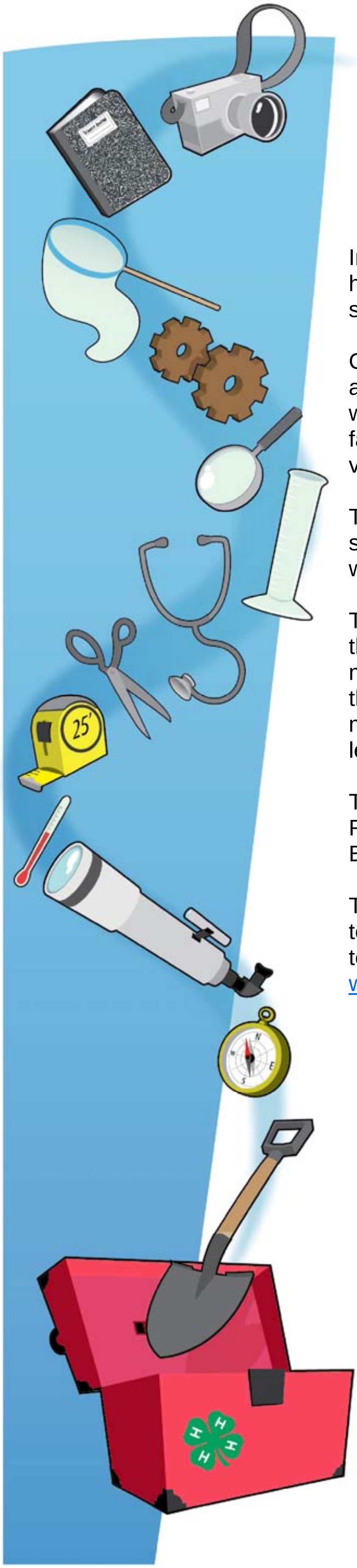
4-H Science Toolkit

Climate



About the 4-H Science Toolkit Series: Climate

In this series of activities, children will explore the impact of weather and climate on humans, animals and plants and begin to understand what causes wind, snowfall, storms and other weather events.

Children will create construction paper snowstorms, indoor thunderstorms, learn how a tree stump can reveal the climate of a region and create an instrument to measure wind speed. By recreating these natural events, children experiment with the various factors that affect weather and climate – humidity, air pressure, temperature and elevation.

They will also learn how weather forecasters use tools like contour maps to predict snowfall and temperature and discuss how animals and plants adapt to changing weather conditions.

These hands-on activities allow students to predict what will happen, test theories, then share their results. By gaining an understanding of the basic forces affecting climate, some of the mysteries of storms and wind are revealed and children can see the impact of human activity on climate and environment. They'll be introduced to climate vocabulary, gain an understanding of the importance of species diversity and learn how to be good environmental stewards.

The lessons in this unit were developed by and are connected to the Paleontological Research Institution in cooperation with Cornell University and Cornell Cooperative Extension.

To find out more about climate and its relation to the environment, visit the Paleontological Research Institution at www.pri.org and to find numerous resources related to climate, weather and environment, check out the 4-H Resource Directory at www.cerp.cornell.edu/4h.

Climate Table of Contents

- **What Causes a Storm?** Learn about the physical forces that cause rainfall and snowstorms.
- **Focus on Snowfall**. Discover how precipitation varies between locations
- **Temperature through Time**. Determine temperatures of past years using proxies like tree stumps.
- **Focus on Wind.** Create an instrument for measuring wind.
- **Water's Incredible Journey.** Understand the water cycle.
- **Climate and Organisms.** Understand the impact of climate on animals and plants and how they adapt.

4-H Science Toolkit

Climate:

What causes a storm?

Activity Series: Climate
Grade: 3-6
Time: 60 min

Main Idea

It takes a number of factors to cause rain, including humidity, warm temperatures and wind. Other atmospheric properties -- including density, air pressure, moisture and temperature – define an air mass that is involved in the creation of a thunderstorm.

Motivator

Climatologists and meteorologists are the scientists who study the reasons why rain happens. Let's create our own rain and thunderstorms to learn about the conditions that cause rain.

Pre-Activity Questions

Before you start the activity, ask the students:

- ❑ Does it rain often in a desert?
- ❑ Does it rain often at the North Pole or in other arctic areas?
- ❑ Why do you think so? What causes a thunderstorm to happen?

These activities will help us find out about the basic forces needed to create rain and thunderstorms.

Activity 1: Cloudy sky — make it rain!

Supplies

- ❑ Empty, clean glass jar (pickle jar, jam jar)
- ❑ Disposable pie pan
- ❑ 6-8 ice cubes
- ❑ Hot water

1. Pour hot water into the glass jar and cover it with the pie pan (right-side up).
2. Let sit for approximately one minute. What's happening inside the jar?
3. Place the ice cubes in the pie pan and watch what happens in the jar. Now what's happening in the jar? Why are droplets forming on the pie pan?

Activity 2: Stormy weather — make a thunderstorm!

Supplies

- ❑ Clear plastic/glass container (9x11 baking pan recommended)
- ❑ Water with blue food coloring
- ❑ Lukewarm water
- ❑ Red food coloring
- ❑ Ice cube tray

Objectives

- Learn about the water cycle.
- Discover forces that contribute to rainfall and storms.

Learning Standards

(See Matrix)

Common SET Abilities 4-H projects address:

Predict
Hypothesize
Evaluate
State a Problem
Research Problem
Test
Problem Solve
Design Solutions
Develop Solutions
Measure
Collect Data
Draw/Design
Build/Construct
Use tools
Observe
Communicate
Organize
Infer
Question
Plan Investigation
Summarize
Invent
Interpret
Categorize
Model/Graph
Troubleshoot
Redesign
Optimize
Collaborate
Compare

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4-H Science Toolkit

Climate:

What causes a storm?

