DASH Grade 3/4 Climate Education is a curriculum resource adapted from the activities of Developmental Approaches to Science, Health, and Technology. From 2013-2015, with the support of the Pacific islands Climate Education Partnership (PCEP), DASH authors updated these sections to enhance how this internationally disseminated curriculum prepares students for higher grade-level climate science education.

Units are aligned with the PCEP Climate Education Framework and relevant sections of the Next Generation Science Standards, and were piloted by 25 classroom educators from Kosrae (FSM), Majuro (RMI), and Pohnpei (FSM).

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DASH Grade 3 Climate Education
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Additional activities by
Carol Ann Brennan

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The Pacific islands Climate Education Partnership (PCEP) is a collaborative network of Pacific communities and organizations responding to the impacts of climate change and committed to improving climate education in the Pacific region. PCEP primarily serves the U.S.-affiliated Pacific, including Hawaii, American Samoa, Guam, the Commonwealth of the Northern Mariana Islands (CNMI), the Republic of the Marshall Islands (RMI), the Federated States of Micronesia (FSM), and the Republic of Palau. Find additional PCEP resources at http://pcep.prei.org.

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A. NGSS Science and Engineering Practices  
B. Classification  
C. Working Definitions  
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Inventors' Box. The Inventors' Box is a materials distribution and storage technique. It is basically a box or other container that holds activity supplies. DASH uses primarily recycled materials. The collection of recyclables and stocking of the Inventors' Boxes is up to the students as directed by the teacher. Boxes with similar materials can be given to each group for a particular activity. Labeled boxes or containers can be used to store often used materials. If the whole class is to retrieve materials from the same box or boxes, the role of material or supply engineer is suggested for each group.

Science Record Book. The creation of a Science Record Book (SRB) for each student is likely one of the first activities to be done. The SRB is simply a place for the students to store their notes, data, plans, and other work. It can be as simple as a manila filing folder with the student's name on it or as complex as a binder with indexed sections. The particular format is left to each teacher’s discretion.

Responsibility Chart. The Responsibility Chart is an efficient way to assign classroom jobs and responsibilities and to quickly see that they have been done. Responsibilities are listed using real-world job titles to enhance career education efforts. For example, use ichthyologist rather than fish feeder for the person who is to feed the fish. The Responsibility Chart can be teacher- or student-made. When students participate in the Responsibility Chart’s design and construction, more classroom ownership usually results. The chart design needs to include a method to add and remove jobs as classroom requirements change, a procedure to rotate student responsibilities, and a way to see when jobs are completed. Spring clothes pins and library pockets with index cards have been successfully used to accomplish these criteria.

Wonder and Discover Book. The Wonder and Discover Book is used to record student questions. Their questions may be about the topic being studied or something else entirely. This technique provides a way to acknowledge good student questions, even when asked at an inopportune time. It also can provide an introduction to independent student research. Research on particular questions may be left to the students to tackle independently, assigned by the teacher as homework, or addressed in any way the teacher sees fit. This book can be a class book in a binder, a section in each student’s Science Record Book, a file on the computer, or whatever the teacher decides. It is suggested that each question have its own page to allow room for recording discoveries. Be cautious of over using this strategy. It should be an honor to record a question in the Wonder and Discover Book. One alternative to using the Wonder and Discover Book is to record student questions on the appropriate concept map if available.
Working Definitions. Working Definitions are definitions constructed by students to describe their current understanding of a particular term. A working definition includes the category, form, and function of the term described. It may also include illustrations and/or examples. Initially, definitions are constructed by the whole class, then in small groups and compared, and finally by each individual student as they become more expert.

Working Dictionary. Working definitions are recorded and stored in the Working Dictionary. This can be a class book such as a binder, a file on the computer, or a section in each student’s science record book. The particular format is again left to the teacher’s discretion.

Concept Maps. Concept mapping in DASH is an instructional strategy. A more complete description of techniques and the developmental levels is found in “Concept Mapping in Science” located in the DASH Instructional Guide. The students first map their prior knowledge of the concept to be studied. This informs the teacher of what the students already know, where they need to construct new knowledge, and of misconceptions or alternative explanations they may hold. This same map is revisited periodically to summarize progressing study on the topic. Information, ideas, and questions may be added, removed, and/or corrected. At the end of the study, the concept map provides a picture of what has been accomplished during the topic study. These concept maps are often used to construct assessment instruments. In DASH, concept maps are saved as they are often revisited at a later date for reference or updating.

