Weather and Climate

Air is Everywhere

https://www.youtube.com/watch?v=v_Unewoomjo&list=PLa3BRSex0pXzgivsqrJuvjyXCFKylfmUu

Passport Question: Air moves from areas of _____ pressure to areas of _____ pressure.

Passport Answer: High to Low

Background Information:
When air is heated up it expands and when air is cooled it contracts. For example, on a really cold day your car's tires may look flat because the air is cold and has contracted and is exerting less pressure on its container, the tire. If air is not in a container the change in pressure from temperature change can go unnoticed. It's often only when we confine air to a container that we can detect this change in pressure. This experiment will let us see this change in pressure from cause by a change in temperature.

Materials:

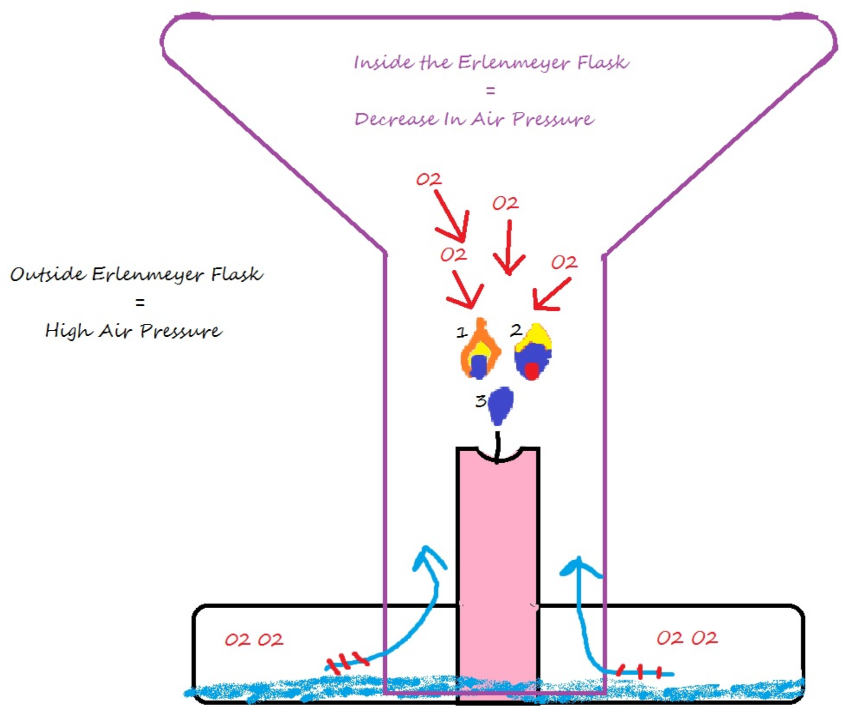
- Glass pan
- Erlenmeyer flask
- Water, with food coloring
- Tea candles
- Lighter

Procedure	
1	Pour the water into the pan and place the candle in the middle of the water.
2	Add 2 or 3 drops of food coloring to the water. This will make the movement of the water easier to see.
3	Ask the students what they think will happen when you place the flask over the candle.
4	Light the candle.
5	Cover the candle gently with the Erlenmeyer flask. If you force the flask down it will not allow air to escape out the bottom.
6	Have the students think about what is taking place both inside and outside of the flask. What invisible thing is inside the flask? Air may be invisible to the eye but it still takes up space!
7	Have the students carefully observe what happens to the water around the flask. It's bubbling! What happens to the candle flame?

Discussion:

- The candle flame heats the air in the flask, and this hot air expands creating a high pressure area inside the Erlenmeyer flask. Some of the expanding air escapes out from under the flask — you might see some bubbles; this is because the high pressure air is escaping out of the bottom.

- When the flame goes out, the air in the flask cools down and the cooler air contracts quickly creating an area of low pressure inside the flask. The cooling air inside of the flask creates a vacuum. This partial vacuum is created due to the low pressure inside the flask and the high pressure outside of the flask. We know what you're thinking; the vacuum is sucking the water into the flask right? You have the right idea, but scientists try to avoid using the term "suck" when describing a vacuum. Instead, they explain it as gases exerting pressure from an area of high pressure to an area of low pressure. After the candle goes out and the air inside the flask cools down and contracts, it has created a low pressure area. The air outside the flask now has a higher pressure, and therefore puts pressure on the water, moving it into the low air pressure area inside the flask.
- A common misconception regarding this experiment is that the consumption of the oxygen inside of the bottle is also a factor in the water rising. While there is a possibility that there would be a small rise in the water from the flame burning up oxygen, it is extremely minor compared to the expansion and contraction of the gases within the bottle. The water level rises rapidly when the flame is extinguished, if oxygen consumption was the main favor the water would rise at a steady rate.



- Relate to weather: High pressure and low pressure system's bring different types of weather. A low pressure system will bring cloudy and possible rainy conditions. A high pressure system brings sunny and clear conditions. They can learn more at the Kissing Balloons station.

Stubborn Balloon

https://www.youtube.com/watch?v=UM6dZ-AmeZg&list=PLa3BRSex0pXzgivsqrJuvjyXCFKylfmUu&index=7

Passport Question: Does hot air or cold air take up more space?

Passport Answer: Hot Air

Background information:

Air pressure is the force exerted on you by the weight and motion of air molecules (tiny particles of air). Although air molecules are invisible, they still have weight and take up space. Since there's a lot of "empty" space between air molecules, air can be compressed to fit in a smaller volume. "Stubborn Balloon" displays the force associated with air pressure and its relationship with temperature and pressure.

Materials:

- Hurricane Vase
- Newspaper
- Lighter
- Water Balloon
- Water
- Straws
- Safety Goggles

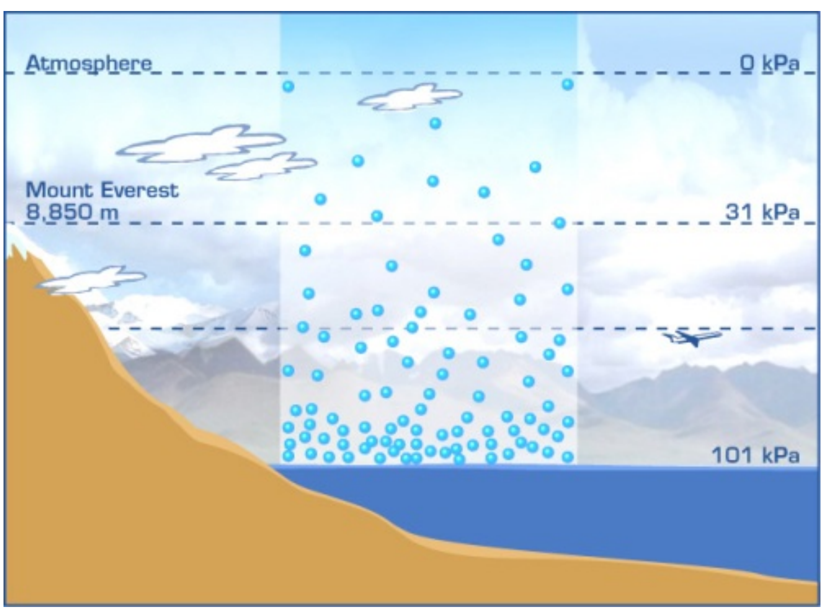
Procedure	
1	Put on safety goggles!
2	Place the water balloon on top of the jar and ask a student volunteer to try and push it into the jar. They will be able to push it in a little but it will always pop back out. (Make sure they don't push too hard or the balloon will pop!)
3	Remove the balloon. **Be careful.** Wad up a piece of newspaper, light it on fire and drop it in the jar. When you are sure it is burning well, put the balloon back on the opening of the jar. The balloon may bounce up and down a couple times and will disappear into the jar. It may pop, that's okay. I have supplied extra water balloons near the sink.
4	After the appropriate applause, ask the students if they want you to do it again (expect a yes!). Ask a student to attempt to pull the balloon back out of the jar. They won't be able to do it.
5	After a sufficient number of tries hand them a straw. Ask them to hold the straw inside the jar, next to the edge, using their other hand pull out the balloon. The balloon should pop right out.