Preparation (to be done before meeting):
Mix water with blue food coloring and pour into ice cube tray; freeze.

Activity:

1. Pour 1 inch of clear lukewarm water into the container, enough to cover ice cubes, but not too much to allow floating. Ask students what will happen when you add blue ice cubes to one end and red food coloring to the other.
2. Add one or two prepared ice cubes to the far end of the container.
3. Add three drops of red food coloring to the other end of the container.
4. Observe what happens to the water. Where does the cold water travel in the container? Where does the lukewarm water travel? Why is that happening?
5. Leave the container for a period of time and re-examine after all of the ice has melted and the water has come to room temperature. What has happened?
6. Repeat with a container of different size/shape, or by adding more/less water, predict what

Science Checkup - Questions to ask to evaluate what was learned

For activity 1:

- Why do you think we saw moisture in the jar and water drops? What was happening in the jar?
- Why do you think it was hard to see through the jar after we put the pie plate on top?
- What is the pie plate surface imitating/modeling from nature when rain forms in the atmosphere? (Answer: dust particles)

For activity 2:

- If you think of the lukewarm water as a normal summer day and the ice cubes as a cold front moving in, what does this experiment show you could happen under these circumstances?
- What happened when you used a different container? Why do you think you saw a different pattern to the colors?
- When you let the container sit for awhile, why do you think you got the result that you did? What happened to all of the various colors?

Extensions

- Introduce your group to the Community Collaborative Rain, Hail and Snow Network. CoCoRaHS is a unique, non-profit, community-based network of volunteers of all ages and backgrounds working together to measure and map precipitation (rain, hail and snow). Find out more at cocorahs.org.
- If you are already involved in the network, think about the characteristics of your community as you make rainfall observations. What does it feel like in the hours before a rainfall? Is it warm? Do your clothes feel like they are sticking to you because the air is so moist? What does it mean when someone describes the air as thick? Record these observations as you record your precipitation data.
- In addition to daily precipitation reports, CoCoRaHS allows you to upload information about intense rainfall and snowfall events. During the next predicted thunderstorm in your community, keep a piece of paper near the window and record when the rain first starts, when the heaviest rain occurs and subsides, and write a descriptive note about the storm event every half hour during the storm. You can then record these observations along with your daily rainfall report or under the "intense precipitation" section once you've logged into your account.

Vocabulary

Humidity: The amount of moisture available in the air.
Air mass: A large body of air with temperature, pressure, and moisture uniform throughout its mass but

changed by the environment through which it passes.
Precipitation: Rain, snow, or hail, all of which are formed by condensation of moisture in the atmosphere and fall to the ground.
Condensation: Tiny drops of water that form on a cold surface such as a window, or on tiny airborne dust particles, when warmer air comes into contact with it.
Climate belt: An area where the weather is nearly the same.
Spatial Variability: When measurements for something – for example, rainfall or snowfall – can differ greatly at different locations.

Background Information

For activity 1:

- A number of forces come together to create rain, including water availability in the air (humidity), a warm temperature to keep rain from turning to snow and winds to bring clouds and low pressure systems together to create a storm.
- In this activity, the hot water warmed the air inside the jar, allowing the air to expand and carry moisture.
- The moist air is trapped inside the jar by the pie pan, so when the ice is placed in the pie pan, the air in the jar is cooled. Cold air cannot hold as much water as warm air, so the water condenses on the pie pan and sides of the jar, making water droplets. These flow down the side of the jar, creating "rain." In the same way, warm, moist air from the Earth rises into the atmosphere, where eventually it is cooled, condenses and creates clouds and rainfall.
- When the hot water was poured into the jar and the pie pan was placed on top, the jar became opaque and hard to see through. This is the same process that forms clouds and fog. If we envision the jar as the Earth and atmosphere, the cloud forming is in the upper atmosphere. If we envision the top of the water as the Earth surface, the cloud forming represents fog, which occurs when the conditions for cloud formation exist at the Earth's surface.

For activity 2:

- The lukewarm water represents a normal, warm summer day. The addition of the ice cubes represents a cold front moving into the system. Cold air is denser than warm air, and as we saw in the activity, the cold forces the warm air up. Forcing the warm, moist air up in the atmosphere cools it, creating rainfall. Further, the air is then unstable, creating high winds and other characteristics typical of a thunderstorm.
- If you used a container with a different shape (circular, one with an uneven bottom, etc.) you may notice other phenomena. For instance, low points in a container with an uneven bottom may allow concentration of the cold, blue food coloring/water. This water is more dense and can concentrate in the low points without mixing.
- Some places in your container may not be affected by the food coloring and remain clear for a time. This represents the spatial variability of storms, and the monitoring of the variability of storms and precipitation is one of the reasons that CoCoRaHS was established.
- Once all of the water returns to room temperature, the water has freely mixed and is of equal density. The result is that the water has turned a shade of purple. This represents the aftermath of a storm. Once the pressure has been resolved, the system re-equilibrates.
- Thunderstorms happen when two very differently characterized air masses are forced together by wind movement or some other event. The air masses have to contain water and warm and cool conditions must combine. Warm air is capable of holding more water vapor in it than cool air. When a low pressure, high density cold front comes in, it forces the warm, moist air mass up. The higher in the atmosphere you travel, the cooler the temperature is. This activity allows us to see how a cool, dense mass can force a warmer, less dense mass upward, as well as observe the instability of the masses once this has occurred. Finally, if we let them interact long enough, the system re-equilibrates.

4-H Science Toolkit

Climate:
Focus on snowfall

Activity Series: Climate
Grade: 3-6
Time: 60 min

Main Idea

Weather forecasters can use contour maps to help find patterns in snowfall amounts during a storm.

Motivator

Ever wonder why you get three inches of snow at your house, while your friend up the hill gets two feet? A contour map can help show us why.