Connections and Reflections
Often students have a difficult time associating what they are learning in school to their home and to other outside-of-school environments. The purpose of this activity is to provide a stimulus to reflect on their learning in science and to look for connections, relationships, and applications. Connections can be recorded on concept maps, in a special Connections Book, or in a special Connections section in the student’s own Science Record Book. Some connection-making questions you might ask include:
- Why is this important for you to know?
- Who else needs to know this?
- Where else could this be used in school? At home? In the community?

Inquiry and Questioning
There are three basic questions that go with the inquiry process. The exact wording may vary based on the activity or situation but the ideas remain consistent. Likewise inquiry is often not a 4 step process. It often moves back and forth between steps.

<table>
<thead>
<tr>
<th>Inquiry Processes</th>
<th>Basic Questions</th>
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<tbody>
<tr>
<td>Problem, need or student question.</td>
<td>What do you think?</td>
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<td>Hypothesis</td>
<td>How could you find out or test your idea?</td>
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<tr>
<td>Test</td>
<td>What did you find out or learn?</td>
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<tr>
<td>Conclusion</td>
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OBJECTIVES
The students
• Begin their collection of local weather data.
• Invent logos to represent local weather conditions.
• Record daily observations of general weather conditions.
• Connect the study of weather to their Pacific Island environment.

CLIMATE EDUCATION FRAMEWORK
• 3-5Weather.A.1 By measuring weather conditions (temperature, amount and kind of precipitation, amount and kinds of clouds, wind direction and wind speed), scientists learn how the weather changes from day to day, month to month, and during the year.

BACKGROUND
This activity builds on the study of general weather begun in earlier grades. It is used to introduce students to the study of weather and climate. The concept maps provide the teacher with some information about their students’ prior knowledge about weather.

The teacher determines an appropriate weather data collection device and format for the class. The class data can be recorded on a daily weather calendar, on a monthly weather chart, in a weather notebook, or however the teacher decides. The student pages can be used to record the collected weather data in a class weather book or individually be each student. It is recommended that a specific place be set aside as a class Weather Center. Weather related charts and graphs, weather measurement equipment, and the data collected should be stored here.

For students new to DASH, this activity provides an opportunity to introduce several DASH components including concept mapping and the Responsibility Chart. For further information about these components see Appendix A, DASH Components.

STUDENT ROLE
Meteorologist

MATERIALS
Class Weather Calendar, Chart, or Data Book
chart paper
markers
Working Dictionary
Sp 3.1 Daily Weather
PRODUCTS
Concept maps about weather
Class weather logos chart
Weather data
Working definition of weather

PROCEDURES

1. **Have the students work in small groups to make concept maps about weather.**
   Have them
   • Include different kinds of weather, tools used to measure weather, and any other ideas they have about weather.
   • Share their group concept maps and then revise and add to them as they choose.
     ✔ Help them to also include weather elements such as temperature, wind, types of precipitation, clouds, and storms.
     ✔ Include humidity only if suggested by the students.

2. **Have the students invent logos to describe different kinds of local weather conditions.**
   Have them
   • Make a list of common kinds of weather found locally such as clear or sunny, cloudy, partly cloudy, rainy, partly rainy, stormy, windless, windy, lightning, hail, foggy, etc.
   • Discuss the idea of using logos to represent the kind of weather.
     ✔ Logos are simple drawings used to represent something. For example, a sun could be used for sunny days. Show some common samples such as a figure of a man to represent the men’s restroom, to help student understand the idea of a logo.
   • Draw logos for the different kinds of weather.
   • Make a Class Weather Logos Chart.

3. **Introduce the Weather Center and post the Weather Logo Chart in the center. Introduce the students to the teacher-selected weather data recording device.**
4. Have the students observe the weather each day and draw the appropriate logo for the weather data recording device. Use SP 3.1 Daily Weather as desired.