Discussion:

- How does this work? It's all about air pressure. The balloon wouldn't go into the jar the first time because the air in the jar was pushing back up on the balloon as the student tried to cram it in. The air compresses slightly but not enough to allow the balloon to enter the jar.
- To understand how we got the balloon into the jar, we have to think about **equilibrium,** which is when opposing forces are in balance. Air molecules will move from areas of high pressure to areas of low pressure to maintain a balance of pressure, or equilibrium!
- When you place the burning paper into the jar, the fire begins to heat up the air inside, which makes it expand. The expanded air molecules try to find a way out of the jar, but the balloon resting on the top acts as a valve blocking the only exit. As the air continues

to heat, the pressure builds inside the jar up until it is strong enough to lift the balloon (opening the valve) just enough to let out a “burp” of air from the inside. Once the jar burps, the pressure is reduced inside so that the balloon once again seals it off (the valve closed). The burping action can occur several times in rapid succession, which makes the balloon look like it is dancing a jog on top of the jar.

- Until now, the air pressure inside was higher than the pressure outside, evidenced by the fact that the air kept trying to get out. Remember though, two different actions are taking place inside the jar. The other action is that the fire is burning and consuming oxygen, which has the effect reducing air pressure. Eventually, the paper burns out when there is not enough oxygen to keep it lit. Then, the gases inside the jar begin to cool causing them to lose energy and slow down. This reduces the pressure inside the jar. Because the air pressure outside of the jar is greater than that inside the jar, the balloon is pushed into the jar by the outside air pressure.
- When we try to get the balloon back out of the jar, we again have the one-way valve problem. As the balloon is pulled to the bottom of the jar, the air inside is trapped behind the balloon. The minute this happens there is a balance of forces both inside and out. This balloon is not going to go anywhere when this happens. By inserting the straw you allow air to pass by the balloon. If the air can get into the jar, the forces never get a chance to balance and the balloon can be pulled from the jar very easily.
- Air pressure contributes greatly to atmospheric stratification. In general as atmospheric height increases air pressure and density decrease. Temperature helps distinguish atmospheric layers: troposphere, stratosphere, mesosphere, thermosphere, and exosphere.



<u>Cartesian Divers</u>

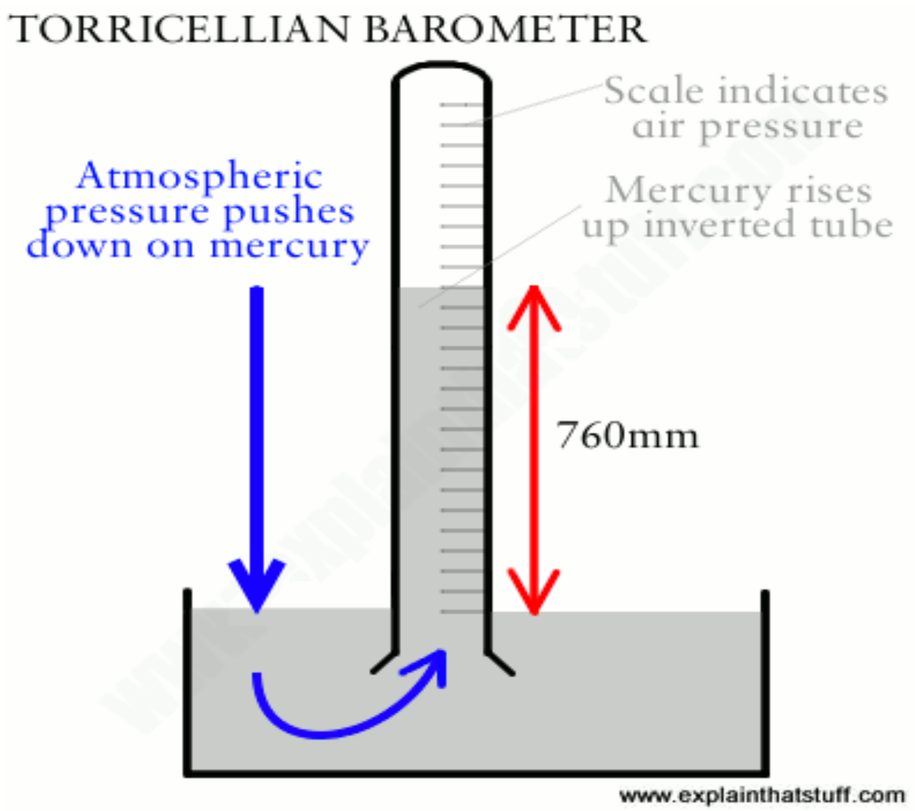
Passport Question: True or False: Molecules of gas compress easier than molecules of liquid.
Passport Answer: True

Background information:
When you build a Cartesian diver, you are exploring three scientific properties of air:
(1) Air has weight
(2) Air occupies space
(3) Air exerts pressure (this is our focus)

Generally speaking, an object will float in a fluid if it's less dense than the fluid. If the object is denser than the fluid, then the object will sink. For example, an empty bottle will float in a full bathtub because the air in the bottle is less dense than the water. However, as you start filling the bottle with water, its density increases and its buoyancy decreases. When it has enough water in it the bottle will sink.

The Cartesian diver, consisting of a plastic pipette and a metal hex nut, will float or sink in the bottle of water depending on the water level in the bulb of the pipette. When pressure is applied to the outside of the bottle, water is pushed up inside the diver, and the air inside the bulb is compressed into a smaller space. <u>Molecules of gases are more easily compressed than molecules of liquids.</u> The more water that is inside the diver, the denser it becomes and the diver sinks. When the pressure on the outside of the bottle is released, the compressed air inside the diver expands and this pushes some of the water back out of the diver. As the water level inside of the diver drops, the diver loses density and floats to the top.

The Cartesian diver activity represents the way a barometer works. When there is high pressure in the atmosphere the air inside the barometer will be exposed to the atmospheric high pressure as well as the water outside the Barometer. This will cause the air to push a bit harder on the water, causing it to rise. Similarly, with the Cartesian Divers, when we squeeze the bottle, we raise the air pressure which will raise the water level.



Materials:

- 1 or 1.5 liter bottles
- Plastic pipettes
- Hex nuts
- Hook and sinker
- Squidy

How to Make a Diver	
1	To make a diver: 1. The standard Cartesian diver is made from a plastic pipette and a hex nut. Screw the hex nut onto the base of the pipette. Several turns of the hex nut should be sufficient to hold it in place. 2. Cut off all but 1/4 of an inch of the pipette stem. This is the standard diver. 3. Place the diver in a cup of water, making sure that the water in the cup is at least four inches deep. Notice that the diver floats. Why? While the diver is still in the water, squeeze the bulb of the pipette to force air out and release pressure to draw water up into the diver. Continue squeezing air out and drawing water up into the diver until the pipette is about half full of water. Let go of the diver and see if it still floats in the water. When properly adjusted, the diver should just barely float in the cup of water. If the diver sinks to the bottom, squeeze out a few drops of water and re-test.
2	**Divers will be all premade, but if one malfunctions try the above tactics to fix it**.

Classic Cartesian	
1	This bottle only has a hex nut and pipette Cartesian diver.
2	Squeeze the bottle and the diver will float down.
3	Fun trick! Magnetic finger: “Test” and see which student has a magnetic finger. Have the first student run their finger down the bottle to see if their finger is magnetic and will bring down the diver. Don’t squeeze the bottle on this one. Have a second student run their finger down the bottle, this time squeezing the bottle stealthily to sink the diver. That student’s finger is “magnetic”! After they are blown away with the trick explain them how you squeezed the bottle to make the diver sink.

Squidy	
1	This bottle has a squid covering a hex nut and pipette Cartesian Diver.

Hook and Sinker	
1	This bottle has two divers, one a hook and one a sinker.
2	The students can play with this, trying to squeeze the bottle enough to drop the hook and hook it onto the sinker.

