built a 3D puzzle? Have you ever felt an earthquake? - *Expectations:* Most likely the students will not have an answer to these questions, but it would be great if some do. You can explain that you can feel earthquake from really far away depending on how strong the earthquake is.

Slide 3:  	- *Script:* The earth itself is kind of like a big 3D puzzle! Geology is the study of this 3D puzzle. It investigates the earth's physical features and its history. The scientists that work in this field are called geologists! - *Questions:* So, why is geology important? - *Expectations:* Well first, geology answers questions about how the Earth came to have its present shape and form. Geology is also useful for finding important materials in the Earth's crust, like oil! And finally, geology is also helpful for predicting earthquakes and other natural hazards.
Slide 4:  	- *Script:* There are multiple fields within Geology. First, geologists can focus on studying rocks and minerals, and how they form. Other geologists might want to specialize in the structure of the earth and the different forces and actions inside it. Geologists can also study how landforms develop and change – think mountains, volcanoes, islands, and more! Some geologists study fossils, which are the traces of prehistoric plants and animals like Dinosaurs! These geologists are called paleontologists. Another field studies how humans can use earth's resources, particularly without harming the environment.
Slide 5:  	- *Script:* One field of Geology includes plate tectonics! This is the theory, or idea, that earth's outer layer is made up of large moving pieces called plates. You can see the major ones in the diagram on the right. There are 7 major plates!

Slide 6:  	- *Script:* So, these moving pieces move! Let's learn more about that. As plates move, their boundaries interact in various ways: They might slide alongside each other. Or they might crash into each other. If they crash, this might damage the edges of one of the plates, or cause both to push into each other, rise, and form mountains! The plates might also move away from each other, which causes the melted rock underneath the plates to seep through and rise. Once it rises, the magma (melted rock) cools and forms a new crust!
Slide 7:  	- *Script:* We mentioned the formation of mountains in the last slide. But the movement of tectonic plates can form other geological features as well, such as earthquakes and volcanoes! The Pacific Plate (that is underneath the Pacific Ocean) has so many earthquakes and volcanoes that it's become known as the Ring of Fire!
Slide 8:  	- Have the students begin the activity! - *Questions:* Do you know the names, and maybe even locations, of mountains and/or volcanoes? Have you ever felt an earthquake? - *Expectations:* Some of the students might be able to respond with names of mountains or volcanoes, but most likely they have not felt an earthquake before. You can share your own thoughts on these questions as well.

Additional Materials: Here is the link to the worksheet,

https://www.angelsnetfoundation.org/kids-corner

5.2 LEGO Ice Excavation

Outline:

Adapted From: https://lemonlimeadventures.com/lego-science-ice-excavation-experiment/

Lesson Objectives:

- Archaeology
- Excavation
- The effects of salt on ice

Materials:

- Ice cube tray or some container large enough to hold a LEGO piece
    - The larger the container the longer it will take to excavate
- Water
- Salt
- Lego pieces

Ease of Preparation: Hard

Online Capability: No

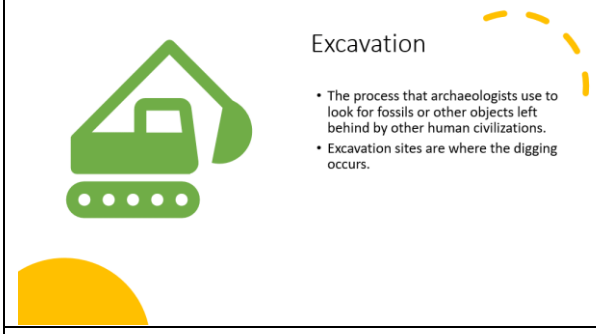
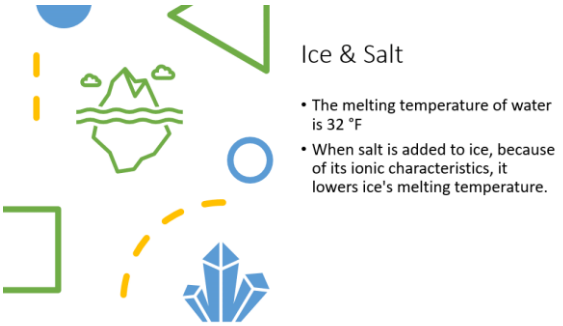
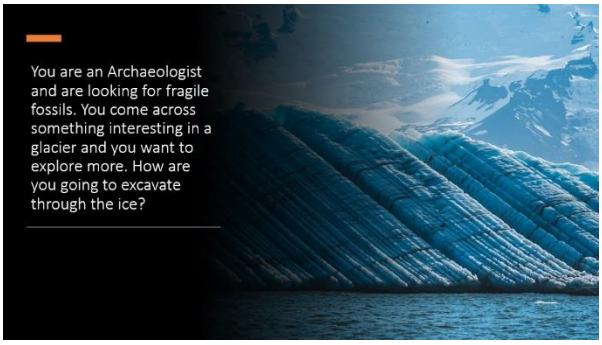
Activity Steps:

1. Preparing the ice sculpture: (Prepare ahead of time)
    a. Fill the ice container halfway with water and freeze.
    b. Once fully frozen, add the LEGO piece and fill it the rest of the way.
    c. Freeze sculpture.
2. Excavation time!

a. Students hypothesize a way to excavate the LEGO piece from the ice.
    i. They can use water and salt.
b. Students excavate the LEGO piece from the ice with their chosen method.
c. If it does not work, students use one of the following activity steps:
    i. Using water and salt:
        1. Coat the outside of the sculpture with a ½ a tablespoon of salt.
        2. Run room temperature water over the sculpture.
    ii. Run the ice sculpture under cold water.

PowerPoint:

Slide 1:  	- *Script:* We will be temporary archeologists for today!
Slide 2  	- *Script:* Archaeology is the study of things that people made, used, and left behind. It is the study explores ancient cultures and how humans have changed throughout history.

Slide 3:  	- *Script:* Excavation is the process that archaeologists use to look for fossils or other objects left behind by other human civilizations. Excavation sites are where the digging for ancient objects occurs.
Slide 4:  	- *Script:* The melting temperature of water is 32 °F. When salt is added to ice, it will lower the ice's melting temperature because it has ionic characteristics.
Slide 5:  	- *Script:* Think about this. You are an archaeologist and are looking for fragile fossils. You come across something interesting in a glacier and you want to explore more. How are you going to excavate through the ice? - *Expectations:* Students will use the knowledge of melting ice with salt to propose a general solution.

Slide 6: Excavation time! 	- *Script*: Now it is time to excavate your ice sculpture! Just like the previous thought exercise, hypothesize a way to excavate the LEGO piece from the ice. Write down your idea and then try it! If you are having trouble coming up with ideas, feel free to ask for a hint or idea. - *Questions:* You are an Archaeologist and are looking for fragile fossils. You come across something interesting in a glacier and you want to explore more. How are you going to excavate through the ice? What was your method for excavating the ice? Did it work well? - *Expectations:* The students will most likely be able to excavate the LEGO person. In doing so, they will have use a certain strategy

Additional Materials: For instructions and photos of the activity:

1. https://lemonlimeadventures.com/lego-science-ice-excavation-experiment/

5.3 Recyclable Car

Outline:

Adapted From: CTPC ANF Team

Lesson Objective:

- Importance of Recycling
    - Harmful chemicals
    - Greenhouse gases
    - Deforestation
    - Global Warming
- Designs for recyclable cars

Materials:

- Balloon
- Recyclables
    - Plastic water bottle
    - Straws
    - Cardboard
    - Bottle caps
    - Pencils
- Scissors
- Tape/Glue