Discuss the data collection by asking such questions as

• When should you make your observations about the general weather conditions for the day?
• When should you record your observation of the weather type, at the end, middle, or beginning of the day? Why?
  ✔ Help the students see that to appropriately describe the weather for the entire day, this should be done near the end of the school day.
• Who will do the observing and recording?
  ✔ Introduce the Class Responsibility Chart. See Appendix A.

5. Have the students create a first working definition for weather and record it in the Working Dictionary. See Appendices A, B, and C for further information on working definitions.

6. At the end of each month have the students summarize their weather data. See Activity 3.6 Monthly Weather Summary.

EXTENSIONS

• Record student questions about the weather in the Wonder and Discover Book as they arise.
• Have the students develop their own questions and investigations about general weather conditions.
• Have the students compare their weather observations with newspaper, Internet, or TV descriptions.
  Ask such questions as these
  • How do your descriptions about the weather compare with the observations of the newspaper meteorologist, the TV weather reporter, or Internet accounts?
  • Why are there differences?
  • The local weather will often differ widely from the broader generalization given by newspapers, the Internet, and TV.
  • Do you need to change the way you are reporting the weather?
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3.2 WIND

OBJECTIVES
The students
• Invent wind direction and speed indicators.
• Use a compass and the sun to determine the direction, north.
• Measure and record wind speed and direction.
• Determine the prevailing local wind direction at different times of the year.
• Record wind speed using the Beaufort Wind Scale.

CLIMATE EDUCATION FRAMEWORK
• 3-5Weather.A.1 By measuring weather conditions (temperature, amount and kind of precipitation, amount and kinds of clouds, wind direction and wind speed), scientists learn how the weather changes from day to day, month to month, and during the year.

BACKGROUND
Students invent and construct wind detectors to find wind speed. This activity provides an opportunity to introduce the Inventors Box. See Appendix A, DASH Components. They most often use the angle of a wind detector similar to a flag, windsock, or other detector to estimate relative wind speeds—no wind, light wind, moderate wind, and high or strong wind. In this activity an abbreviated Beaufort wind speed scale is introduced that will help the students quantify wind speed observations. The Beaufort scale allows the students to look at things that are moved by wind to get an approximation of the wind’s speed. Then they are asked to invent a wind speed detector that can be standardized using the Beaufort wind speed scale.

Next they invent a wind vane to find wind direction. They learn how to use the body as a compass with the rhyme and song below.

<table>
<thead>
<tr>
<th>Body Compass Rhyme</th>
<th>Body Compass Song</th>
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<tbody>
<tr>
<td>Right, rising east.</td>
<td>The sun is rising in the east, the east, the east.</td>
</tr>
<tr>
<td>Left, leaving west.</td>
<td>The sun is setting in the west, the west, the west.</td>
</tr>
<tr>
<td>Nose north.</td>
<td>My nose is north, my seat is south,</td>
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<tr>
<td>Seat south.</td>
<td>And earth rotates itself about.</td>
</tr>
<tr>
<td></td>
<td>The sun is rising in the east and setting in the west.</td>
</tr>
</tbody>
</table>

Sung to the tune of When Johnnie Comes Marching Home
Then the students use a magnetic compass to verify direction and locate north when the sun is not shining. They make their own magnetic compass using a magnetized paperclip in a piece of Styrofoam that floats in a plastic dish of water.

**STUDENT ROLES**
Inventor
Meteorologist

**MATERIALS**
cardboard
wire
nails
wood blocks
wood dowels, chopsticks, or skewers
yarn or light weight string
hammer
plastic pen tops
waterproof or duct tape
cork or Styrofoam
plastic dish
paperclips
magnet
pliers
scissors
magnetic compass
plastic wrap
Working Dictionary
Weather Data Book or Chart
Student Page 3.2A BEAUFORT SCALE
            3.2B WIND DIRECTION
            3.2C DAILY WIND DATA

**PRODUCTS**
Wind speed detectors
Wind vanes
Daily data on wind speed and direction
Working definitions for wind, wind direction, and wind speed
PROCEDURES

1. **On a windy day very early in the year introduce the activity.**
   Ask such questions as:
   - How do you know when it is windy? What do you see? What do you feel?
   - Does the wind always feel the same? How is it different?
     ✔Get at the idea that the wind can be gentle, strong, etc.
   - What do you see when there is a strong wind? Gentle wind?
     ✔Have them identify things in the environment that move with the wind
     like flags, trees, etc. Contrast how they look or move with different kinds of
     winds.
     ✔Introduce the term, wind speed, as the way scientists describe different
     wind strengths—how fast the wind is blowing.