Pre-Activity Questions

Before you start the activity, ask the students:

- ❑ Ever wonder why you get three inches of snow at your house, while your friend up the hill gets two feet? A contour map can help show us why.

Activity: Confetti snow maps

Supplies

- ❑ Colored construction paper
- ❑ At least 15-20 paper cups. You may choose to use a numbered cup for each individual, or assign each group/individual a row of cups. Groups may choose to name their cups instead of numbering them, as long as each cup is distinctly identifiable
- ❑ Graph paper (Students could make their own graph paper on a plain piece of paper.)

Preparation (to be done before meeting):
Decide what amount of snowfall each color will represent.
For example:

- Blue and green may be light snowfall, 1 piece = 1 inch of snow
- Orange and red may be heavy snowfall, 1 piece = 2 inches of snow
- Or all colors could equal the same amount of snow

Cut construction paper into tiny pieces, so there is a large amount of multi-colored confetti available.

Activity:
1. Place the cups in a grid on the floor (4x4, 5x3, 3x3, etc., depending on the number of participants. See below.)

   *Note: Cups should not be placed too far apart; a grid with around 20 cups should cover no more than ~2 to 3 square feet.

   OOOOO
   OOOOO
   OOOOO *This would be a 4x5 grid shape
   OOOOO

Objectives

- Discover that precipitation varies between places.
- Create a contour map.

Learning Standards

(See Matrix)

Common SET Abilities 4-H projects address:

Predict
Hypothesize
Evaluate
State a Problem
Research Problem
Test
Problem Solve
Design Solutions
Develop Solutions
Measure
Collect Data
Draw/Design
Build/Construct
Use tools
Observe
Communicate
Organize
Infer
Question
Plan Investigation
Summarize
Invent
Interpret
Categorize
Model/Graph
Troubleshoot
Redesign
Optimize
Collaborate
Compare
Recognize patterns

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4-H Science Toolkit

Climate:

Focus on snowfall

2. Students should draw on their graph paper a grid that matches the arrangement of the cups on the floor, noting the name or number of each cup and labeling them. (See chart at right.)

Bobby's Cup	Jamie's Cup	Jill's Cup
Eleanor's Cup	Billy's Cup	Fred's Cup
Kate's Cup	Nikki's Cup	Jared's Cup

3. Grab a handful of confetti and toss it randomly over the grid arrangement of the cups
4. Have groups count the number of confetti pieces in their cup (i.e. four red pieces, two blue pieces, etc.) Be sure students record those numbers in the appropriate place on their graph paper.

Bobby's Cup Red/orange-1 Blue/green-2	Jamie's Cup Red/orange-2 Blue/green-0	Jill's Cup Red/orange-1 Blue/green-1
Eleanor's Cup Red/orange-0 Blue/green-3	Billy's Cup Red/orange-1 Blue/green-0	Fred's Cup Red/orange-1 Blue/green-1
Kate's Cup Red/orange-0 Blue/green-2	Nikki's Cup Red/orange-0 Blue/green-1	Jared's Cup Red/orange-2 Blue/green-1

Climate:
Focus on snowfall

5. Have students share their information with each other or record information on one large grid on a chalkboard or sheet of paper and allow students time to record from that master copy (see grid above).
6. Ask students to total up the amount of snow that fell in their cups and in their neighbors' cups (see totals below)

Bobby's Cup Red/orange-1 Blue/green-2 Total: 4 in	Jamie's Cup Red/orange-2 Blue/green-0 Total: 4 in	Jill's Cup Red/orange-1 Blue/green-1 Total: 3 in
Eleanor's Cup Red/orange-0 Blue/green-3 Total: 3 in	Billy's Cup Red/orange-1 Blue/green-0 Total: 3 in	Fred's Cup Red/orange-1 Blue/green-2 Total: 4 in
Kate's Cup Red/orange-0 Blue/green-2 Total: 2 in	Nikki's Cup Red/orange-0 Blue/green-1 Total: 1 in	Jared's Cup Red/orange-2 Blue/green-1 Total: 5in

7. Have students choose a color for each total and color the grid points the correct color. (For instance, all the 5 inch cups are blue, all the 4 inch cups red, all 3 inch cups pink, all 2 inch cups orange, all 1 inch cups yellow, all empty cups purple, etc.) OR go to step 8.
8. Students then may wish to make contour maps of snowfall by outlining all of the colored areas. This step works significantly better with a larger grid than the 3x3 that has been demonstrated thus far, so you may choose to skip this step if working with younger children or fewer cups.
9. Circle the cup/grid square with the highest amount of snowfall. If more than one cup had the same highest amount, make a circle that encompasses all of them, but none of the other snowfall amounts (how can you do this if some of the lower areas are in between?)
10. Find the cup/cups with the next highest amount of snowfall. Make a circle that encompasses them and the smaller circle with the higher amounts of snowfall. Be sure to avoid the lower amounts of snowfall.
11. Find the next highest amount of snowfall.
12. Repeat steps 10 and 11 until all snowfall amounts have been graphed in a contour map.

Bobby's Cup Red/orange-1 Blue/green-2 Total: 4 in	Jamie's Cup Red/orange-2 Blue/green-0 Total: 4 in	Jill's Cup Red/orange-1 Blue/green-1 Total: 3 in
Elenor's Cup Red/orange-0 Blue/green-3 Total: 3 in	Billy's Cup Red/orange-1 Blue/green-0 Total: 3 in	Fred's Cup Red/orange-1 Blue/green-2 Total: 4 in
Kate's Cup Red/orange-0 Blue/green-2 Total: 2 in	Nikki's Cup Red/orange-0 Blue/green-1 Total: 1 in	Jared's Cup Red/orange-2 Blue/green-1 Total: 5in

4-H Science Toolkit

Climate:
Focus on snowfall

Science Checkup - Questions to ask to evaluate what was learned

- ❑ How can snowfall totals affect where people decide to live?
- ❑ How can snowfall in one region be a benefit to another region?
- ❑ Is there any pattern to the contour map you made?
- ❑ How could a map like this help you during the next snowfall?