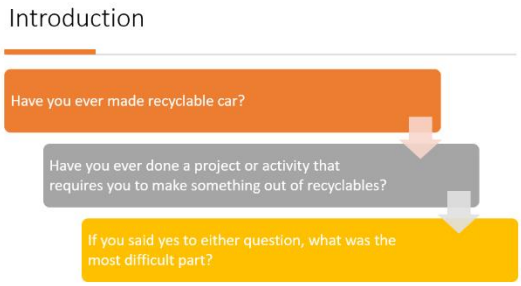
Ease of Preparation: Medium

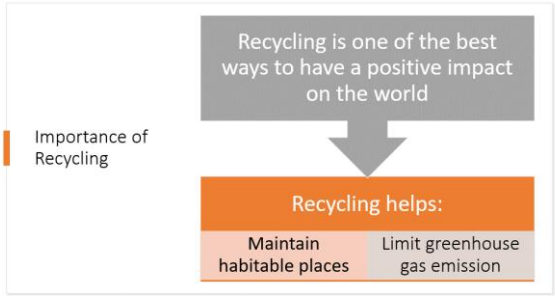
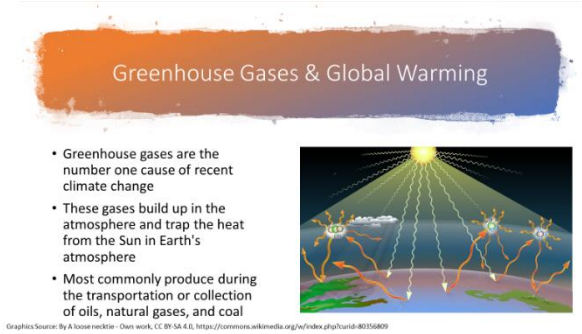
Online Capability: Yes

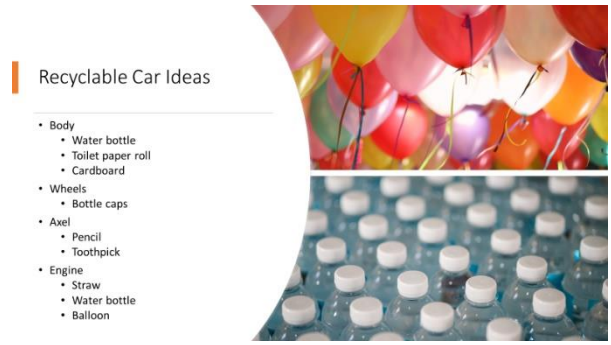
Activity Steps:

1. Students start building their recyclable racecars after the lesson.
2. Students have creative freedom to design their racecar how they want. The students must include a balloon attached to their car and the wheels must be able to spin.
3. Students can look at some of the designs on the slide to help create their racecars.

PowerPoint:

Slide 1:  	- *Script:* Today we will be making Recyclable Cars!
Slide 2:  	- *Questions:* Have you ever made recyclable car? Have you ever done a project or activity that requires you to make something out of recyclables? If you said yes to either question, what was the most difficult part? - *Expectations:* There should be some students that have done either of these activities and can answer so if they do make sure to make them feel proud about, they did. However, if no students answer, then that it is okay because you can tell them that you will help guide them through the process and inform the importance of recycling.

Slide 3:  	- *Script:* Recycling is one of the best ways to have a positive impact on the world. Recycling helps to maintain habitable places and limit greenhouse gas emissions. - *Question:* Give an example of how recycling can help maintain habitable places on Earth. - *Expectations:* There should be some students that can answer because there are so many reasons, but if there are no responses then go onto the next slide where you will answer this question.
Slide 4:  	- *Script:* Recycling can prevent harmful chemicals, greenhouse gasses, deforestation, and global warming. These dangers are leading towards destruction of habitable places on Earth. The photo on the top right of an artic habitat is being ruined by global warming. The ice is melting away. The bottom picture is showing pollution and how forests habitats are being destroyed.
Slide 5:  	- *Script:* Greenhouse gases are the number one cause of recent climate change. These gases build up in the atmosphere and trap the heat from the Sun in Earth's atmosphere. They are most commonly produced during the transportation or collection of natural gases, oils, and coal. - *Expectations:* You should expect that some students might know a couple greenhouse gases, but if not list some major greenhouse gases. Some major ones are carbon dioxide, methane, and nitrous oxide. You will talk more about carbon dioxide in the next slide.