2. **Introduce the Inventor’s Box and have the students individually or in**
   **small groups design and construct wind detectors, tools to measure**
   **how hard or fast the wind is blowing. Have them test their inventions in**
   **various wind conditions. Have them share how their wind detectors**
   **react in different wind speeds.**

3. **Introduce the Beaufort Scale to the class using Student Page 3.2A**
   **BEAUFORT WIND SCALE.**
   Working outside, have the students
   - Agree on the speed of different wind gusts.
   - Agree on the average wind speed—the speed most of the time.

4. **Have the students try to use their devices to measure wind speed and**
   **standardize them using the Beaufort scale. Encourage them to modify**
   **their devices as needed.**

5. **Discuss the measurement and recording of wind speed. Select or build**
   **a class wind detector. Begin to collect and record wind speed data.**
   Ask such questions as
   Where should your wind detector be placed to measure wind speed?
   When should wind speed be observed?
   Where should this wind speed data be recorded?
   - Add this data to the daily weather data record. Use SP 3.2C Daily Wind
     Data if desired.
   - Add this job to the Responsibility Chart.
   - Have the students design logos for the different wind speeds.
   - Post a copy of SP 3.2B Beaufort Scale with logos in the Weather Data
     Center.
6. **Ask the students how they can find the directions north, south, east, and west.**
   - Work to the idea of using a magnetic compass.
     ✔ If no compass is available, have students construct a compass using a magnet, straightened (2-inch) piece of a paperclip, and a small piece of Styrofoam. Remember to rub the magnet along the length of the paper in only one direction, NOT back and forth. When it can pick up a small paperclip, it is sufficiently magnetized. Insert into the Styrofoam and float in a plastic bowl of water.
   - Ask the students how else they can find directions.
     ✔ Work toward using the sun’s position in the sky.
   - Teach the Body Compass Rhyme and Song.

7. **Help the students explore wind direction.**
   - What does it mean when someone says there is a north wind? A west wind?
     ✔ Work to the idea that the wind is coming from that direction.
   - Have students work in groups of four to simulate wind directions.
     - Have each group make a simple compass rose labeling the directions north, south, east, and west on a sheet of paper.
     - Have each student or student group make a wind detector by tying a 4-8 inch piece of yarn or string to a pencil, skewer, or chopstick.
   - Place the compass rose on the floor.
   - Assign each group member a wind direction.
   - Have them arrange themselves around the compass rose so they face each other.
   - Have the “North Wind” blow on a wind detector.
   - Ask the students to observe and report on the direction of the string.
     ✔ It will flow toward the south (in the opposite direction).
   - Repeat for the other three cardinal (S,E,W) directions.
   - Combine 2 groups to form groups of eight.
   - Add and label the ordinal (NE, NW, SE, SW) directions to the compass rose.
   - Assign each of the 8 group members a cardinal or ordinal direction.
   - Have them arrange themselves around the compass rose so they face each other.
   - Have the “Southwest Wind” blow on a wind detector.
   - Ask the students to observe and report on the direction of the string.
     ✔ It will flow toward the northeast (in the opposite direction).
   - Repeat for the other seven directions.
   - Ask if anyone has ever seen a wind vane? What does it tell you?
8. **Show the students an example of a wind vane and have them work alone or in groups to design wind direction finders. Use the Inventors Box or have them collect the materials from home.**
   Have them consider that
   - The vane should move freely through 360 degrees.
   - The free movement can be produced by a nail turning in a solid sleeve. (Pen top, test tube, etc.)
   - The base needs a compass rose similar to the one on the Student Page 3.2B WIND DIRECTION.
   - They can cut out and attach a compass rose or label the base of their wind vane with a waterproof marker.
   - They need to take into account that wind direction will have to be taken on rainy as well as dry days.
   ✔ Work to the idea of covering paper or cardboard parts with plastic.

