What Does Weather Have To "Dew" With It?

Key Topics: Weather Station, Climate, Atmosphere, Precipitation, Weather Tracking Tools, Humidity, Air Pressure, Wind
Grade Levels: K, 3
Inside and Outside

Lesson Overview:

Since weather plays a big role in the success of school gardens, students will learn to observe and make sense of it! Students will learn how to track different types of weather components through engineering homemade, weather-measuring devices to help them observe rain, air pressure, humidity, and wind. Students will measure and describe weather, think and act like scientists, look for patterns, and make sense of data to understand weather's impact on plant growth!

Suggested Time Allowance:

Part 1 - Weather Observation Warm Up, Intro to Weather Tracking Instruments: 20 minutes
Part 2 - Engineering Weather Tracking Instruments and Presenting: 30 minutes
Part 3 - How Will We Record Our Data? Wrap Up Discussion: 10 minutes

Suggested Activities and Learning Objectives by Grade Level:

- K:
  - K-ESS2-1 Observe local weather patterns over time.
  - K-ESS3-2 How can we forecast severe weather?
- 3:
  - 3-ESS2-1 Record weather patterns in a particular season.

Essential Question(s) that Connect CCCs and SEPs:

- What factors affect our local weather? How does weather impact our garden? Although a certain amount of rain may fall in your garden in a given period, not all plant roots will have the same access to it. What are some relationships between plants, water, and other environmental factors? (Cause and Effect; Asking Questions and Defining Problems)
- What is the desired outcome of the weather tracking instrument? How can we model a structure to perform this function? What is the purpose of the material? (Structure and Function; Asking Questions and Defining Problems; Developing and Using Models)
- How can I explain how the structure of our weather instrument is related to the function? What is the purpose of the different materials used? Did you change your design throughout the

engineering to improve the function? (Structure and Function; Construct Explanations and Design Solutions)

Materials:

- Daily Weather Chart (see prep below)
- Guidance Sheets
- Rain Gauge
  - Rain Gauge Photo
  - Container - large can, clear glass jar, or clear plastic container. (Clear works best for students to take measurements)
  - Straw
  - Ruler (from their classroom to assist with marking measurements)
  - Sharpie
- Barometer
  - Barometer Photo
  - Large can of large glass jar
  - Balloon material or plastic wrap
  - Rubberband
  - 1 or 2 straws
  - Glue or tape
- Hygrometer
  - Hygrometer Photo
  - Thick piece of cardboard
  - Thick paper or plastic (to be cut into arrow)
  - Scissors
  - Tape
  - Marker
  - A piece of hair 12 inches
  - Thumbtack
- Anemometer
  - Anemometer Picture
  - Five three-ounce paper cups (such as Dixie Cups)
  - Paper hole punch or sharpened pencil
  - Ruler
  - Two straws
  - Pin
  - Stapler
  - Pencil with eraser
- Windsock
  - Windsock Variations Photo
  - Container - plastic container (yogurt), bottomless tin can, a ring of some sort
  - Body - plastic recycle bag, paper bag, paper to make a hollow tube
  - Paper, ribbon, string, etc for decoration
  - Scissors
  - Tape
  - Paper hole punch or sharpened pencil

- Weather Vane
    - Weather Vane Photo
    - A piece of clay
    - Square piece of cardboard – a piece from a cereal box will do
    - Pencil with a fresh eraser
    - Pin
    - Straw
    - Scissors
    - Construction paper
    - Markers or crayons
    - Compass