Slide 6:  	- *Script:* Plants take in carbon dioxide and release oxygen, which is why we can live on Earth. Deforestation is the wide clearing of forests for materials or land. The clearing of large amounts of forests will cause carbon dioxide levels to rise, which is one of the major greenhouse gases.
Slide 7:  	- Start the activity with the students based off the activity steps. Explain to them that for each part of the car there are recommended recyclable materials that can be used depending on what they have. Don't forget to mention that tape, glue, or rubber bands can be used to put the pieces together. The additional materials can be used as inspiration for the student's cars. - *Questions:* Besides your racecar, who's racecar did you like the most and why? What was the toughest part when constructing your racecar? If you did this again would you use a different approach due to the time constraint?

Additional Materials: For recyclable car ideas:

1. https://www.youtube.com/watch?v=IacekOC-gwI
2. https://www.youtube.com/watch?app=desktop&v=QzY9RH_JnL0&feature=youtu.be

6.0 Technology

6.1 Make Your Own Robot

Outline:

Adapted From: https://www.sciencekids.co.nz/projects/makearobot.html

Lesson Objectives:

Designing Robots:

- How they work
- Materials
- Robotic Engineering
    - Computer Science
    - Electrical Engineering
    - Mechanical Engineering

Materials:

- Household items such as: (Not all are needed)
    - Tin foil
    - Ice cream containers
    - Straws
    - Paper
    - Cardboard boxes
    - Scissors
    - Empty toilet paper/paper towel rolls
    - Empty cans, bottles

- Glue
- Tape
- Markers/crayons/colored pencils

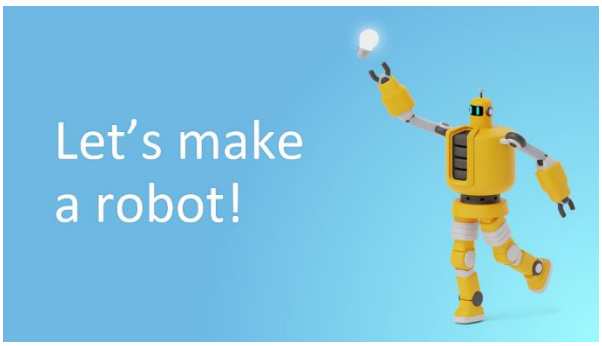
Ease of Preparation: Medium

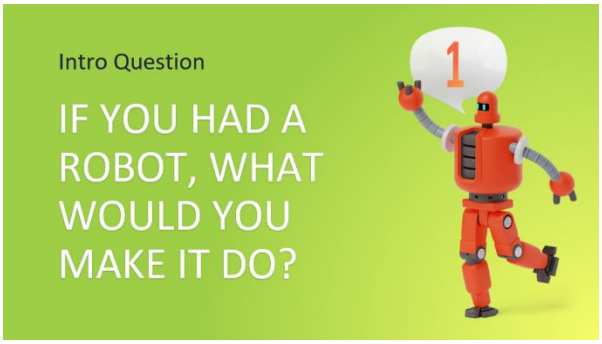
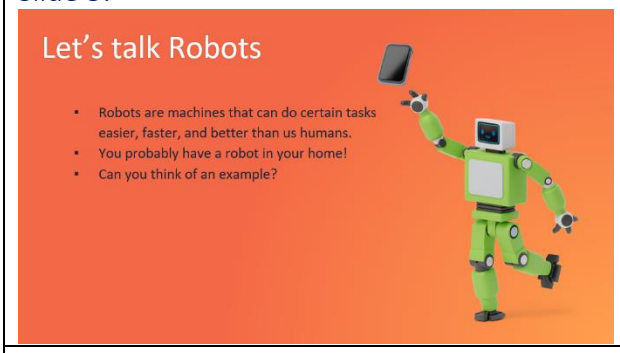
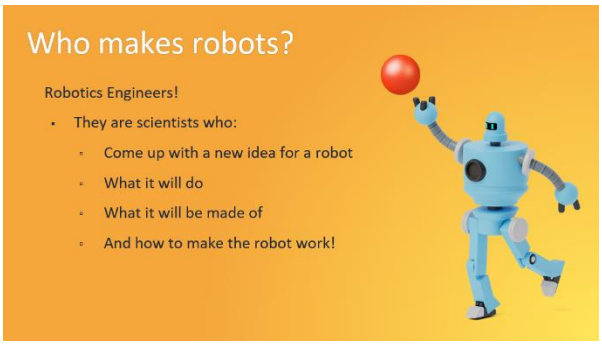
Online Capability: Yes