Extensions

- You may wish to make a 3-D model of the contour map, visually representing the density of snowfall with Play-Doh, paper mache or cup stacking, to better represent the amount of snowfall. This may be an appropriate county/state fair project with enough preparation.
- Using the CoCoRaHS Web site: http://www.cocorahs.org/, after a heavy snowfall in your area, print off a map of your state or county with all of the stations and their recorded snowfall data. Using what you've learned from this activity, draw a contour map of snowfall in your area and determine which parts of the county or state were hit hardest, and which received little to no snowfall

Vocabulary

Contour map: A map that uses curved contour lines to show a pattern; in our case it shows snowfall amounts.
Random: Something that has no identifiable pattern, plan, system, or connection.
Variable: Something that can change or vary, such as snowfall amounts in different regions.

Background Information/Resources

- This activity allows students to see that snowfall and other forms of precipitation can be variable.
- These precipitation patterns do exist in real life and affect where people live, where animals live and how snowfall buildup in one area can replenish rivers and lakes in many other areas. These patterns can seem very random over an area, with one side of town getting hail or snowfall, and the other side of town having nearly no snow or hail.
- Have students talk about different regions that experience different amounts of snowfall and other precipitation. Talk about how that precipitation affects where people are living.Snow falls on a mountaintop year-round. Few people live up in mountainous areas, yet the snow melts into the valleys below where people have settled
- Snow falls in the northern U.S. states. That snow melt trickles down streams and lakes and feeds more arid regions in the south like New Mexico and Arizona.

Activity Series: Climate
Grade: 3-6
Time: 60 min

Climate:
Temperature through time

Main Idea

All over the planet, organisms react to changing temperatures. From an organism's habitat, one can infer what type of climate, what consistent temperatures and how much or how little precipitation the organism can tolerate. With that knowledge, we can learn things about temperature long before we had accurate thermometers all over the globe. We can use nature's thermometers, the organisms themselves, to help figure out the temperatures of regions all over the planet for hundreds of years!

Motivator

Did you know that by looking at tree rings, you can "see" into the past, to determine what the weather and temperature were hundreds of years ago? Let's take a look and find out how.

Pre-Activity Questions

Before you start the activity, ask the students:

- ❑ How can you tell a tree's age by looking at an old tree stump?
- ❑ What other kinds of information can you gain?
- ❑ How could you find weather information for 200 years ago?

Activity: Tree ring treasure hunt

Supplies

- ❑ The History of Temperature handout
- ❑ The Stump Worksheet

The Stump Worksheet

In this activity, we will learn a little about how to read tree rings from a tree cookie like the one you see below. In the first part of the worksheet, we'll learn how to read the tree rings, and in the second part of the worksheet, we'll learn how to make a timeline from the tree rings.

Look at the tree stump picture on the next page to start the activity.

Objectives

- Learn about using proxies to determine past temperatures.

Learning Standards

(See Matrix)

Common SET Abilities 4-H projects address:

Predict
Hypothesize
Evaluate
State a Problem
Research Problem
Test
Problem Solve
Design Solutions
Develop Solutions
Measure
Collect Data
Draw/Design
Build/Construct
Use tools
Observe
Communicate
Organize
Infer
Question
Plan Investigation
Summarize
Invent
Interpret
Categorize
Model/Graph
Troubleshoot
Redesign
Optimize
Collaborate
Compare

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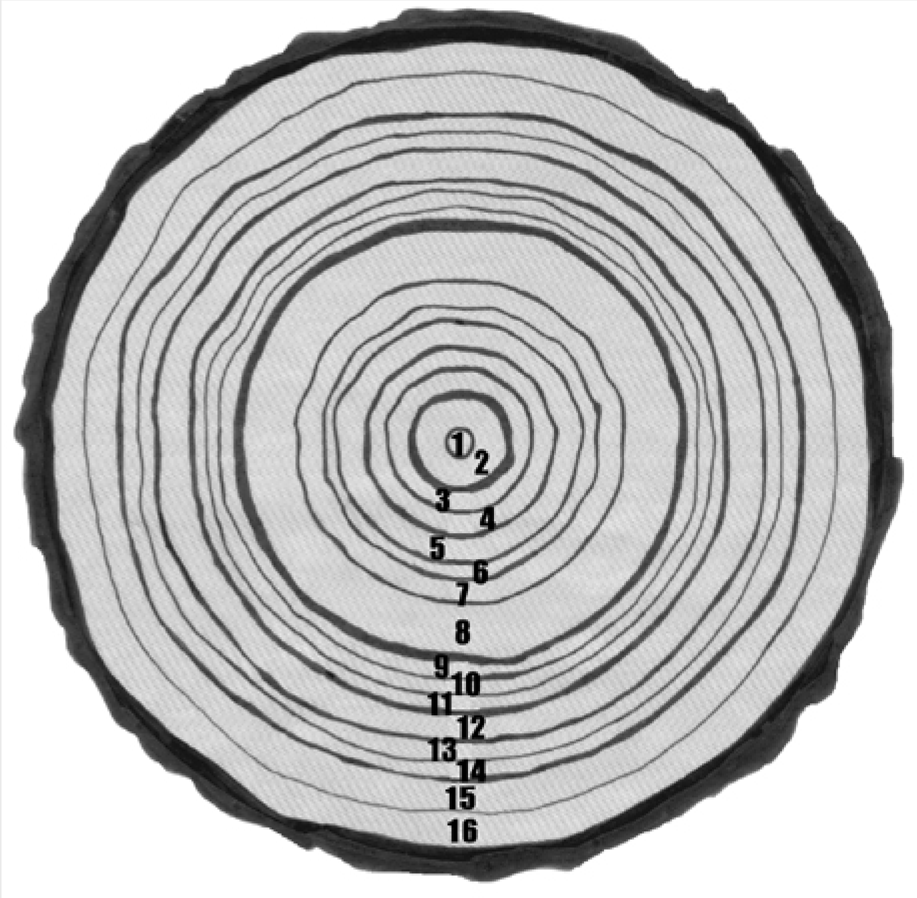
Climate:
Temperature through time