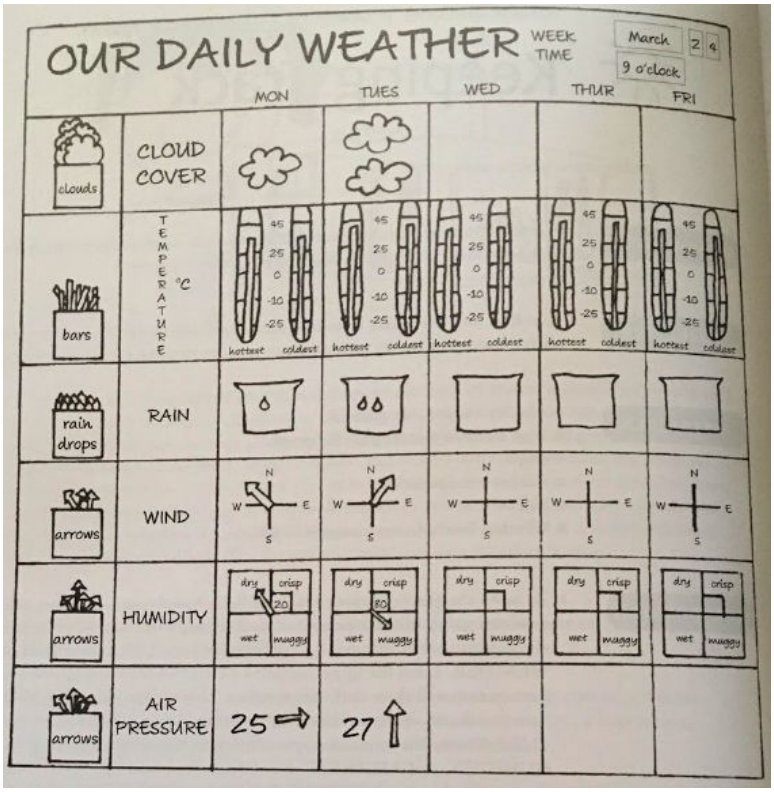
EG Team Support Needed:

- Collect items that can be upcycled into weather tracking instruments eg. plastic containers, tin cans, glass jars, plastic bags, paper bags, ribbon, straws, pencils, and balloons.

Prep:

Ample table space is needed for the engineering of the weather instruments, and therefore inside may be more accommodating to this activity. If you would like to do this activity outside, please plan for workstations by checking out tables from the custodian on your campus. You may also have the students do the initial weather observation warm up activity outside.

- Pre-choose 2-4 weather instruments that you will have your class construct! For K-2nd grade, you will construct these as one large group using equity sticks to involve children. For 3rd-5th grade, you will break students into groups of 4-5 and have each group engineer an instrument (they could all engineer the same kind, or each group could engineer a different instrument!)
- Decide ahead of time with classroom teacher where they will keep their weather tracking instruments. Discuss that after the experiment design and set-up, it will be the classroom's responsibility to track their weather for one week to get the most out of the lesson. Tell the teacher that you will be providing them with a classroom weather data collection chart for them to easily track the weather readings from their tools.
- Anemometer: Prepare four cups this way: Punch one hole in the side of each cup, about one half an inch below the rim. For the fifth cup, punch four equally spaced holes in its sides, about one quarter an inch below the rim. Also punch one hole in the center of the bottom.
- Make a daily weather chart prior to the lesson on a large piece of butcher paper. You can adapt the one below! Because students will be engineering their own weather tracking tools, results will not be as precise to provide numbers for humidity and air pressure. Students will record data however makes sense to the class!



Activity Procedure:

Engage:

Divide the class into groups of six. Have each group silently pass around a piece of paper with each person adding one observation about today's weather. Set a time limit of two minutes. *How many different observations did your group make?* List on the board the types of observations students made: temperature, wind speed, shape of clouds, and so on.

Comprehension Check

Write the following underlined question on the board, record answers, and discuss with the class:

What is weather? Weather is the stuff that happens outside the window and changes on a daily basis eg. fog, rain, wind, sun. *What is our local weather pattern like? What factors affect our local weather?* (lattitude, global wind directions, being near an ocean or near mountains.)

How does weather impact our garden? (Cause and Effect; Asking Questions and Defining Problems) As gardeners, we respond to the weather. If it is raining outside, we don't need to water the garden. If it is freezing, we protect transplants from the frost. Different fruits and vegetables grow in different seasons based on the weather and amount of daylight hours. For example, watermelons like hot weather and grow in summertime. They also like a lot of water, so knowing the weather forecast allows us to plan for how often we should water the garden.

How could tracking the weather help us as gardeners? What do you think the temperature is right now? How could we find out? How can we tell the wind direction? Do you know of any tools to help us track

weather? Tracking weather allows us to know when conditions are right for seeds and transplants, when to protect tender transplants from frost, and when to provide "rain" when Mother Nature doesn't. Scientists have developed instruments to help us accurately describe our weather. By accurately recording our weather we can compare it from day to day, average it to find out what it is usually like, and prepare for upcoming weather. Today we are going to build our own weather tracking tools!