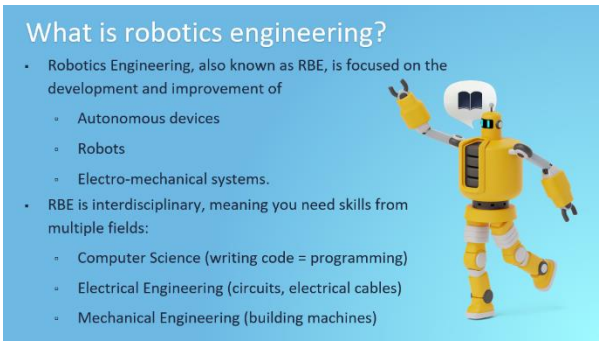
Activity Steps:

1. Students can build their own robot with creative freedom. But each robot should have:
    a. Minimum of two legs
    b. Minimum of two arms
    c. A head

PowerPoint:

Slide 1:  	- *Script:* Today we will be making our own robots!

Slide 2:  	- *Questions:* If you had a robot, what would you make it do? Have you seen any movies with robots in them? - *Expectations:* Try to have the students respond to these questions because they can all answer them. These are just opinion questions. However, if you are unable to get them to respond, then you can throw out some of your ideas to the questions to start sparking their interest.
Slide 3:  	- *Script:* Robots are machines that can do certain tasks easier, faster, and better than humans. And we likely already own a variety of robots! - *Questions:* Can you think of robots that already exist in people's homes? - *Expectations:* Answers may include (but not limited to): phones, computers, electric mixer, Roombas.
Slide 4:  	- Script: So, who makes these robots? These people are called Robotics Engineers! They are scientists who come up with a new idea for a robot, what the robot will do, what it will be made of, and they will try to figure out how to make it work.

Slide 5:  	- *Script:* These Robotics Engineers work in a field called Robotics Engineering! This field is also referred to by its acronym, RBE. RBE focuses on the development and improvement of autonomous devices, robots, and electro-mechanical systems. RBE includes aspects from multiple fields, so to be a successful Robotics Engineer you should understand things such as computer science, electrical engineering, and mechanical engineering! Computer science usually refers to writing code, or programming, which is writing the instructions telling a computer how to do its job. Electrical engineers work with wiring, circuits, and electrical cables. They figure out how to make electricity flow properly through devices so that everything is powered, and in the right order. Mechanical engineers build machines! They design them, figure out how to make them work, then build them themselves.
Slide 6:  	- *Script:* Have the students begin designing and building their own robots! - *Questions:* Why did you design your robot that way? What tasks can your robot do?

Additional Materials: N/A

6.2 Design Your Own Website

Outline:

Adapted From: CTPC ANF Team

Lesson Objectives:

- The World Wide Web/Internet
- Website design

Materials:

- Paper
- Pen and/or pencil
- Coloring pencils, and/or markers

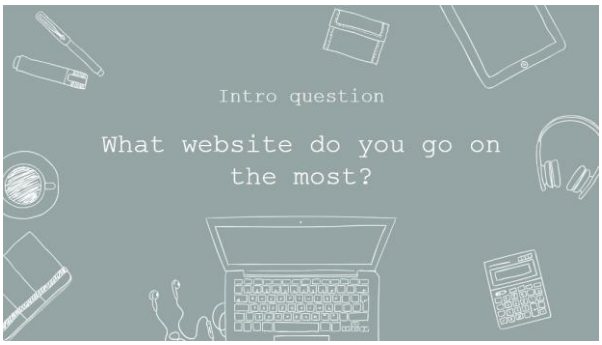
Ease of Preparation: Easy

Online Capability: Yes

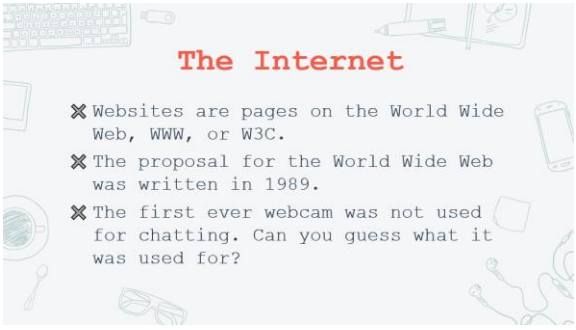
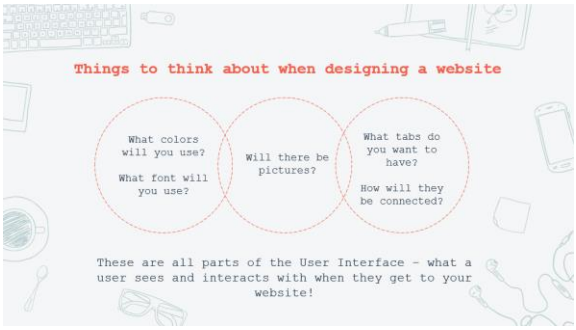
Activity Steps:

1. Students begin designing their own websites on the sheets of paper. They can draw each tab separately, but can put 1,2,3 or 4 views on one side of the sheet.
2. Students make their websites about their favorite animal or favorite activity. Each website should include:
    1. A homepage
    2. A minimum of 3 different tabs
    3. A minimum of 3 “buttons”

PowerPoint:

Slide 1:  	- *Script:* Today, we will be learning about the internet, websites, and then we'll work on designing our own websites!
Slide 2:  	- *Questions:* What website do you go on the most? What's your favorite website? - *Expectations:* Every student should be able to respond to these questions because they are just opinion-based questions. You can also answer the questions yourself before the class in order to spark their interest and make them feel more comfortable responding.

Slide 3:
 
 	
	- *Script:* Here are three fun facts about the internet!
	  - Did you know that there are currently almost 1 Billion websites online? To be exact, there are about 945,357,100.
	  - The first website ever made is still active! It was made in 1991.
	  - In 2010, Finland, a country in Europe, became the first country in the world to make access to the internet a legal right for its citizens.

Slide 4:  	- *Script:* Moving on to a few more facts! First, websites are pages on what is known as the World Wide Web, www, or W3C. A lot of websites start with "www." The proposal for the World Wide Web was written in 1989 by a British scientist and engineer named Sir Tim Berners-Lee. - *Question:* Nowadays, we use our webcams for communicating with our families and loved ones – think, Zoom! But the first ever webcam was not used for chatting! Can you guess what it was used for? - *Expectation:* The students will most likely not know this and not respond to this question so you can inform them of the answer. It was meant for monitoring a coffee maker to ensure that people would not walk down to the coffee maker only to find that the pot was empty. The webcam was deployed at the computer lab of Cambridge University.
Slide 5:  	- *Script:* Let's switch gears to thinking about our own websites. Here are a few things you should keep in mind when you design your own website. The color and font are important. Are you going to include pictures? Also, what tabs will you have? And how will the user move from one to the next? These are all concepts that make up the User Interface. This is what the user (your website's audience) sees and interacts with when they get to your website! We want to make our websites as user-friendly as possible.
Slide 6:  	– *Script:* Have the students begin making their own website! – *Questions:* Why did you design your website that way? How does a user move from one page to the next?