9. **Have the students make and test their wind vanes.**
   Have them
   - Orient their wind vanes first using their body compass and then with a magnetic compass.
   - Observe that the wind vanes act differently when they are placed next to buildings than when they are in the open.
   - Agree upon a common location where the wind direction (and speed) will be taken each day.

10. **Have the students plan and begin to record the daily wind direction in the Wind Center in the class weather book or chart. Use SP 3.2C Daily Wind Data as desired.**

11. **Have the students write a working definitions for wind, wind direction, and wind speed. Put these in the Working Dictionary.**

12. **At the end of each month review the wind speed and wind direction data with the students. See Activity 3.6 Monthly Weather Summary.**

**EXTENSION**
- Have the students investigate ways that wind speed is measured by meteorologists.
<table>
<thead>
<tr>
<th>SCALE</th>
<th>MPH</th>
<th>INDICATORS</th>
<th>KIND</th>
<th>LOGO</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1</td>
<td>Smoke goes straight up.</td>
<td>Calm</td>
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<tr>
<td>1</td>
<td>1-8</td>
<td>Smoke drifts sideways. Leaves move gently.</td>
<td>Slight Breeze</td>
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<tr>
<td>2</td>
<td>8-13</td>
<td>Leaves and twigs move.</td>
<td>Gentle Breeze</td>
<td></td>
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<tr>
<td>3</td>
<td>13-19</td>
<td>Small branches move. Dust and paper flies.</td>
<td>Moderate Breeze</td>
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<tr>
<td>4</td>
<td>19-24</td>
<td>Water ripples. Small trees sway.</td>
<td>Strong Breeze</td>
<td></td>
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<tr>
<td>5</td>
<td>25-38</td>
<td>Large branches move. Tree trunks bend. Walking is difficult.</td>
<td>Strong Wind</td>
<td></td>
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<tr>
<td>6</td>
<td>39-75</td>
<td>Twigs break off. Shingles get torn off. Trees uprooted. Widespread damage.</td>
<td>Wind Storm</td>
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<tr>
<td>7</td>
<td>Over 75</td>
<td>General disaster.</td>
<td>Hurricane Tornado</td>
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<td>DATE</td>
<td>Wind Speed</td>
<td>Wind Direction</td>
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OBJECTIVES

The students

- Invent and make rain gauges.
- Measure and record the depth of rainfall.
- Compare the depth of rain falling in different places.

CLIMATE EDUCATION FRAMEWORK

- 3-5Weather.A.1 By measuring weather conditions (temperature, amount and kind of precipitation, amount and kinds of clouds, wind direction and wind speed), scientists learn how the weather changes from day to day, month to month, and during the year.
- 3-5Climate.A.3 Many tropical Pacific islands have a wet season and a dry season.

BACKGROUND

Start this activity on a rainy day after the students have begun to record wind and weather condition data.

This activity introduces the measurement of rainfall. Equally important, it helps the students discover that certain procedures in operating a measuring instrument work better than others and that these procedures must be standardized if consistent data are to be collected.

Gauges

Rain gauges are made from tin cans, milk cartons, and other kinds of containers that have straight sides and flat bottoms.

Location and Measurement

Initially students set up rain gauges at various places on the school grounds. They will discover that the best place for a rain gauge is in a location where there are no obstructions and it will not be bothered. Gauges under roofs and trees and on the sides of buildings get less water than gauges that are in the open. Once a place is found for a gauge, it should be kept there. Measurements should be made at the same time each day, water depth should be measured the same way, and the gauge should be emptied after each reading.

Gauges that are in accessible areas are likely to be vandalized. Suggestions for protecting gauges should be offered only as a last resort. Here is a place for students to be very inventive and develop respect for other student’s projects.

Building Student Understandings

In grade 3 the first objective is for students to begin to understand that what is being measured is the depth of the rain that falls in a given area. Secondly, the objective is for students to recognize that so long as the container has a flat bottom and straight sides, the depth of water collected will be the same no matter what the surface area or size of the container’s opening may be.
Records
Records of rainfall are kept in the Weather Center and on a class graph. Have the students discuss ways of measuring water depth and how to graph these data. Report depth of rainfall in inches or centimeters to correspond to local weather reports.