Explore and Explain:
Use the following instructions to make your own rain gauge, barometer, hygrometer, wind sock or anemometer, and weather vane. Remind students what the callback will be for these projects (give me 5, silent coyote, chime, etc) and stick with it! Explain that we are first going to take a look at what these tools measure and how they work. **After we discuss all of the weather tracking tools** (only discuss the ones you have pre-chosen for them to engineer), then we'll make our own! Groups will be given materials and parameters but will have the freedom to be creative in their design. Do you think you can improve on any of these tools? Let's try it!

Rain Gauge: Since water is vital to plant growth (the rule of thumb is an inch a week for garden plants), growers should be able to keep tabs on rainfall. A rain gauge collects and measures rainfall so that we know how many inches of precipitation we received. The basic components are a collection vessel and a measurer of some type.

Action:

1) Ask students to raise their hands to share: Challenge them to come up with suggestions for building a tool to track the amount of precipitation in a given time period.
2) Show students all of the materials they will be working with to create their rain gauge and give them a couple minutes to brainstorm how they might construct it. Let students know that the ruler is to assist them with marking increments (on the straw and container) and not for them to incorporate into their design. What is the desired outcome of the rain gauge? What is the purpose of the straw and ruler? (Structure and Function; Asking Questions and Defining Problems; Developing and Using Models)

3) Display the photo of the rain gauge.

*Discuss the next weather tracking tool with your students. Circle back after discussing all of the tools to have students begin engineering.

How to construct:

- They'll need a container for collecting rainwater, such as a straight-sided coffee can or a clear glass jar.
- They will also need a way to measure collected rain. One method is to mark a clear plastic straw with inches or centimeters (and fractions), and insert it into the bottom of the container daily or weekly, depending on how often you want to record data. By putting a finger on top of the straw and withdrawing it, students will be able to keep the measured water within the straw as they remove it from the container and read the rainfall depth. Demonstrate this for your students!
- Mark both the container and the clear plastic straw with inches and centimeters using a sharpie and a ruler.

Barometer: If we want to predict when our gardens and habitats might see some rain, then we should tune in to air pressure! In general, high pressure means that clearing or fair weather is in store. Decreasing air pressure often indicated that clouds and precipitation are looming. Here's how we will make a simple barometer:

Action:

1) Ask students to raise their hands to share: Challenge them to come up with suggestions for building a tool to measure air pressure.
2) Show students all of the materials they will be working with to create their barometer and give them a couple minutes to brainstorm how they might construct it. Let students know that the plastic wrap / balloon material is to be attached to the top of the jar. Explain that high pressure will make the balloon or plastic wrap cave in. *What type of weather is this high pressure forecasting?* (Clear weather!) *What type of weather is this low pressure forecasting?* (Clouds and precipitation!) What is the purpose of the straw? How could the straw be attached to help us in measuring air pressure? What would happen if the straw was attached to the top (like in the