Part 1: Reading the tree rings

1. This tree was cut three years ago. Write that year: ________________
2. How old was the tree? _________________
3. What year did the tree start growing? _________________
4. Find the ring that grew the year you were born. Was it a wet or dry year? How do you know?
5. ____
6. In what year of growth was there the least rainfall? ________________
7. In what year of growth was there the most rainfall? ________________

Part 2: Making a timeline from tree rings

1. Take your tree cookie and fold it in half, so that the tree rings make a "C" shape.
2. Place the folded tree cookie on a clean sheet of paper.
3. With a pencil, place a small tick mark on the clean sheet of paper where each tree ring stops.
4. Remove the folded tree cookie paper.
5. You now have a series of vertical lines (tick marks). With a ruler, draw a horizontal line connecting each of the tick marks.

Climate:
Temperature through time

6. Extend the tick marks so each is around ¼'' long.
7. Based on what you learned in part 1 of this exercise, label the year each tick mark represents.
   You now have created a timeline from your tree rings!

Science Checkup - Questions to ask to evaluate what was learned

- ❑ What can tree rings tell us about the weather the tree lived through?
- ❑ What else can tree rings tell us other than information about weather and the age of the tree?
- ❑ What would wider rings signify?
- ❑ What would narrow rings signify?

Extensions

- If you can, find tree rings from two different trees growing in the same area. Do you see any patterns in the rings?

Vocabulary

Proxy information: Information you receive from another source, second-hand information.
Adapt: The way a plant or animal changes to suit different conditions or a different purpose.
Dendrochronologists: Scientists who study tree rings
Infer: To derive by reasoning; to conclude or judge from premises or evidence.

Background information

- Thickness of the tree rings tells us about the environment that the tree was growing in. If another tree starts growing 50 years after the first tree, and the second tree continues to grow for 50 years after the first tree has died, the years that both trees were alive at the same time will have the same tree rings. This is because they lived under the same environmental conditions. By finding multiple trees of different ages, we can 'paste' the tree rings together by matching up the parts of each tree that were alive at the same time. Just like a bar code, each series of years has its own unique signature, and when trees are alive during the same period of time, their signatures are the same. Some of the environmental conditions that can be inferred from tree rings include moisture, temperature, precipitation and even gas composition of the atmosphere.

The History of Temperature

We take our understanding of temperature for granted today. As we get up in the morning to start our days, newspapers and television sets forewarn us of the expected temperature highs and lows each day, so we are prepared when we leave the house. Many of us also look outside our window to see a thermometer displaying the temperature at our house at that moment. Our instruments for predicting and recording temperature have gotten much better through time, and we can certainly be thankful. Since around 1850, our thermometers have been accurately calibrated and our recordings have been frequent enough throughout the day for us to have a very accurate record of temperature each day in regions around the Earth.

We also can approximate (make an intelligent guess) the temperature without turning on our tv or looking out the window. Based on the area where you live, you know that winter will be chilly and summer will be warm. Farmers do this, too. Farmers and gardeners want to know when the last frost will be in their area so that they can plant their crops and flowers without fear of losing them to cold weather. To do this, they look up the temperature in their area in past years for each day to determine a good time to plant their crops. Using that information, they predict the earliest safe time to plant in their area that year, so that their plants will have plenty of time to grow without perishing in the cold weather.

Weather patterns that are consistent in an area for a long period of time constitute a climate. Having a warm or cold climate does not mean that every day will be warm or cold, certainly a cold climate can have some hot days, and a warm climate like Florida can have some very chilly days, even snowy days! But, on average, a warm climate will have mostly warm days and a cold climate will have mostly cold days.

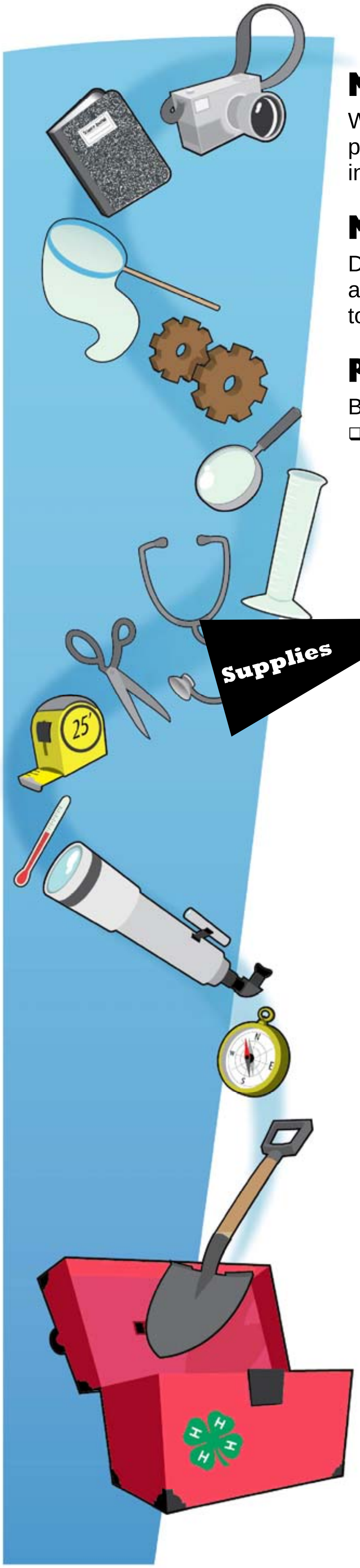
Humans are not the only creatures on Earth that are affected by changing temperatures; birds migrate south for the winter, deciduous trees shed their leaves and slow their growing until spring, bears hibernate until there is more food for them to feed on. All over the planet organisms react to changing temperatures. And where an organism lives relates to what type of climate, what consistent temperatures and precipitation the organism can tolerate. We certainly don't find palm trees in Canada, nor do we see many pine trees in Florida. Organisms may adapt their physiology and/or their behavior to a particular climate over long periods of time, so that they are able to handle the consistent temperatures and precipitation in their environment.