Irregular Containers
The problem involved in using irregular containers (containers with rounded bottoms, indented sides, or conical shapes) is not confronted here. These problems will be dealt with next year. All containers used as gauges should have straight sides (tin cans, milk cartons).

Depth of Rainfall
In this activity the students discover that during the same rainfall, straight-sided containers collect about the same depth of water no matter how large their opening. Treat this as a fact. Explanation will likewise emerge next year.

STUDENT ROLES
Inventor
Meteorologist

MATERIALS
- tin cans with straight sides
- wax coated cardboard containers with straight sides
- other straight-sided containers as available
- stiff wire such as coat-hanger wire
- rulers
- waterproof or duct tape
- pliers
- strips of construction paper to act as dip sticks
- glue
- pencil

Working Dictionary
Student Page 3.3A DAILY RAINFALL
Student Page 3.3B CM-GRID

PRODUCTS
- Rain gauges
- Rainfall data
- Class graph of weekly or monthly rainfall
- Working Definition of rain
PROCEDURES

1. **On a rainy day introduce the collection of rainfall data to the students.** Ask such questions as
   • How could you measure how much rain falls?
   • If you put a container outside in the rain, what do you think will happen?
   • How is the amount of rain reported locally—on TV, the internet, and/or in the newspaper?
     ✔ Have the students report back. Measurements are stated in inches or centimeters of rainfall.

2. **Have the students put straight-sided cans of different sizes in a place where they will get the same depth of rain. Leave them long enough to collect a measurable amount of rain.**

3. **Have the students invent a way to measure the depth of water in inches. If needed, demonstrate a dipstick method of putting a strip of construction paper in the can and measuring the depth.**

4. **Compare the depths of water measured.** Ask such questions as
   • What happened when you put the cans in the rain?
   • How do the depths of water compare?
     ✔ They will be about the same depth.
   • Could you use the depth of the water to tell how much rain has fallen?
   • Can you think of other situations where you use depth when you talk about the amount of liquid you have?
     ✔ How deep is the water in a tide pool? How deep is the ocean?

5. **Have the students invent rain gauges. Discuss with the students how they will use their gauges.** Ask questions such
   • When should you check the gauge? Why?
   • How often should you measure the water in the gauge?
   • Should all gauges be checked at the same time or at different times? Why?
   • After you have measured the water in the gauge, should you leave the gauge full? Should you empty it? Why?

6. **Discuss with the students where they are going to put their rain gauges and help secure them.**

7. **After the first measured rain have the students collect and record their data.** Compare data and ask such questions as
   • Did every group measure the same depth of rain in their gauge?
   • Did any groups get more than others? Why?
   • What are you trying to measure?
3.3–4

✔ Get at the idea that you want to get a measure of the water falling directly from the sky, not from a rainspout or off the roof.
• Does anyone want to change the location of their gauge? Why?

8. **After the second rain, establish standards for the rain gauge with the students.**
   Ask such questions as
   • Did every group measure the same depth of rain?
     ✔ Measurements should now be about the same.
   • Which groups got the most rain? Why?
   • Where were their gauges located?
   • What do you want your gauges to measure?
   • Where are the best kinds of places to locate rain gauges?

9. **Have the students again relocate the rain gauges and begin data collection.** Keep a class record in the Weather Center on SP3.3 DAILY RAINFALL. Add this job to the Responsibility Chart.

10. **Make a class bar graph of the rainfall each week and add a discussion of the rainfall to the monthly weather summary.** See Activity 3.6 Monthly Weather Summary.

11. **Help the students construct a working definition for rain and record it in their Working Dictionary.** Introduce the term *precipitation* if appropriate.

**EXTENSION**
• Help the students organize to measure, record, and compare the depth of rain that falls at their home.
# Daily Rainfall

**SP 3.3A**

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Name: ____________________
Date: ____________________
OBJECTIVES
The students
• Measure temperature three times each day.
• Graph daily temperature.
• Make hypotheses and generalizations about temperature and time of day.
• Develop a sense of how the sun affects outdoor temperature.