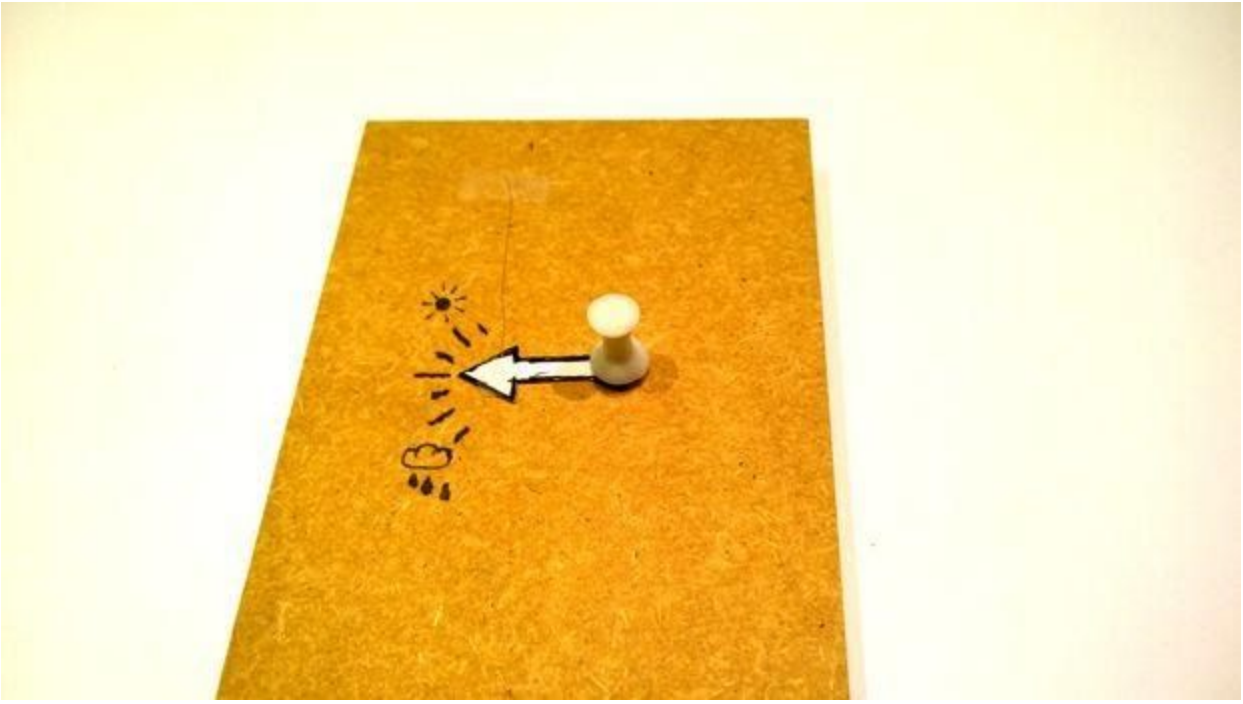
photo) and the plastic expanded? (Structure and Function; Asking Questions and Defining Problems; Developing and Using Models)

3) Display the laminated photo of the barometer

*Discuss the next weather tracking tool with your students. Circle back after discussing all of the tools to have students begin engineering.

How to construct:

- Stretch a layer of balloon material or plastic wrap over the top of a jar or coffee can to form a membrane. Secure it with a rubber band, ensuring that there is a good seal so the can is airtight.
- Place a straw horizontally across the top of the container with about two-thirds of it on the container. Glue or tape the straw to the stretch membrane. (To observe more exaggerated movement of the straw as air pressure changes, tape another straw to the end of the first one.)
- Next, challenge students to figure out how to record the straw's movement. They might tape an index card to the can and record the location of the straw daily or place the barometer near a sheet of paper on a wall and record the straw's movement on the paper. Challenge students to track changes in air pressure over time and look for related patterns of changes in weather. How accurately can they predict storms using their barometer?



Hygrometer: The next weather tool we are going to make measures humidity. *Who knows what humidity is?* Humidity is the amount of water vapor in the air. The more vapor, the higher the humidity. It is the opposite of a dry day. *What does the air feel like after it has rained? Why should gardeners care?* When humidity is low, plants tend to dry out faster. More important, low humidity and frost can go hand in hand. When night skies are clear (with no clouds to act as a blanket), the earth loses heat. When the air cools to the point where it can no longer hold water vapor, the vapor condenses and forms dew. If the air temperature is below this "dew point" and below freezing, frost occurs.

Did you ever notice that humidity and "bad hair days" sometimes go hand-in-hand? Hair has a special hidden ability to shrink when dry and expand when wet. Scientists in 1783 used that concept to create a cool tool – a "hair hygrometer" – for measuring changes in humidity. When there is more moisture in air the hair will be longer and the arrow will point more downwards. When the air is dry, the hair will shrink and move arrow upwards.

Action:

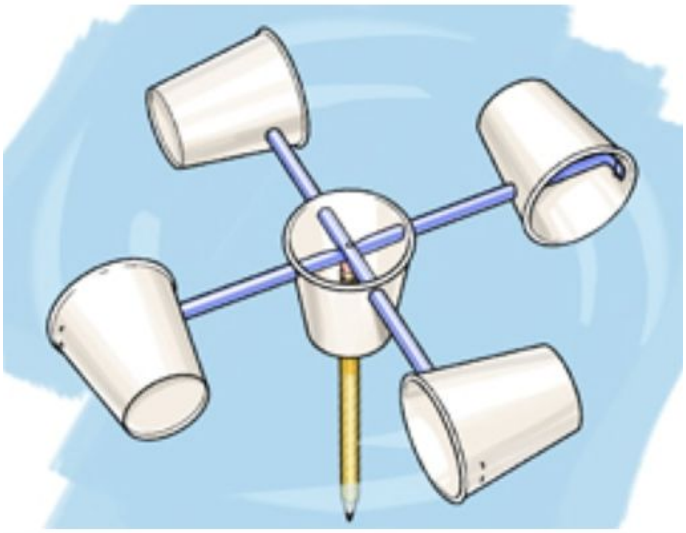
1) Show students all of the materials they will be working with to create their hygrometer and give them a couple minutes to brainstorm how they might construct it. *What is the purpose of the piece of hair? What happens to hair if there is moisture in the air? (It gets longer!) How can we incorporate the hair into our design to help raise and lower the arrow?* (Structure and Function; Asking Questions and Defining Problems; Developing and Using Models)
2) Display the laminated photo of the hygrometer.

*Discuss the next weather tracking tool with your students. Circle back after discussing all of the tools to have students begin engineering.

How to construct:

- Draw an arrow on a thick piece of paper or plastic. The arrow doesn't have to be big. Cut it out using scissors.
- Help students with this next step. Make a hole in the arrow to make a pivot point. The hole needs to be a little bigger than the pin so the arrow can move freely. You can check it by twisting the pin. It is loose enough when you hold the pin with one hand in the air and the arrow always points down no matter which way you turn the pin. When you finish, pin the arrow to the cardboard/plywood and check again if the arrow spins freely. Unpin for the next step.
- Cut one small piece of tape and stick it to the hair (about 12 inches long) and then to the arrow. Pin the arrow to the cardboard and tape the other end of hair to it so that the arrow is horizontal and the strand of hair is vertical (see laminated photo for example)
- The pointer on your hygrometer is now set to show changes in humidity! We now need to draw a guide on the sign that lets the reader know what they are looking at. Draw a sample picture of a cloud with rain drops and a picture of a sun on the board. Draw bar lines to the side of where the arrow is pointing. *Does the cloud with raindrops signify high humidity or low humidity? Where should we draw the cloud with raindrops, the top or bottom? Why?* The bottom! When there is a lot of moisture in the air (high humidity), the hair gets just a little bit longer. That makes the pointer droop lower. Pull one equity stick and have the student draw the cloud with raindrops on the hygrometer and label it high humidity.
- *How does hair react to low humidity?* When the air gets drier (low humidity), the hair gets a little bit shorter and the pointer goes higher. Pull one equity stick and have the student draw the sun on the hygrometer and label it low humidity.

Anemometer / Windsock: The next weather tool we are going to make measures wind speed! Have you ever wondered how wind is made? Wind is caused by a difference in air pressure. Air travels from areas of higher pressure to places where there is less pressure. Imagine a balloon. *The air stays inside if it is tied, but as soon as the opening is untied or the balloon pops, where does the air go?* It flows out of the



high-pressure area from in side of the balloon. Air in the atmosphere will do the same thing, moving to a lower pressure area, creating wind. The speed of that wind can be measured using a tool called an anemometer (or a windsock for younger kids K-2)!

Anemometer (3rd-5th)

Action:

1) Ask students to raise their hands to share: Challenge them to come up with suggestions for building a tool that could show wind speed.
2) Show students all of the materials they will be working with to create their anemometer and give them a couple minutes to brainstorm how they might construct it. *What is the desired outcome of the anemometer? What is the purpose of the cups?* (Structure and Function; Asking Questions and Defining Problems; Developing and Using Models)
3) Display the laminated photo of the anemometer.

*Discuss the next weather tracking tool with your students. Circle back after discussing all of the tools to have students begin engineering.