Counting Cartesian	
1	This bottle has numbered Cartesian Divers 1-5, made with hex nut and pipette.
2	The five different divers contain different amounts of water, labeled 1 through 5.
3	When you squeeze the bottle, diver #1 will descend followed by diver #2 and so on.
4	You can have quite a bit of fun with this just in the way you present it to the students. “Here is a bottle with five trained Cartesian Divers. What? You don’t believe me? I’ll show you. Watch as I command diver #1 to sink.” Hold the bottle up and gently squeeze to make diver #1 sink to the bottom. Don’t let anyone know you are squeezing the bottle. “Now, it’s #2’s turn.” Secretly squeeze the bottle a little harder and make the second diver sink. Divers #3 through #5 are more difficult to sink because they have less water and may require the use of the special pump. Lift the top of the pump and push it back down. The pump forces a small amount of air into the bottle and this, in turn, increases the pressure on the air in the divers. By repeating the pumping action, it is very easy to make all of the divers sink. Loosen the cap just as you would when you open a bottle of soda and the divers will jump back up to the top.
5	Diver #1 contains the greatest amount of water because you adjusted the water level inside so that it would just barely float. Since diver #1 has the most water, it has the smallest pocket of air. When you squeeze the bottle, this diver will descend first. On the other end of the scale, diver #5 contains the least amount of water and has the largest pocket of air. Diver #5 is the most buoyant of the five divers and should

	be the last one to sink. The divers will progressively sink in the order 1 to 5 if the densities of the divers are properly adjusted. You will also notice that you have to squeeze harder and harder to get each successive diver to sink. In essence, you have created a strength tester. One person may only be strong enough to sink three divers while someone else may have the strength to sink all five. How strong are you?

Discussion:

- <u>How Does It Work?</u> The Cartesian diver, named after French philosopher and scientist René Descartes, works because of several factors.
- When you squeeze the sides of the bottle, you are increasing the pressure on the liquid inside. That increase in pressure is transmitted to every part of the liquid. That means you are also increasing pressure on the pipette itself.
- Squeeze hard enough and you will push some more water up inside the dropper. The air inside the pipette squeezes tighter as more water is forced in.
- <u>Increasing the Density:</u> Now, water is much denser than air. So when you push more water inside the pipette, you increase its overall density. Once its density is greater than that of its surroundings, it will sink.
- Release the pressure on the bottle's sides and you stop forcing water inside the pipette. The air inside it will now push out the extra water again, and the pipette will rise. That's the Cartesian Diver!

<u>Weather Glass</u>

- A weather glass is a small open barometer filled with water. It is a simple instrument designed to indicate atmospheric pressure rises and falls as the water in its spout falls or rises. It does not provide quantitative measurements of atmospheric pressure.
- The principle is that the air left in the bottle above the water exerts the pressure of the air at the time the bottle was filled, while the liquid in the spout is exposed to the changing atmospheric pressure. As the atmospheric pressure falls, the water in the spout rises, and vice versa. Because the spout is much narrower than the bottle, changes in water level in the bottle are amplified in the spout and so are easily visible.

Galileo Thermometer

- The weight of each tag is slightly different from the others.
- The bubbles are calibrated by adding a certain amount of fluid to them so that they have the exact same density
- The basic idea is that as the temperature of the air outside the thermometer changes, so does the temperature of the water surrounding the bubbles. As the temperature of the water changes, it either expands or contracts, thereby changing its density. So, at any given density, some of the bubbles will float and others will sink. The bubble that sinks the most indicates the approximate current temperature.

Freak out! Is Tahoe weirding?

Passport Question: According to the data, which date range experienced a higher frequency of severe weather and storm events?

Passport Answer: 2000-2019

Background:

Climate change is affecting the frequency and intensity of natural disasters across the world. These events can range from extreme flash flooding to long-term droughts. The climates where we live will expose us to different types of severe weather events. It is important for humans to record these different weather events in order to have a comprehensive understanding of how they are changing over time. We will see that in the last century, extreme weather events are more likely to occur and with a higher intensity. The data we record can help us determine how much our climate is changing over time.

Supplies:

Computers with internet access
Severe Weather Event Graph
White Boards
Datasheets

Procedure:

Procedure	
1	Ask students to list some of the different types of extreme weather events that occur in Lake Tahoe. Allow students to raise their hands and let a couple of them share. You can explain that depending on where they live they might experience different weather events. You can also ask them if they know the difference between weather and climate? **Weather is what you experience when you walk out of the door. Climate is the average overall weather for a longer period of time.**
2	Tell students that today they will be researching the frequency of different extreme weather events that have occurred in Lake Tahoe in the last 40 years in order to determine if the climate has changed in that timeframe. After we find how many times these weather events have occurred, we will create a graph to compare how the frequencies of each weather event have changed over time (1980-1999 to 2000-2019).
3	The computers/ipads will already be logged on to the National Climatic Data Center's online Storm Data Archive at https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=6,CALIFORNIA
4	Help students locate the state they want to look up (California for Placer County or Nevada for Washoe County).
5	Remind the students that they are investigating the difference in weather and storm frequency for two different time periods to observe the change in the climate. They

	must look up each weather event for **both date ranges**.
6	Help the students change the begin date to January 1st, 1980 and the end date to December 31st, 1999. The second date range starts January 1st, 2000 and the end date is December 31st, 2019
7	Help the students locate either Placer or Washoe County.
8	After the students enter the state, county, and dates have them look at the severe weather event tab and have them select Avalanche events. They should then be sent to the Data page and should look at the "Number of days with Event" row.
9	After locating the row have them record the number of days that avalanches have occurred on their datasheet under the correct date range.
10	Have students additionally search for drought, flood, hail, heavy snow, high wind, wildfire, and winter storm and record all of the events on the graph. Have them look up as many of these different weather events as they can in 5-10 minutes. They don't need to get through all of the weather events as long as they have enough data recorded to make a graph.
11	Next have them graph their data on the whiteboard provided. You can ask them if they have learned about graphs before and what kind of graph they think best represents their data. You can help them create the axis because this can be confusing for some students. The two graphs that work best for this activity is a side by side bar graph or a scatter plot. See below for tips on graphing this data.
12	Once they have graphed everything have the students make observations about any patterns they see on the graph. It should paint a picture of how much more frequent severe weather events have become over time.

Tips for graphing the data:

For a bar graph: The weather events go on the x-axis, and the number of days with the event goes on the y-axis. There should be two bars per weather event, one for each date range. These bars should be colored in two different colors to highlight any patterns between the date ranges. The other graph that works has the same set up but instead of bars it would be scatter points. After they have put two dots for each event they can connect the 1980-99 dots and the 2000-19 dots to create two lines. This is a good visual representation because the lines should never cross, the 2000-19 line will always be higher. **However, if they make this kind of graph you must point out that there is no connection between the weather events.** We are only connecting the line to highlight the pattern the graph shows.

Discussion:

This activity is a good introduction into the world of data and research. It is very important for Scientists to keep records of past events in order to analyze and look for patterns. It also allows us to present information to the public in an easy and digestible way.

Do you think that the data you collected shows a pattern of climate change in Lake Tahoe?

Yes, it does! The frequency of every severe weather event is higher in the 2000-2019 date range than the 1980-1999 range.

Is this pattern a good or bad thing, or neither?

How does this graph give us insight into our climate?

Do you think that in twenty years from now the data will continue to show this pattern?

Updrafts in Action

https://www.youtube.com/watch?v=i2SLwD4G2q0&list=PLa3BRSex0pXzgivsqrJuvjyXCFKylfmUu&index=8

Passport Question: What two things together cause large hail to form?

Passport Answer: Very strong updrafts and super cooled water droplets.

Background:

Rain and hail will be suspended by the updraft (an upward current of air) inside a thunderstorm until the weight of the hail and water can no longer be supported. The stronger the updraft in a thunderstorm, the more intense the storm will be, and the larger the size of hail that can be produced. Suspending a ping pong ball in the stream of air supplied by a hair dryer will demonstrates how hail is supported in thunderstorm updrafts, and why with very strong thunderstorms we can see very large hail.