Additional Materials: N/A

6.3 Play That Tune

Outline:

Adapted From: http://appinventor.cs.trincoll.edu/csp/hourofcode/q/apps/tunes/

Lesson Objectives:

- Pseudocode
- Loops
- If Statements

Materials:

- Paper
- Pen and/or pencil
- Coloring pencils, and/or markers

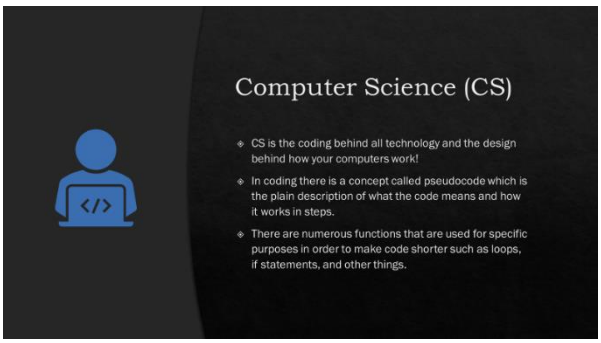
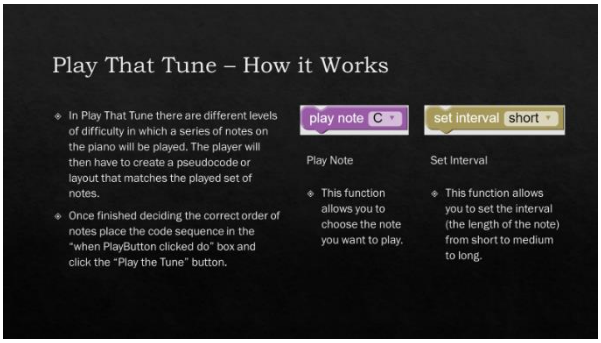
Ease of Preparation: Easy

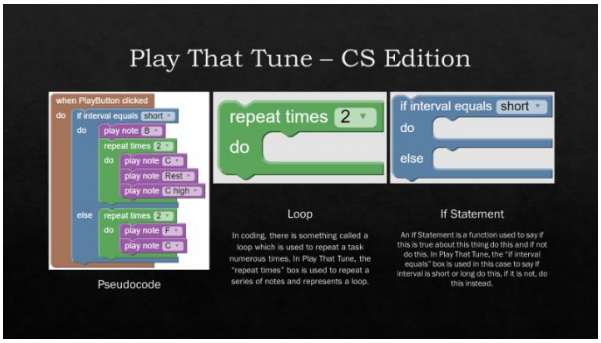
Online Capability: Yes

Activity Steps:

1. Students go through at least levels 1-4 of “Play That Tune”.

PowerPoint:

Slide 1:  	- *Script*: Today we will be using the program "Play That Tune" which dives into the overlap of music technology and computer science. - *Question*: Has anyone ever coded before? - *Expectation:* Students will not have much to any experience coding. This is alright, this lesson only dives into the basics.
Slide 2:  	– *Script:* CS is the coding behind all technology and the design behind how your computer works! In coding there is a concept called pseudocode which is the plain description of what the code means and how it works in steps. There are numerous functions that are used for specific purposes in order to make code shorter such as loops, if statements, and other things.
Slide 3:  	– *Script*: In Play That Tune there are different levels of difficulty in which a series of notes on the piano will be played. The player will then have to create a pseudocode or layout that matches the played set of notes. Once finished deciding the correct order of notes, place the code sequence in the "when PlayButton clicked do" box and click the "Play the Tune" button. The "Play Note" function allows you to choose the note you want to play. The "Set Interval" function allows you to set the length of the note to short, medium, or long.

Slide 4:  	– *Script*: In coding there is a function called a loop which is used to repeat a task numerous times. In "Play That Tune" the "repeat times" box is used to repeat a series of notes and represents a loop. An if statement is a function used to direct the path of a code depending on the characteristics of a variable. In "Play That Tune", the "if interval equals" box is used in this case to say if interval is short or long do this, if it is not, do this instead.
Slide 5:  	- Send the link to the students and have them play it on their own laptops. - *Expectations:* Students may need help with their specific levels. A goal could be to have them complete up to level 4.

Additional Materials:

Play that Tune Link:

http://appinventor.cs.trincoll.edu/csp/hourofcode/q/apps/tunes/