With that knowledge, we can learn things about temperature long before we had accurate thermometers all over the globe. We can use nature's thermometers, the organisms themselves, to help figure out the temperatures of regions all over the planet for hundreds of years!

This data is called proxy information, because it is recorded with second-hand knowledge. Think about a conversation you had recently with your parents, where you recount what you and your friends did at school one day, or at the beach. They don't get the accurate account of how you spent every minute of your day, but by the end of your story, especially if you were very detailed, they understand what you did, who was there, if you had fun, if you have homework, and other important information. They experienced your trip 'by proxy,' with second-hand information.

We're going to focus in on using trees as a proxy today. Trees can live a long time. There are some redwood trees in the US that are nearly 2000 years old! When trees die, often they fall into the swamp in which they are growing, or into a nearby lake and are preserved until geologists find them. And how do we calculate the age of the tree? Tree rings! Each year, a tree grows a new ring of wood under their bark. The width of the ring tells us about the climate that year because the growth rate depends largely on temperature and precipitation during the growing season. Trees grow more during warm, wet years (wider rings), and less during cold, dry years (narrow rings). They can also tell stories about extraordinary events that happened during the tree's life, like fires, that may have affected growth. Scientists who study tree rings are called dendrochronologists (dendro=tree, chronology=timeline).

When you look at the rings of trees alive since 1850, the width of the ring can be calibrated to the accurately recorded temperature and precipitation conditions of the year. Then, the older rings of live trees and those of dead trees can be used as proxies of temperature and precipitation for those years before we had accurate temperature records. In the case of the redwoods, we could get a temperature/precipitation record of the northwestern US for almost 2000 years!



Climate:
Focus on wind

Activity Series: Climate
Grade: 3-6
Time: 60 min

Main Idea

Wind is the movement of air masses caused by the tendancy of a temperature gradient to seek equilibrium. Wind is an important factor in creating our global climate.

Motivator

Did you know that wind causes ocean currents and helps move weather across the Earth? We're going to create a device, called an anemometer, to measure how strong the wind is blowing!

Pre-Activity Questions

Before you start the activity, ask the students:

- Do you know how weather forecasters measure wind?

Activity: Make your own wind dial

Supplies

- Five 3-oz paper Dixie cups
- Two straws
- Pin
- Paper punch
- Scissors
- Stapler or tape
- Sharp pencil with eraser

Activity:

1. Take four Dixie Cups and punch a hole in each, about one half inch below the rim.
2. Punch four equally spaced holes in the fifth cup, about a quarter inch below the rim.
3. Punch a hole in the center of the bottom of the fifth cup.
4. Take one of the first four cups and push a straw through the hole.
5. Fold the end of the straw, and staple it to the side of the cup across from the hole.
6. Repeat for another "one-hole" cup and the second straw.
7. Slide one cup and straw assembly through two opposite holes in the cup with four holes.
8. Push that straw through another "one-hole" cup, so that there is a cup on either end of the straw and one in the middle.
9. Bend the straw and staple it to the newest cup, being sure to make the cup face the opposite direction from the first cup. De-

Objectives

- To understand how wind is measured by making your own wind measuring device.

Learning Standards

(See Matrix)

Common SET Abilities 4-H projects address:

Predict
Hypothesize
Evaluate
State a Problem
Research Problem
Test
Problem Solve
Design Solutions
Develop Solutions
Measure
Collect Data
Draw/Design
Build/Construct
Use tools
Observe
Communicate
Organize
Infer
Question
Plan Investigation
Summarize
Invent
Interpret
Categorize
Model/Graph
Troubleshoot
Redesign
Optimize
Collaborate
Compare

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pending on your material, it may be easier to tape than staple pieces together. If you choose to tape, please use evenly sized pieces throughout to keep the weight similarly distributed.

10. Repeat steps 7-9 with the other cup and straw assembly and remaining “one-hole” cup.
11. Align the four cups so that their open ends face in the same direction, clockwise or counterclockwise around the center cup.
12. Push the straight pin through the two straws where they intersect.
13. Push the eraser end of the pencil through the bottom hole in the center cup as far as it will go.
14. Enjoy your new anemometer!

Science Checkup - Questions to ask to evaluate what was learned

- Why do scientists measure the wind speed and direction?
- What can changes in the wind tell weather forecasters?
- Why is the wind so important to our understanding of what weather might be coming next?

Extensions

- Have the group build a pinwheel from paper and sticks or pencils and a pin as a way to demonstrate wind turbines and wind energy. Encourage exploration of how a pinwheel operates compared to an anemometer and how kinetic energy of wind is converted to electricity in a wind turbine.

Vocabulary

Anemometer: An instrument that calculates wind speed.
Velocity: How fast something is moving.
Drag: The resistance experienced by an object as it moves through a medium, like air or water.
Friction: The resistance experienced by an object as it rubs against another object.