Bournoulli Principle - named after Daniel Bernoulli, an eighteenth-century Swiss scientist, who discovered that as the velocity of a fluid increases, its pressure decreases. The ping pong ball remains in the stream of air due to lower pressure created around the surface of the ball due to the Bournoulli Principle.

This low pressure effect also can be seen around the ping pong ball albeit in a different way. Instead of a narrowing in the center as in the venturi tube, the narrowing takes place around the perimeter of the ping pong ball (see figure right). In effect, there is an area of low pressure immediately adjacent to the ball.

Supplies:

- Ping Pong Balls/Styrofoam Balls
- Air Pump/Hair Dryer
- Pictures of Hail
- Different Styrofoam balls to show the sizes of hail

Procedure:

Procedure	
1	Ask students if they know how hail is created? Allow some answers. Tell students that today they will be learning about updrafts and how pressure plays a role in the formation of hail.
2	To demonstrate how updrafts and pressure affect the formation of hail and rain we will be using an air blower and ping pong balls or Styrofoam balls.
3	Turn the air pump on and slowly insert one of the balls into the air stream. They should see the ball being held and oscillating in the air stream a bit. Ask them why they think the ball is moving around? (Allow time for input)
4	Now tell them that we are going to put two balls in the air stream, and if we are lucky we might see them change position.
5	Attempt to put one ball in again, and then put another ball in the air stream. They should both be held and could possibly switch places in the stream. (Have some extra balls nearby in case they fall out of the stream and roll away.)
7	You can then attempt to use the other blowers. Some of them have very strong air streams. Attempt to hold the ball in a powerful airstream. The ball should be held at

	a higher elevation. You can then explain that at higher elevations the air is colder. Allowing larger hail to form. Again, the stronger the updraft, the larger the hail possible.
6	Once you have done the demonstration a couple times lead the students into a discussion about hail and updrafts.

Discussion:

Why do you think the ping pong ball moved from side to side in the air stream? (Explain to them that as the speed of air increases the pressure will decrease. The air sped up around the ball creating an area of low pressure just to the side of it.)

Hail is formed when very strong thunderstorm **updrafts** meet super cooled **water droplets**. Super cooled **water droplets** are liquid water drops that are surrounded by air that is below **freezing**, and they're a common occurrence in thunderstorms.

(Ask students how they think extremely large hail is formed?)

Tell them that if the updrafts is strong enough it will suspend the hail in the air allowing more water to freeze around the other frozen water droplets until it is too heavy to be held by the updraft. Extremely strong updrafts can create very large hail!

They can then view the pictures of different hail and look at the different sized Styrofoam balls that represent the hail sizes.

Cloud in a Bottle

https://www.youtube.com/watch?v=q77F18eTD48&list=PLa3BRSex0pXzgivsqrJuvjyXCFKylfmUu&index=2

Passport Question: What causes clouds to form? Circle all that apply.

Passport Answer: Water Vapor, Air Pressure, and Condensation.

Background Information:
A **cloud** is a visible mass of liquid droplets made of water, suspended in the atmosphere above the earth's surface. They are formed by two processes: cooling the air or adding water vapor to the air. Often these processes act together to form clouds.

There are several different types of clouds, classified by their shape, altitude (height in the atmosphere), and density. Latin roots are used to indicate the shape and density, with prefixes occasionally used to indicate altitude:

Latin Root	Translation	Example
cumulus	heap	fair weather cumulus
stratus	layer	altostratus
cirrus	curl of hair	cirrus
nimbus	rain	cumulonimbus

Cumulus clouds are the big, fluffy type; stratus clouds appear in layered sheets; cirrus clouds take the form of thin wisps; and nimbus clouds are the thick, dark types that often produce precipitation. Have students think about what types of clouds they see during pleasant weather or during storm events.

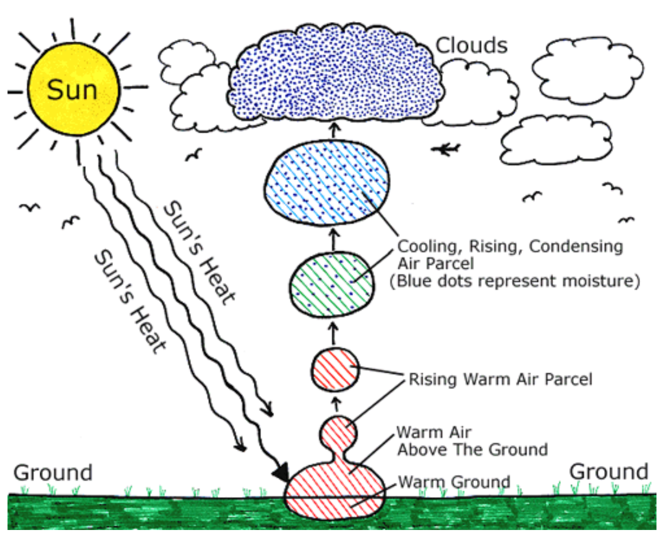
Materials:
- 1-liter clear plastic bottle with cap
- Foot pump with rubber stopper attached
- Water
- Rubbing alcohol
- Temperature sticker and guide

Procedure	
1	Ask the students what they know about clouds. *How are they formed? What are they made of?* Explain that water molecules are in the air all around us. These airborne water molecules are called water vapor. When the molecules are bouncing around in the atmosphere, they don't normally stick together. Clouds are formed when the water vapor cools and compresses into visible droplets. We'll explain this a bit more after making a cloud of our own!
2	Place a few drops of rubbing alcohol in the bottom of the 1-liter bottle. We use rubbing alcohol instead of water because it volatilizes quickly and works better in this demo. <u>You don't have to tell the students you're using rubbing alcohol.</u>
3	Swirl the alcohol around in the bottle, making sure to coat the sides. Then put the rubber stopper in the bottle.
4	Have the students pump the foot pump 10 times while holding the stopper down to

	make sure it doesn't pop off the top of the bottle. You can hold the rubber stopped down for them.
5	As they are increasing the pressure inside the bottle have the students look at the thermometer on the side (it looks like a skinny black sticker). You should be able to see the temperature change as the pressure does. Ask the students if they know why the temperature is changing (increasing the pressure increases the temperature).
6	When they are done pumping, pull out the stopper. You should see a cloud form in the bottle!
7	You can then pump air back into the bottle and watch the cloud disappear.

Discussion:

- *Ask students why you were using the pumper.* Pumping the bottle forces the molecules to squeeze together or compress. Releasing the pressure allows the air to expand, and in doing so, the temperature of the air becomes cooler. This cooling process allows the molecules to stick together - or condense - more easily, forming tiny droplets. Clouds are nothing more than groups of tiny water droplets!
- The reason the rubbing alcohol forms a more visible cloud is because alcohol evaporates more quickly than water. Alcohol molecules have weaker bonds than water molecules, so they let go of each other more easily. Since there are more evaporated alcohol molecules in the bottle, there are also more molecules able to condense. This is why you can see an alcohol cloud more clearly than a water cloud.
- Clouds on Earth form when warm air rises and its pressure is reduced. The air expands and cools and clouds form as the temperature drops below the dew point. Invisible particles in the air in the form of pollution, smoke, or even tiny particles of dirt help form a nucleus on which the water molecules can attach.
- The temperature inside the bottle increases as you increase the pressure with the foot pump. This is due to the relationship between temperature and pressure ($PV=nRT$). As air warms up the molecules expand which increases the pressure on the container the air is in. As the temperature decreases, the air molecules condense and the pressure lowers.
- **<u>Connection Chance –</u>** When you pump air back into the bottle and watch the cloud disappear you are simulating what happens in the natural world. High pressure brings clear conditions while low pressure brings clouds.



Kissing Balloons

https://www.youtube.com/watch?v=-DJ4jQHFtL8&list=PLa3BRSex0pXzgivsqrJuvjyXCFKylfmUu&index=4

Passport Question: Blowing between the balloons creates a low pressure system which brings them together and results in what type of weather?

