**Weather**

**Lesson #1:** **Atmosphere and Air Pressure**

**Time Frame:** 60 minutes

**Reminder:** For one of the demonstrations the gallon jar must be refrigerated overnight.

**Learning Standards:**

*Science*

Earth and Space Science: Weather

1. Explain how air temperature, moisture, wind speed and direction, and precipitation make up the weather in a particular place and time.

**Student will be able to:**

1. Describe the atmosphere of the earth and air pressure.
2. Explain how different levels of air pressure create weather.

**Resources and Materials:**

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| **Item** | **Amount** |
| Science notebooks |  |
| Atmosphere diagram | 30 (in bin) |
| Objects in the atmosphere diagram | 30 (in bin) |
| Gallon jar | 1 (in bin) |
| Made balance | 1 (in bin) |
| Brown paper bags | 10 (in bin) |
| Light bulb | 1 (in bin) |
| Hot Air Balloon Book | 1 (in bin) |
| **Optional Activity:**  Straws  Gallon plastic bags  Masking tape  Two folding tables around 3’ by 6’ | 3 boxes (in bin)  40 (reuse) (in bin)  1 (in bin)  2 (not provided) |

**Focus Activity:** Show the weather segment of the news station at the school, or show a recent weather broadcast from YouTube. Discuss the following questions as a class: Why is weather important enough to be a part of the daily news? How does it affect our daily lives? What types of weather vocabulary did you hear during the broadcast? Make a list on the board and discuss possible definitions.

**Introduction:** The **atmosphere** is the layer of gases surrounding the earth. Explain that weather is the condition of the atmosphere and results from the interaction between the sun, the atmosphere, and the earth. Weather involves heat or cold, wetness or dryness, calm or storm, and clearness or cloudiness. Explain that meteorology is the study of weather patterns and making weather predictions. Explain that they will learn more about the atmosphere and air pressure to understand more about weather.

**Activity:**

1. Hand out the diagram of the earth’s atmosphere and the diagram showing the location of different objects in the atmosphere to the class. Discuss that the atmosphere has different layers. It is thickest near the surface (more gas molecules) and thins out with height until it eventually merges with space. Note: This information is meant to provide students with a brief introduction to these ideas.
   1. The **troposphere** is the first layer above the surface and contains half of the Earth's atmosphere. Weather occurs in this layer.
   2. Many jet aircrafts fly in the upper troposphere or **stratosphere** because it is very stable. Also, the ozone layer in the stratosphere absorbs harmful rays from the sun.
   3. Meteors or rock fragments burn up in the **mesosphere**.
   4. The **thermosphere** is a layer with auroras. It is also where the space shuttle orbits.
   5. The atmosphere merges into space in the extremely thin **exosphere**. This is the upper limit of the atmosphere.
2. Where would students send a weather balloon? Ask the students to discuss this question in pairs or small groups and then share responses and discuss as a class. (You would send it above the clouds in the troposphere so that you could see weather patterns that affect your location from far away.)
3. Define and discuss **air pressure** with the class. Discuss pressure as related to the idea of weight. Ask a student volunteer to come to the front of the room and load their arm with books. Ask them how their feet feel, is there more pressure on their feet? If air weighs more, then it feels heavier. Write the definition on the board.

**Air pressure:** weight of molecules pressing down on the earth due to gravity, the heavier the weight of the air, the more air pressure on the earth’s surface

1. Explain that air pressure is all around us. Do a demonstration in front of the class to show the difference in air pressure between hot air and cold air. Do this by hanging one of the made balances from a chair, bookshelf, etc. With string, suspend small paper bags, mouth side up, from either end of the stick. Adjust the stick until the system is in balance.
   1. Place an open gallon jar in an upright position in a freezer over night. **(Note: The teacher must do this the day before the demonstration.)** Just prior to the demonstration, remove the jar from the freezer. In transit from the freezer to the demonstration, keep the jar in an upright position.
   2. Pour the cold air from the jar into one of the bags. Ask the students to explain what they observe. Since there are more air molecules in cold air than in the same volume of warm air, the cold air is heavier and the bag containing the cold air sinks.
   3. Have students propose ways to demonstrate the same effect by heating the air in one of the bags. (Tie the bags with their mouths facing downward. Place an incandescent light bulb beneath one of the bags. The bulb heats the air, causing the molecules to move faster, bounce off of each other, and move farther apart. This causes some of the molecules to be pushed out of the bag. With fewer molecules in the heated bag than in the cooler bag, the heated bag is lighter and will rise.)
2. Watch the video segment about hot air balloons:

https://www.youtube.com/watch?v=77Ej\_Ayugxk

1. Discuss how a hot air balloon demonstrates what happens in the atmosphere. Use the book provided about hot air balloons to show pictures. As air is heated it expands, gets lighter, and rises, and when air cools it contracts (gets smaller) and lowers. Warm molecules spread out and rise. Cooler molecules come closer together (more dense) and sink. Cold air is heavier than warm air. Lighter warm air creates less (lower) pressure on the earth and heavier colder air creates more (higher) pressure on the earth.

**Closure:** Discuss the following questions with the class. What is the atmosphere made of? Why is the atmosphere important to understanding weather? How could you make a hot air balloon rise? How could you make a hot air balloon go back down to the ground?

**Assessment:** Science notebook responses, participation in class activities and discussions

**Optional Activity to Demonstrate the Power of Air Pressure**: Complete this activity as a class. **Note:** This activity requires two identical folding tables that can support the weight of a person. These tables are not provided so please plan to get them in advance with your teacher.

**Materials:** Straws, gallon plastic bags, masking tape, two folding tables around 3’ by 6’ (not provided)

**Procedure:**

1. Make a cuff around each bag so the openings are 3 inches wide. Keep the bag flat and insert the straw into the bag with about 5 inches of the straw sticking out. Tape the straw to the bag so that it cannot move.
2. Using masking tape, seal up the bag around the straw so that no air escapes when the students blow into the bags. After testing the bags for leaks, remove all of the air again.
3. Have the students place their bags flat on top of the first table with only the straws sticking out. Then, place the second table on top of the first table.
4. The teacher or a student can now climb up and sit on top of the upside down second table.
5. Ask each student to return to their straw and blow into their straw, all at the same time (will take around 15 students). Observe and discuss the results. What happens to the table? Where does the force to lift the table come from? Discuss the power of air pressure. **Extension:** Try to same activity with objects of different weights.