Background resources

- A wind dial, or anemometer, allows you to calculate the speed of the wind by measuring the revolutions (spins) of the cups. The wind carries things such as small particles, bugs, moisture and weather with it, so to understand climate, it is important to understand wind. Think about the direction of wind in your area. Does wind generally come from the same direction? Why or why not?
- To calculate the velocity at which the anemometer spins, determine the number of revolutions per minute (RPM), the number of spins the cups take in one minute. Next, calculate the circumference (in feet) of the circle made by the rotating paper cups. Multiply your RPM by the circumference of the circle and you will have an approximation of the velocity at which the anemometer is spinning (in feet per minute), which is about the speed of the blowing wind. It is important to remember that some forces are being ignored in this model, like drag and friction, which is why this is only an approximation of speed.

4-H Science Toolkit

Climate:
Water's incredible journey

Activity Series: Climate
Grade: 3-6
Time: 60 min

Main Idea
Water is a limited resource on earth and is constantly being reused. There is only a small amount of fresh water available, but salt water and contaminated water travel through a series of ecological systems to become freshwater.

Motivator
Did you know the glass of water you had with lunch might be the same water that a Tyrannosaurus Rex drank millions of years ago?

Pre-Activity Questions
Before you start the activity, ask the students:
- ❑ Can water be created or destroyed?
- ❑ How much of the earth's water is actually drinkable?

Activity: The incredible journey game

Supplies

- ❑ Nine large pieces of paper
- ❑ 30-50 beads in each of nine different colors (dependent on number of participants)
- ❑ A pipe cleaner for every person participating
- ❑ Nine home-made dice (see below for description)

Preparation

1. On each sheet of paper, draw (or have students create in a previous meeting) each of the nine scenes below and label each:
   Clouds
   Animals
   Lakes
   Soil
   Groundwater
   Rivers
   Ocean
   Plants
   Glacier
2. Out of old gift boxes, shoe boxes or mug boxes, create nine six-sided dice that are around 15 inches per side. Each die will be associated with one of the scenes above and will have six different labels.
3. See the table on the next page, which explains how to label your dice.

Objectives
- To understand the hydrological cycle.

Learning Standards

(See Matrix)

Common SET Abilities 4-H projects address:
Predict
Hypothesize
Evaluate
State a Problem
Research Problem
Test
Problem Solve
Design Solutions
Develop Solutions
Measure
Collect Data
Draw/Design
Build/Construct
Use tools
Observe
Communicate
Organize
Infer
Question
Plan Investigation
Summarize
Invent
Interpret
Categorize
Model/Graph
Troubleshoot
Redesign
Optimize
Collaborate
Compare

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Climate:
Water's incredible journey

Station	Die Side Labels
Soil	Plant, river, groundwater, cloud, cloud, stay
Plant	Clouds, clouds, clouds, clouds, stay, stay
River	Lake, groundwater, ocean, animal, clouds, stay
Clouds	Soil, glacier, lake, ocean, ocean, stay
Ocean	Clouds, clouds, stay, stay, stay, stay
Lake	Groundwater, animal, river, clouds, stay, stay
Animal	Soil, soil, clouds, clouds, clouds, stay
Groundwater	River, lake, lake, stay, stay, stay
Glacier	Groundwater, clouds, river, stay, stay, stay

Activity:

1. Choose a bead color to represent each of the nine stations. Place the nine large sheets of paper with scenes, their respective dice, and their beads around the room. If outside, you may wish to place things relative to their geographic positions (i.e. plants, animals, rivers, lakes, and soil closer together, ocean slightly offset, groundwater and glaciers a distance from the others).
2. Hand out pipe cleaners to students and explain to them that they are going to travel around the room as water molecules going through the water cycle. Their pipe cleaners are their timelines, and as they travel from place to place they will collect a bead to represent the time they spent in each place.
3. Instruct students to place a hook or knob at the end of the pipe cleaner so beads don't fall off of their timelines.
4. Assign an even number of students to each station, if possible.
5. Ask students about the water at each station and how it could travel from one station to another. Tell students that as they travel, they need to think about how their water molecule would travel from one place to another (melt, evaporate, etc.)
6. Explain to the students that in this game, a roll of the die determines where water will go. At each station, line up in a single file line, collect a bead and place it on your pipe cleaner, then roll the die. If the die tells you to go to a different station, go to that station and repeat. If the die rolls "stay", return to the back of the line in your station and repeat. Be sure to collect beads every time before the die is rolled.
7. Tell students that each bead represents 10 years in the cycle of their water molecule. Have them total up how much time they spent in each station. Use discussion points below to supplement steps six through eight.
8. Choose one or two students' timelines to discuss. Write how much time they spent at each station on the board or a sheet of paper. Discuss where water spends most of its time (oceans, clouds, glaciers, groundwater) and why that might be the case (huge storage capacity, less likely to cycle).
9. Draw the hydrologic cycle on the board or a sheet of paper with all of the stations represented in one scene. Using a red pen for water traveling in gas form and a blue pen for water in liquid/solid form, draw the path of one student's water molecule journey. Be sure to put arrows in the direction of travel.

Climate:

Water's incredible journey

Science Checkup - Questions to ask to evaluate what was learned

- ❑ Where did you spend much of your time as a water molecule? Why do you think that's so? (They may say they got caught in the glaciers, in groundwater, or the ocean or that there were always long lines at those stations.)
- ❑ Why are some students' pipe cleaners full of various colors and others have only one or two colors? What can this tell us about the time water spends in animals or plants versus in water storage areas?

Extensions

- This lesson offers a good opportunity for introducing watersheds, what can impact a watershed and why watersheds are important.

Vocabulary

- **Molecule**: The smallest part of a compound, it consists of one or more atoms held together by chemical forces.
- **Groundwater**: Water that's underground in soil or permeable rock, which feeds springs and wells.