Passport Answer: stormy

Background information:

Air pressure is the force exerted on you by the weight of tiny particles of air. These air molecules are invisible, but, they still have weight and take up space. Changes in temperature affect how many molecules are packed into the atmosphere.

Warm air = low-pressure systems:

Warm air expands so there are fewer air molecules in the atmosphere. Low pressure systems usually bring clouds and rainy days.

How low-pressure systems create clouds and rain:

In the Northern Hemisphere, a low-pressure system forces winds to spiral counterclockwise. Air is forced toward the center of this spiral and has nowhere to go but up. As the air rises, it cools (because the atmosphere gets colder as altitude increases). Cold air can't hold as much water vapor as warm air, so the water condenses or comes together, to form clouds. When the water droplets join together and get too heavy, they may fall as rain or snow (which meteorologists call "precipitation").

Cool air= high-pressure systems:

Cooler air contracts, which means air molecules become smaller and take up less space (so more of them can be packed into the atmosphere). High-pressure systems usually bring sunny days.

How high-pressure systems create clear skies:

In the Northern Hemisphere, high-pressure system winds spiral clockwise, moving from the center outward. To replace the air that flows out of the storm's center, more air is sucked down from up higher in the atmosphere. This air warms up as it is pulled down. The warm air expands, and any clouds or precipitation that had formed disappear.

Materials:

- Balloons
- String
- Rod

Procedure	
1	Tie the strings to the rod; make sure the balloons are at the same height.
2	Ask the student: What happens if you blow between the balloons? Where will they go?
3	Blow in between the balloons. Were your predictions correct?

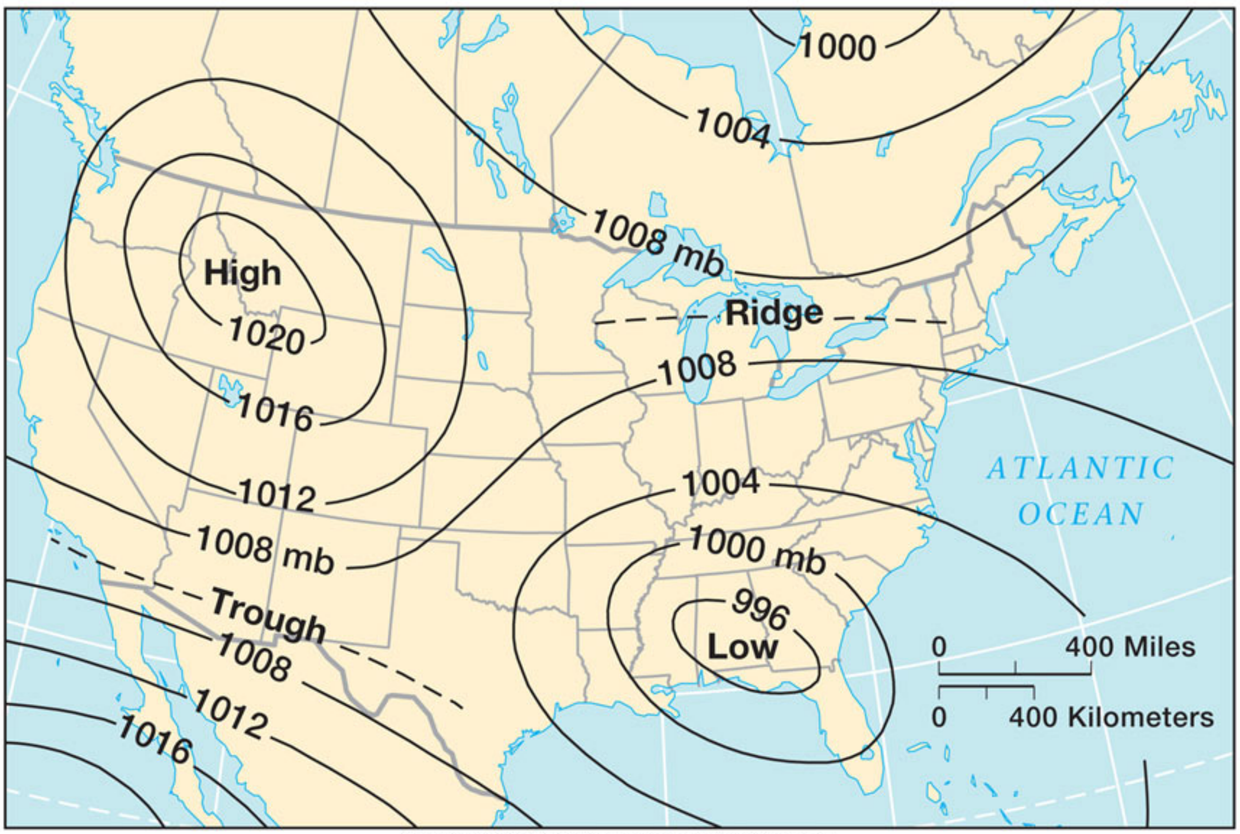
Discussion:

- Why do the balloons blow together instead of apart? In your experiment a low pressure area is created between the balloons when you blow in between them. The faster the air moves between the balloons, the lower the air pressure in that space.

- Meanwhile, the air surrounding the balloons now has higher pressure so it pushes the balloons together. This is an example of how low pressure systems cause air molecules to expand, and then condense into clouds.

Follow up: test students weather prediction skills! Print out weather isobar weather maps indicting H and L pressure systems.

a) Where is their potential for rain?
b) Where is it probably sunny?



[Thermal Spirals](https://www.youtube.com/watch?v=i2SLwD4G2q0&list=PLa3BRSex0pXzgivsqrJuvjyXCFKylfmUu&index=8)

https://www.youtube.com/watch?v=i2SLwD4G2q0&list=PLa3BRSex0pXzgivsqrJuvjyXCFKylfmUu&index=8

Passport Question: What causes the air to rise?
Passport Answer: Heat

Background information:
We feel the wind every day. The air is almost always in motion. One day it may be from the north and the next day from the south. There are many sources for wind: mechanical sources such as fans and, in nature, falling rain as it drags air along. But what is the origin of wind on the earth?

Supplies:
Paper plates
Scissors
String
Colored pencils/crayons
Toaster or other heat source

Set up	
1	There are premade spiral paper plates provided with this activity. You or the students can use these premade ones for the activity, or the students can make and decorate their own.
2	If the student wants to make their own: give the student a paper plate and allow them to use the colored pencils to design their plate (optional).
3	For the next step use your best judgment on whether the student should cut their own paper plate or if you assist them with this step. Cut the paper plate into a spiral.
4	Tie a string to the center of the spiral so when you hold it by the string it can hang from the center and spin.
Procedure	
1	Turn the toaster on to allow the unit to heat.
2	Ask the student where wind comes from.
3	Ask the students if a toaster can create wind.
4	Hold the spiral paper plates (10-15 inches) over the top of the toaster. What happens? Do not hold it any lower, this is a fire risk.
5	Turn the toaster off.

Discussion:

- Students may say clouds or trees cause the wind and that toasters cannot produce wind. They will quickly see that toasters do produce wind. Explain that wind is just air molecules in motion.
- We have all heard that "heat rises," but why? The glowing coils in the toaster produce infrared radiation, heating the toaster. The heated metal then warms the air in the toaster, making the air less dense. Less dense air rises and cooler, denser air moves in to take its place, creating wind that spins the paper spiral.
- The source for the earth's heat is the sun. The radiation from the sun heats the ground. The ground, in turn, heats the air and we know that hot air rises. As it rises, cooler air comes in to replace the rising air. We feel this as wind.

- The faster the air rises, the faster the wind blows to take its place. Every time we feel the wind, regardless if is from the north, south, east, or west, somewhere else around the world the air is rising. The term for this rising air is **convection**. The wind patterns we experience have their source in convection.