How to construct:

- Take a single-hole cup and push a straw through the hole until about one inch of the straw is inside the cup. Make sure the straw is horizontal and staple it to the side of the cup. Repeat this with another single-hole cup and straw.
- Push the empty end of each straw into one of the side holes in the five-hole cup and out the one across from it. Turn the cups so that they face the same direction. *Why do you think the cups should face the same direction?*
- Push the empty ends of each straw protruding from the fifth cup into the other two single-hole cups until about one inch of the straw is inside each cup. Turn the new cups so all the bottoms of the cups face the same direction. Staple the ends of the straws to the side of each cup like you did for the first two cups.
- After making sure all cups are about the same distance from the center of the five-hole cup, carefully push the pin through the two straws where they intersect, in the middle of the five-hole cup. Use caution when handling the sharp pin. *Why do you think it is important to use something as small as a pin for this?*

- Push the pencil through the hole in the bottom of the five-hole cup, eraser-end first, until it reaches the straws. Carefully push the pin into the eraser.
- The anemometer is now ready to measure wind speeds. While sitting down, try blowing very gently straight into one of the four open cups for a few seconds, then blow harder. *How did blowing harder change how the anemometer turns?*

Windsock (K-2nd)

Action:

1) Ask students to raise their hands to share: Challenge them to come up with suggestions for building a tool that could show wind speed.
2) Show students all of the materials they can work with to create their windsock and give them a couple minutes to brainstorm how they might construct it. *What is the desired outcome of the windsock? What is the purpose of the bags?* (Structure and Function; Asking Questions and Defining Problems; Developing and Using Models)
3) Display the laminated photo of the windsock.

*Discuss the next weather tracking tool with your students. Circle back after discussing all of the tools to have students begin engineering.

How to construct:

- Create an opening for the windsock. This could be by cutting the rim off an empty plastic yogurt or sour cream container to create a ring. It could also be a bottomless tin can, or other container.
- For the body of the windsock, students can use a recycle bag and keeping one corner intact, cut it into a large triangle. They can also use a paper bag, or wrap paper into a hollow tube.
- Attach the opening and body of the windsock. Eg. Put the plastic bag cone into the ring you created with the open side up, pulling almost all the way through. Wrap the edge of the bag over the ring and tape into place with clear packing tape.
- Make sure wind can pass through! Snip the end off the corner on the bag (now the end of the cone), or make sure that there is an opening if paper was rolled into a hollow tube.

- Students can decorate with long pieces of paper, ribbon, etc. for a more dramatic effect in the wind.
- Hole punch the body right near the opening. If you don't have a hole punch, you can use the tip of a pencil.
- Loop a piece of string around the opening through the hole you just made and tie a double knot. Leave a long end on the string.
- Tie the long end of the string to a post or high railing outside.
- Use the windsock to observe and record wind speed and wind direction. This is a great way to talk about compasses and to have younger students gain some practice with direction. If the cone is pointing North, the wind is blowing south. Wind speed can be gauged by the windsock's angle relative to the pole it is attached to. When there is very little wind, the windsock droops and at high wind speed, it flies horizontally.

Weather Vane: The next instrument we are going to construct will help us determine which direction the wind is blowing. *Has anyone ever ridden a bike with the wind? How does this feel different from riding a bike against the wind? How could the wind effect plants in our school garden? (*Wind can be rough on young plants! It can also cause evaporation of water. Think of fanning something in the wind to help it air dry).

1) Ask students to raise their hands to share: Challenge them to come up with suggestions for building a tool that could show which direction the wind is blowing.
2) Show students all of the materials they will be working with to create their weather vane and give them a couple minutes to brainstorm how they might construct it. *What is the desired outcome of the weather vane? What is the purpose of writing North, East, South, and West? If we knew that the wind often comes from one direction, what could we do to protect our plants from the wind? (*plant trees to create a natural wind block!) (Structure and Function; Asking Questions and Defining Problems; Developing and Using Models)

3) Display the laminated photo of the weather vane.

***Now that you have introduced all of the weather tracking tools and given some parameters for the design, use the recommendations below to assign small groups of 4-5 students to the weather tools they will be engineering!**

How to construct:

- Have the kids find North using a compass (or you can simply point out North if you know where it is). Then have them write North, South, East and West on the piece of cardboard. You can introduce mnemonic devices like ***N**ever **E**at **S**our **W**heat*, or, point out that West and East spell out **WE** on a compass.
- Cut a notch into each end of the straw.
- Cut an arrow and a tail out of construction paper. Slip them into the slits on the straw.
- Place a piece clay in the center of the cardboard. Stick the tip of the pencil into the clay.
- Use a pin to affix the straw to the top of the eraser. Make sure it's centered. You may also want to work the pin a bit to help the arrow spin more easily.
- Now observe. The arrow will point into the direction the wind is blowing.