Background information

- The hydrologic cycle is the basis for most of our weather events and climate regimes. It is very important for students to understand that there is only so much water available to us on the Earth, and only a small percentage of it is fresh water. The water on the planet today has been cycling for millions of years, so it is possible that the water we drink today may have been the same water that was ingested by a dinosaur more than 70 million years ago.
- One example of the hydrologic cycle looks like this: Water falls as rain from a cloud to the lake; it is absorbed into groundwater; then expelled from the groundwater by a spring or river; ingested by an animal and panted out or expelled in urine; finally, evaporated back into the clouds.
- Different paths can take varied amounts of time to occur, so it's also important to know long water remains in each part of the cycle.

4-H Science Toolkit

Climate:
Climate and organisms

Activity Series: Climate
Grade: 3-6
Time: 60 min

Main Idea

When a climate changes, the animals in that environment can either adapt, move or die. Students will discover how important it is to have a variety of species in an environment.

Motivator

Meteor strikes and a warming earth brought about death for dinosaurs, saber tooth tigers, mastodons and mammoths. What if they had been able to adapt to the climate changes?

Pre-Activity Questions

Before you start the activity, ask the students:

- ❑ Why do you think some species of birds live only in northern climates and some only in the south?
- ❑ What can animals do to adapt to changes in their climate related to temperature, rainfall or a lack of food?

Activity: Climate change game

Supplies

- ❑ Three to five recess balls/rubber balls
- ❑ Color-coded cards or stickers for your group; two green, three red, four blue and five yellow

1. Give out color cards or stickers.
2. If possible, use a large room, gym or a yard to play the game. Tell the youth to spread out far enough to toss the balls to each other with a bit of difficulty and tell them that all colors need to spread evenly in the space
3. Explain that you are representing an environment; green cards are plants, red cards are animals, blue cards are habitats and yellow cards are humans. The balls being tossed represent the climate.
4. Discuss the options (in background) that organisms have when there is a rapid change in their environment: moving to a new environment, adapting to the changes in their environment or dying. Explain that the first time someone drops the ball, they may take three large steps away from everyone else in an attempt to move to a new environment or adapt. The second time they drop the ball they have unsuccessfully adapted to or left the environment and must sit down
5. Begin tossing a ball (or multiple balls if you have enough participants) around the group
6. As youth begin to sit down, have them announce the color card they carried and their place in the environment.

Objectives

- Understand how animals adapt to climate change.
- Learn about species diversity.

Learning Standards

(See Matrix)

Common SET Abilities 4-H projects address:

Predict
Hypothesize
Evaluate
State a Problem
Research Problem
Test
Problem Solve
Design Solutions
Develop Solutions
Measure
Collect Data
Draw/Design
Build/Construct
Use tools
Observe
Communicate
Organize
Infer
Question
Plan Investigation
Summarize
Invent
Interpret
Categorize
Model/Graph
Troubleshoot
Redesign
Optimize
Collaborate
Compare

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Climate and organisms

7. Once all of the plants have perished, pause the game.
8. Ask youth why the plants perished (they explain that they got too far away to catch the ball, etc.) Explain that some plants have a very hard time adapting to their environment because they cannot move to another area, so if they cannot adapt quickly, they will die. Ask youth who eats the plants? Explain that without a food source, the animals cannot survive long in their environment and must either adapt to the smaller food amount or move to a new area. All animals must take three large steps back.
9. Restart game. Once all animals or habitats have perished, pause the game.
10. Talk about how a lack of animals would make it hard for humans to survive because animals provide a food source for humans. If all animals have perished, humans must take three large steps back. If all habitats have perished, ask youth how animals or humans can live without a habitat (they will explain that they cannot, and would have to move to find a new home). Animals and humans, in this instance, would both take three steps back.
11. When there is only one person left standing, stop the game and have a discussion about what happened when they had to step backward, when they perished and how the game progressed.

Science Checkup - Questions to ask to evaluate what was learned

- ❑ Give some examples of organisms that adapt physiologically mainly and some that can adapt either physiologically or behaviorally.

Extensions

- Play the game "telephone" with kids demonstrating how small changes over the course of many generations can result in huge, unexpected even unrecognizable change.
- The "telephone" game can be adapted by using drawing instead of speech. Have someone draw a cartoonish animal, then the next person gets 10 seconds to study the picture. Then, they draw it from memory. Repeat for many "generations" and compare the first and last pictures.

Vocabulary

Phenology: The study of regularly recurring biological phenomena such as animal migrations or plant budding, especially as influenced by climatic conditions.
Genetics: The branch of biology that deals with heredity and genetic variations

Background Information

- In geologic time, we can't observe the "warning signs" of extinction as well as we can today. Today, we notice if the mating season of endangered species are shortening and if our plants are changing their times of budding, growth and fall coloration. This is called phenology. These local changes are responses to climate changes. If some individuals from a species are able to adapt and survive through these changes, these genetic traits are passed down to their offspring. Note that this isn't a choice the individual makes, but rather something they are capable of genetically, just like some of us are double-jointed or were born with red hair. If these traits can be used to adapt to an environment successfully, they have a survival advantage over other individuals. Of course, this is an evolutionary adaptation, and takes multiple generations to create a breed of organism capable of surviving in a totally new climate. Some organisms can adapt within their lifetime by changing their behaviors.

Climate:

Climate and organisms

- Since adapting to a climate takes time, and the only way to adapt is to have certain genetic traits passed down, certain organisms have a better chance of adapting than others, simply because they reproduce more frequently. In our lifetime, we may see three or four generations of humans together. If we're really lucky, we'll see five. But in that same time frame, we could see maybe 40 generations of cats, and too many generations of beetles, ferns or flowers to count. Since many organisms reproduce much more quickly than humans, they are more likely to adapt to a rapidly changing environment than we are. What other organisms today reproduce slowly? How would they be affected by a rapidly changing environment?