Airzooka (bonus activity)

- After they have created their thermal spiral and learned that wind is just the movement of molecules they can try their hand at the Airzooka
- The Airzooka is a device that fires a vortex of air when you pull the elastic chord backwards and create a pressure vacuum.
- Explain to students that they can now try to manipulate the movement of molecules in the air to knock the cups over that are placed on the small table behind Thermal Spirals.
- Have the student stand behind the tape line that is about ten feet from the cups.
- Give them 2-3 tries each (The Airzooka can be hard to fire correctly at first).
- Fun online information about air vortices:
    - A large air vortex cannon, with a 9 feet (2.7 m) wide barrel and a displacement volume of 2,873 US gallons (10.88 m^3) was built in March 2008 at the University of Minnesota, and was able to blow out candles at 180 feet (55 m).
    - In 2012 a large air vortex cannon was built for Czech television show *Zázraky přírody* (English: *Wonders of Nature*). It was capable of bringing down a wall of cardboard boxes from 100 meters (330 ft) in what was claimed to be a world record

Mini Greenhouse Effect

https://www.youtube.com/watch?v=X_omSPrK6TU&list=PLa3BRSex0pXzgivsqrJuvjyXCFKylfmUu&index=5

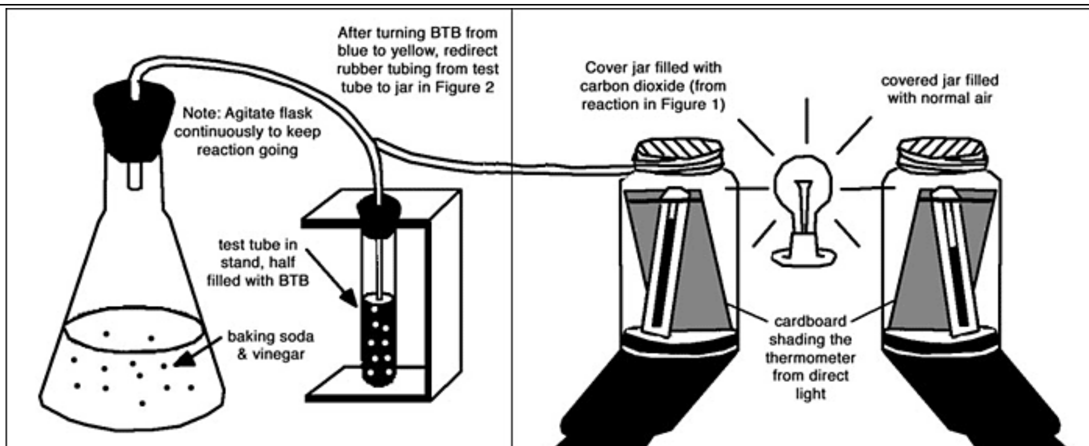
Passport Question: What greenhouse gas is released in this experiment?
Passport Answer: CO_2

Background information:
Earth's atmosphere is composed of a mixture of gases: 78% nitrogen, 21% oxygen, >1% argon and trace amounts of other gases, including carbon dioxide. Some gases absorb and re-radiate infrared energy that we sense as heat. These heat-absorbing gases are often referred to as greenhouse gases. Human activities have been adding carbon dioxide and other greenhouse gases to the atmosphere. How will earth's atmosphere respond to this increase in the amount of greenhouse gases? Scientists create physical models or experiments to compare how systems respond to changing conditions.

In this experiment students will observe two model atmospheres: one with normal atmospheric composition and another with an elevated concentration of carbon dioxide. These two contained atmospheres will be exposed to light energy in a sunny window or from a lamp.

Supplies:
Vinegar
Baking Soda
Erlenmeyer flask
Test tube
Stoppers
Connector Tubes
2 thermometers
Black paper
Light/ heat source
2 tanks (or mason jars)
BTB
Small Whiteboard to graph results

Procedure	
1	Intro Questions: 1. Explain to students that air is a mixture of many different gases, including some greenhouse gases that absorb infrared energy. 2. Ask students if they know what a greenhouse is and what it does? 3. Ask students if they know any greenhouse gases and their sources. (Answers may include: Water Vapor; naturally present from evaporation and transpiration. Carbon dioxide; burning fossil fuels, burning forests. Methane; rice agriculture, digestive systems of cattle, decaying organic matter. Nitrous oxide; agriculture through the use of nitrogen based fertilizers, livestock waste). 4. Ask Students: What human activities have been changing the concentration of these gases in our atmosphere? (Answers: see above.) Tell students that over the past 200 years, the concentration of these gases increased from approximately 278 ppm (parts per million) in 1800 to 405 ppm in 2016. 5. How does that happen? Use carbon poster and black “carbon” dots to tell the story of where carbon is emitted and where is it stored. • Carbon stored (plant mass (through photosynthesis), soil carbon, fossil fuels, oceans)

	• Carbon released (plant respiration, decomposition, burning fossil fuels) • The earth has had an increase in CO_2 release from burning fossil fuels and now there is a lot more carbon in the atmosphere. • Ask students: If we burn fossil fuels what is released? And where does it end up? 6. Show graph of CO_2 increase.
2	 Figure 1 Figure 2
	Assemble the flask, stopper, and tubing as seen in the illustration (should already be set up for you).
3	Remove the stopper and have a student place 100 ml of vinegar into the flask and another student add a half teaspoon of baking soda, then replace the stopper.
4	Place the flexible tubing into the BTB solution and notice the color of the liquid as the gas bubbles through the indicator solution. What color change do you notice? (Answer: Blue to Yellow)
5	Discuss what gas is being produced; CO_2 is a byproduct of the reaction between vinegar and baking soda.
6	Add 2 teaspoons to the flask to keep reaction happening. Now put the flexible tube into one of the tanks. Allow the tubing to stay in the tank for a minute or so. Ask students what invisible gas we are adding into the tank? (Answer:CO_2)
7	Keep one control (the tank without added CO2) identical to other tank but without added gases.
8	Record both temperatures every 10 minutes in the table on the white board/graph paper.
9	Once a few data points have been collected, begin graphing temperature vs. time on the other white board. Continue this throughout the session. (This is optional. There is already a lot going on with this activity so if you don't get to the graphing portion just make sure students understand that the container with CO2 added has a higher temperature due to its ability to absorb heat).
10	Data collection and graphing will continue with first tank you did the experiment with. You can continue to show the vinegar and baking soda and BTB experiment to the students as they come by, but there might not be enough time to collect new data.

Discussion:

- As one can see from this controlled experiment, greenhouse gases absorb heat. Our control tank and our CO_2 tank were exposed to the same amount of heat from the light and are identical in every other way. The only difference is the CO_2 addition.
- The BTB changed color because BTB is an indicator solution. Meaning it will turn yellow in the presence of acid. When CO_2 mixes with water it becomes Carbonic Acid. We can see the effect of CO_2 acidifying things when we look at our oceans. When too much CO_2 gets into the ocean it affects the way crustaceans form their shells. This can, in turn, alter the oceanic food web, which we are a part of. Show them the shells and ocean acidification poster.
- Ask students how they can reduce their carbon footprint!

Lightning Room!

Passport Question: Lightning is an example of ________ electricity.
Passport Answer: static

Background:
What is lightning?
Lightning is a bright flash of static electricity produced by a thunderstorm. All thunderstorms produce lightning and are very dangerous. If you can hear thunder, then you are in danger from lightning. Lightning kills or injures between 75 to 100 people each year on average; more than hurricanes or tornadoes.

What causes lightning?
Have you ever rubbed your feet across carpet and then touched a metal door handle? If so, then you know that you can get shocked! Lightning works in the same way. Lightning is an electric current. Within a thundercloud high in the sky, many small bits of ice (frozen raindrops) bump into each other as they move around in the air. All of those collisions create an electric charge. After a while, the whole cloud fills up with electrical charges. The positive charges or protons form at the top of the cloud and the negative charges or electrons form at the bottom of the cloud. Since opposites attract, that causes a positive charge to build up on the ground beneath the cloud. The ground's positive electrical charge concentrates around anything that sticks up, such as mountains, people, or single trees. The charge coming up from these points eventually connects with a charge reaching down from the clouds and - zap - lightning strikes!