Assigning Groups to Weather Tools

Break students into small groups of 4-5. Assign groups to weather tools through one of the following methods:

1. Ask rapid fire review questions! The first group to raise their hands with the correct answer gets to choose which tool they'll engineer.
2. Select groups who are showing they are ready to learn to select first (respectful, paying attention, sitting properly)
3. Pull equity sticks. Either allow the student from that group to select based on what their group would like to engineer, or have them pull a paper out of a jar with the tool written on it.

Provide groups with the laminated photo, a Guidance Sheet, and all of the materials they will use. Walk around and give guidance to struggling groups. Allow them 20 minutes to engineer their tracking instruments!

Elaborate:

Have groups present their designs to the class. Their presentation should include showing their tool and discussing how they expect it to function. Can you explain how the structure of your weather instrument is related to the function? What is the purpose of the different materials they used? Ask them to briefly share challenges and successes they had in their design build. Did you change your design throughout the engineering to improve the function? (Structure and Function; Construct Explanations and Design Solutions)

Present the Weather Tracking Chart to the class and determine how they will record humidity, air pressure, and rain. Because they have engineered their own tracking tools, they will not provide them with exact numbers. Let students track data in a way that makes sense to them and is relative to the data collected the previous days (Eg. they could number the bars on their hygrometer to give some sort of measurement, measure the difference in the barometer reading from the day before, etc.) Remind students that everyday for one week they should track the weather and record the data to share!

Where should we place our weather tracking tools? The rain gauge should be placed outside (It is, after all, the one tool you don't want to keep under cover!) The wind instruments should also be kept outside. The barometer and hygrometers can stay in the classroom, and for more dramatic results can be placed outside (in a covered area if raining) one hour prior to collecting data.

Evaluation:

Ask students to raise their hands to share:

Is there a relationship between shifts in humidity and the general weather? How do nighttime air temperatures, humidity, and the occurrence of dew or frost relate to one another? How do classmates' hairstyles vary with changes in humidity?

Although a certain amount of rain may fall in your garden in a given period, not all plant roots will have the same access to it. Why is this? (Water drains more quickly through sandier soils than through clay soils. Also, in a heavy downpour, much of the water that falls can run off the soil surface before soaking in.) Encourage students to observe the relationships among plants, water and other environmental factors. (Cause and Effect; Asking Questions and Defining Problems)

At this point the classroom teacher will take over monitoring the class weather tracking experiment. Remind the class that they should set aside time each day for one week to track the weather using their instruments. A great extension activity is to have a group of students prepare a weather report for the week. Encourage them to be creative. Their report should include a summary of the week's weather and how it affected school activities, explanations of environmental factors that affected the weather, a prediction for what the weather will be like on the weekend, and what types of activities are appropriate, considering the weather! To allow every student the opportunity to present, the teacher can have a new group of students give a weather report every day to the class.

Also, refer back to the Learning Objectives for your grade level and ensure that they have been met by asking the given learning objective question.

Extension Activities:

- Ask students to listen to the weather report on the evening news. What information is given? What kinds of instruments provide this information?
- Students can place instruments in different locations around their school campus and garden to measure variations in the weather.
- Exchange weather information with another school!

- Educate the whole school. Change the weather information daily on a bulletin board in a corridor or in the library or lunchroom.
- The following are passages from Native American writings or speeches from the mid-1800s: Rainy Day Stories - Mother Earth

Tips and Caveats:

Adaptations for K-2

❑ Engineer the weather tracking tools together as a class! Explain that we will walk through all of the steps together and make one of each tool for the class to use. *"We'll all contribute our ideas and when I need volunteers I'll be pulling equity sticks!"* (Most classroom teachers have equity sticks, which is a can full of popsicle sticks that each have a student's name. This makes it fair!)

Cited Curriculum:

- LifeLab - The Growing Classroom: Keeping Track
- LifeLab - The Growing Classroom: Station Creation
- Kidsgardening.org: Weather Tracking Tools
- Thechaosandtheclutter.com: How to Make Your Own Windsock
- Scientificamerican.com: Build an Anemometer
- Pbs.org: Make a Homemade Weather Vane