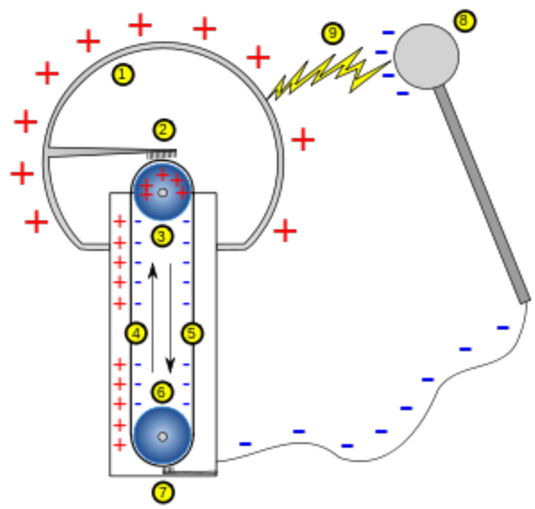
Supplies:
Fluorescent light bulbs
Balloons

Procedure: Balloons and Light Bulbs	
1	Have students grab a blown-up balloon.
2	Pass out light bulbs, one per student or pairs depending on the number of students.
3	Have students rub the balloon on their heads to generate static electricity, which builds up due to the friction between the balloon and the students hair.
4	Turn off the lights and have students press the balloon on end of light bulb.
5	The light bulb lights up! (Sometimes it takes a few tries before it will light up.)
6	Repeat if students want to do it again.

Procedure: Van de Graaff	
1	Crank the Van de Graaff generator by hand to produce static electricity. While cranking the generator place the big wand within proximity of the large ball at the top of the generator and notice the arc current between the 2 balls.

Discussion:

- The Van de Graaff generator is an electrostatic generator which uses a moving belt to accumulate very high electrostatically stable voltages. Look at how the rubber belt rubs against the wheel at the bottom of the generator -- as the rubber and wheel come in contact with each other they produce electrons (negatively charged particles) that are captured by the ball; this is also known as static electricity. The small wand is capturing protons (positively charged particles.) Why does your hair stand on end? Because the generator is charging you with electrons and each of the strands of your hair have the same negative charge. Like charges repel each other, so each of your hair strands want to move away from each other.



- Rubbing the balloon generates static electricity the same way as the Van de Graaff generator. Friction can separate positive and negative charges. As negative charges build up on the balloon, they attract the positive charges on the wall. The balloon will stay against the wall until all the static electricity is dispersed. Similarly, the fluorescent bulb lights up because of the electrical charge that is conducted from the static electricity, from your hair, and into the bulb.

This Activity should come before the Rumbling Road as lightning happens before thunder.

The Rumbling Road

Passport Question: Which travels faster: light (lightning) or sound (thunder)?

Passport Answer: Light

Background:

Thunder is a result of the rapid expansion of super-heated air caused by the extremely high temperature of lightning. As the lightning bolt passes through the air, the air expands faster than the speed of sound generating a "sonic boom". Therefore, lightning creates thunder.

Since the sonic boom is created along the path of the lightning bolt, in effect, millions of sonic booms are created, which we hear as a rumble.

Thunder from a nearby lightning strike will have a very sharp crack or loud bang, whereas thunder from a distant strike will have a continuous rumble. The primary reason for this is that the sound shock wave modifies as it passes through the atmosphere.

Sound travels roughly 750 mph (1,200 km/h), or approximately one mile every 5 seconds (one kilometer every 3 seconds). The speed actually varies greatly with the temperature, but the rule of thumb is 5 seconds per mile (3 seconds per kilometer). On the other hand, lightning can travel 220,000 mph.

Through a series of examples, the student will be able to determine the distance to a lightning strike.

Supplies:
Flashlight

Thunder sound files or the Thunder stick

Speaker or some kind of sound amplifier

White board

Procedure:

Procedure	
1	Instruct the students about thunder and why it occurs. Ensure they know sound travels about one mile every five seconds (three kilometers every three seconds). Instruct the student that they can approximate "seconds" by counting "One-Mississippi", "Two-Mississippi", "Three-Mississippi", etc.
2	Have the student look at the end of the flashlight and instruct them to begin counting once they see it light up
3	Rapidly turn the flashlight on and off
4	After you count five seconds, play the sharp thunder sounds.
5	Have the students divide the time from the first light to hearing the sound by 5 seconds to determine the distance in miles from the lightning bolt. You can

	write this on the whiteboard to help them with the math.
6	Repeat the procedure but wait 10 seconds between flashing the light and playing the sound. (Sharp Rumble)
7	Repeat the procedure but wait 15 seconds between flashing the light and playing the sound. (Far Rumble)
8	Repeat the procedure several more times but vary the time from flash to sound (two seconds, 14 seconds, etc.). Remember, the longer the time between flash and sound, the farther away the lightning is so use the thunder sounds (distant rumbles) that, by themselves, are an indication of distance.

Discussion:

- Each time you do the procedure there will be some variability in the student's results due to inconsistent counting of the seconds. However, you will quickly be able to understand the student's grasp of the concept by inquiring how many seconds they counted.

Rising Sea

https://www.youtube.com/watch?v=OQ99aVR6_Rg&list=PLa3BRSex0pXzgivsqrJuvjyXCFKylfmUu&index=6

Passport Question: Is sea ice melting in the Arctic or Antarctic leading to rising sea levels?

Passport Answer: Arctic

Background information:

The global sea level is rising over time due to climate change. This is different from the daily rising tides caused by gravitational forces exerted by the Sun, Moon, and rotation of Earth, or by extreme weather events—which are also related to climate change. There are many different changes to the sea level and the coastline. Some of those changes are short-term and regular, like the rise and fall of the tides every day. Some of those changes are short-term and temporary, like storms that create floods on land. And some of those changes are long-term and potentially permanent, like the increase in sea levels due to climate change.

Some participants might think that melting glaciers and ice wouldn't change the sea level because it would be like an ice cube melting in a cup of water. It can be hard to envision how sea levels can rise because Earth is so big, and there are so many different sources of water and ice. One thing to remember is that there is a lot of ice and snow on top of land, and when it melts it flows into the ocean and adds to the total amount of water in the ocean.

Some participants might dispute climate change. You can respectfully respond, "Yes, not everyone is in complete agreement about climate change. The great majority of scientists agree it is occurring, and have a lot of supporting evidence. We are presenting the scientific perspective on sea level rise in this activity."

This activity provides a hands-on model of an important change that is occurring on Earth: sea level rise and the corresponding inundation of coastal land by water. Participants will create a topographic map that documents this relationship. As you facilitate the activity, you can ask questions that prompt participant observation and reflection, and provide opportunities for you to share relevant information

Materials:

- Basin and landform
- Clear acrylic
- Dry erase marker
- Eraser
- Large pitcher for water
- Blue food dye
- Sponge (or paper towels)
- Observing Earth information sheet
- Two Tupperware models
- A lamp
- Ice and water

Procedure	
	What is causing sea levels to rise?
1	**Ask the students what they know about global warming, climate change, and sea levels rising**. You can explain how this activity is going to model what is causing sea levels to rise and how that affects coastlines around the world. **Ask the students if they know what a model is?** A model is a small scale representation of something you are studying. Scientists use models to visualize scientific concepts that would otherwise be more difficult to study.
2	Show the students the two Tupperware models. These models represent the Arctic and the Antarctic. **Ask them if they know what the main difference is between these two places?** If they don't know you can hint by asking why is one considered a continent and the other is not. The Arctic is sea ice floating on the ocean, Antarctica is a continent because it is a land mass with ice covering its surface.
3	In the Tupperware without clay, place ice cubes in water and mark where the surface level is at. This model represents the Arctic. In the Tupperware with clay, fill the bottom with a bit of water and mark where the surface of the water is at. Then place the ice cubes on top of the clay. This model represents Antarctica.
4	**Ask the students what they predict will happen in these two models as the ice melts.** Leave the two models in front of the lamp while you start the next part of this activity. Come back to it after the students work through the next model. You should be able to see that the water level has increased in the Antarctic model because the ice melt-off is adding to the volume of the water. In the Arctic, the ice was already in the water and therefore does not change the total volume of the water as it melts.
	What is the effect of the sea level rising?
1	Now tell the students that while they wait for the ice to melt they are going to learn how scientists study the effects of the sea level rising on the coastlines. **Ask the students how they think coastlines have been affected by sea ice melting.**
2	Tell the students the basin and landform is a model of an island in the ocean. Fill the pitcher with water and add a few drops of blue food coloring. Then fill the

	basin with about an inch of water.
3	Place the clear acrylic over the basin and have the students to use a marker to trace around the outside edge of the island landform.
4	After they draw the outside edge, add more water to the basin. Have them draw a new line after each addition of water. Repeat this process 3 or 4 times until they have drawn a topographic map.
5	**Ask them if they know what topography means or if they have ever seen a topographic map.** Topography is the study of the shape and features of a landform. **You can also ask them if they understand what the addition of water represents in this model.** Adding more water between each line represents how much the sea level is rising due to ice melting.
6	After they have drawn their map, **ask the students if they know what the lines represent on the clear acrylic.** They have drawn a topographic map that represents how much the coastline has changed on this island due to rising sea levels. Make sure they know that this is not a typical topographic map. This map is different because each line they drew represents the coastline at different points in time, rather than showing the topography of the island at one point in time. Their map shows how the coastline has changed as the sea level rises. There could be months to years between each line that they drew.
7	**Ask them to explain how all three of these models relate.** As the average global temperature rises, more of the glaciers in Antarctica are melting which contributes to rising sea levels. As the sea level rises, the coast lines are being affected dramatically. Scientists can monitor and asses these issues by using models and by mapping the change in coast lines.

Discussion:

Ask them why they think it is important to track the changes in the coastline?

> Rising sea levels will have consequences for life around the world. Many people and animals depend on the ocean and on stable coastlines. Man of the world's largest cities are found on coast lines. As the sea level rises, these cities will be directly affected.

In the model, the water is raising in the basin because the sea level is rising. Why that is occurring on Earth right now? What are other causes of sea level rising?

> Rising sea levels are caused by climate change. As the Earth warms, the ocean absorbs heat and expands. Glaciers and ice sheets on land melt, adding water to the ocean. Within our lifetime, we'll see major changes to ocean coastlines.

Ask the students what they know about NASA and what they study (many students will be surprised to learn that NASA studies the Earth, not just space).

> Scientists are monitoring sea levels, providing information that can help us prepare for and adapt to changes. Researchers keep a long-term record of sea surface height to predict how rapidly sea levels are rising and how those changes will affect coastal areas and communities. For example, NASA's Jason-3 spacecraft uses radar to measure the height of the ocean. The satellite also records wind speeds and wave heights. These data help scientists determine how climate change is affecting the world's oceans and develop accurate models of what will happen in the years to come. It's up to all of us to take this information into account and plan for the future.

[Investigating Albedo](https://www.youtube.com/watch?v=yD2cEk-J9Qg&list=PLa3BRSex0pXzgivsqrJuvjyXCFKylfmUu&index=3)

https://www.youtube.com/watch?v=yD2cEk-J9Qg&list=PLa3BRSex0pXzgivsqrJuvjyXCFKylfmUu&index=3

Passport Question: What absorbs more heat, dark pavement or a snowy glacier?

Passport Answer: Dark pavement

Background:

What Is Albedo? While the Earth's temperature is dependent upon the greenhouse-like action of the atmosphere, the amount of energy retained by the Earth is strongly dependent on the albedo of Earth surfaces. Just as some clouds reflect solar energy into space, so do light-colored land surfaces. Scientists use the term **albedo** to define the percentage of solar energy reflected back by a surface. This surface-albedo-effect strongly influences the absorption of sunlight. Forests, grasslands, ocean surfaces, ice caps, deserts, and cities all absorb, reflect, and radiate solar energy differently. Sunlight falling on a white glacier surface strongly reflects back into space, resulting in minimal heating of the surface and lower atmosphere. Sunlight falling on dark soil or rocks is strongly absorbed, and contributes to significant heating of the Earth's surface and lower atmosphere.

Understanding local, regional, and global albedo effects is critical to predicting global climate change. Light colored ice and snow are very weakly absorptive, reflecting 80-90% of incoming solar energy. Dark-colored land surfaces, are strongly absorptive and contribute to warming, reflecting only 10-20% of the incoming solar energy. If global temperatures increase, snow and ice cover may shrink. The exposed darker surfaces underneath may absorb more solar radiation, causing further warming. The magnitude of the effect is currently a matter of serious scientific study and debate.

Supplies:

- 2 Lamps with 150 watt bulb
- 2 Laser Thermometers
- Satellite images of cities from space and glaciers
- Images of the globe in winter/summer

Procedure:

Procedure	
1	Ask students if they have ever noticed that wearing a black shirt on a warm, sunny day made them hotter. Ask them if they have noticed that they are hotter when standing on blacktop pavement/asphalt or a paler cement surface. Why is that the case? Discuss how dark surfaces absorb light (or the sun's energy and transforms it into heat energy.
2	Ask students what they think might happen if the Earth was wearing a white or black tee-shirt. Of course, the Earth cannot wear a tee-shirt and, the color of the

	Earth's surface is not the same everywhere. Show students the pictures of the globe. What colors do they see? Which parts of the Earth are the lightest colors? Which are the darkest? Where do they expect that most sunlight will be absorbed? Where do they expect that the least sunlight will be absorbed?
3	Have groups look at the laminated world map. Ask students what they see in the picture. The dark parts of the map could be land or ocean. The white sections are ice and snow. Most of our ice and snow is held at the poles and in glaciers. Explain what a glacier is (persistent body of dense ice that is constantly moving under its own weight; it forms where the accumulation of snow exceeds melting and sublimation over many years, often centuries).
4	Ask students to make a hypothesis about which areas of the photograph they think would absorb the most solar energy and which would absorb the least.
5	Have one lamp over one picture of the globe. Have the other lamp over the other picture of the globe.
6	Turn the lamps on over the pictures, wait about a minute and have the students examine the difference in temperature over different colored areas on the map using the laser thermometers. Ask the students if their hypothesis was correct. The dark colored area should get hotter faster. After about a minute or two turn the lamps off.
7	You can then add a clear transparency over the picture of the earth. The pictures should get hotter a little faster.
8	Have them examine temperatures again. You should see the dark areas getting hotter even faster. The light areas will get hot as well.
9	You can then experiment with the other laminated pictures and discuss the difference between asphalt and grasslands. We sometimes pave over grasslands to build parking lots. How does this influence albedo?

Discussion:

Point out how this model is different than the real world (For example, would either ice or the land surface ever get to those temperatures?) This model shows relative differences based on the color of the surface but does not take into account the type of material or its reflective abilities. Explain that ice is melting. How would less ice affect the system?

In our lake conditions app we can check the temperature of different places around the lake. We have placed temperature sensors at these locations in order to study how temperature in those places changes by season. The sensor placed near to Zephyr cove always reads about 10-15 degrees hotter than the other stations. Why do you think that is?

The station is always 10-15 degrees hotter because it is placed right next to an asphalt surface whose radiant heat is warming the sensor. If it were next to a lighter colored surface, the reading would be much cooler.

Why did we add the sheets of clear plastic?

We added the plastic to simulate a thicker atmosphere. Similar to our atmosphere, the sheets of plastic trap heat but also let some heat out. The more greenhouse gases we add to our atmosphere the thicker it will become and the more heat it will retain.

Domino Effect – As the globe warms and the earth becomes hotter, more and more of our ice and snow will melt. Buried underneath much of our ice and snow is dark colored rock. As the reflective snow and ice is melted, the darker rock underneath will absorb more heat and in turn melt the surround ice at an even faster rate. This is known as a domino effect, one change leading to another, which leads to another and so on, and so forth.

These dark and light colors can cause something called the urban heat island effect. When we alter the natural landscape by building cities we change the reflectivity of the surface. By building dark colored structures we can actually raise the temperature of a city by several degrees. Sometimes, the temperature spikes can be so high that they are harmful to organisms living in the city, even to humans!