CLIMATE EDUCATION FRAMEWORK
• 3-5Weather.A.1 By measuring weather conditions (temperature, amount and kind of precipitation, amount and kinds of clouds, wind direction and wind speed), scientists learn how the weather changes from day to day, month to month, and during the year.
• 3-5Energy.A.1 Whenever anything happens or changes, energy is involved. For example, whenever there is a change in an object’s motion or temperature, energy is involved in those changes.
• 3-5Energy.A.2 Light is a form of energy that moves from one place to another place.
• 3-5Energy.B.1 Energy from the Sun travels to the Earth as light. When this sunlight is absorbed, it warms Earth’s land, air, and water.

BACKGROUND
This activity should be started in the first weeks of school during the setting up of the Weather Data Center. Students begin by collecting, recording and graphing temperature data. They began to correlate changes in daily temperature with months and seasons. Next they add the relationship of temperature and sunlight. There are two aspects to this study. First, there are daily temperature variations that will be correlated with the shadow of cloud cover in the next activity 3.5 CLOUDS. Second, they will look at monthly and seasonal temperature variations that will be correlated with other weather data.

It is suggested that temperature be taken at the same time and place each day. Ideally, temperature is taken three times—when the students first arrive in the morning, at noon, and right before the students leave in the afternoon. The three temperatures can be put on a triple line or bar graph using different colors.

Ideally, the thermometer will be mounted right outside the classroom window so that it can be read from inside. However, in many schools the thermometer is carried outside and read or is placed in some other permanent place.

STUDENT ROLES
Meteorologist
Mathematician (when graphing)
MATERIALS
chart paper
markers
Wonder and Discover Book
Celsius-Fahrenheit thermometer—large, with each degree marked is preferred
Class Responsibility Chart
Class Weather Data book or chart
Working Dictionary
Student Page 3.4A Daily Temperatures
Student Page 3.4B CM Grid

PRODUCTS
Concept map about temperature
Class chart about temperature predictions
Class graph of daily temperatures
Class temperature data
Working definition of temperature

PROCEDURES
1. Help the students create a class concept map about temperature to assess their prior experience with temperature and thermometers.

2. Review the use and care of thermometers with the students.

3. Introduce the activity with a discussion about the Celsius-Fahrenheit thermometer if the Fahrenheit scale is used locally. If only Celsius is used, skip this step.
Show them a thermometer and ask questions such as these:
• Can anyone show us the Celsius scale on this thermometer?
• Can anyone read the Celsius scale?
✔ The hands raised in answer to this question will provide a hint for teaming the students to carry out the remainder of the activity.
• What is the other scale called?
• Can anyone read this scale?
✔ This is another question that will help to organize work teams.
4. Have the students make predictions about the temperatures they will measure during the coming year. List the students’ predictions and their hypotheses as to why on a class chart about temperature predictions. Ask such questions as
   • What do you predict will happen to the temperature during the day if you measure it when you first come in the morning, at noon, and right before you leave in the afternoon? Why?
     ✔ Have students discuss why the temperature changes during the day. Record the students’ hypotheses and ideas.
   • When do you predict it will be hottest during the day? Why?
     ✔ There is a natural anomaly here. The hottest part of the day could reasonably be argued to come at the time of most sunlight or noon. However, there is a lag, and the hottest time is most often in the early afternoon. The sun is still warming the earth at noon. The students will discover this. Accept and record all predictions and hypotheses.
   • How do you predict that temperatures will compare between times when there are clouds and times when it is clear? Why?
   • What do you predict will happen to the temperature from month to month? Why?
   • What do you predict the highest temperature will be this month? The lowest temperature?
   • What do you predict the average temperature will be in the morning this month? At noon? In the afternoon?
     ✔ Discuss the meaning of average temperature with the students. This does not need to be computed mathematically but can be simply defined as the most common temperature for that time on the graph.
   • How do you think the temperature at noon on a sunny day will compare with temperature at noon on a cloudy day?
     ✔ This will be investigated in Activity 3.5 Clouds.

5. Have the students graph daily temperature data on a class graph. Record measurements on Student Page 3.4A Daily Temperatures. Have them
   • Add temperature data collection to the class Responsibility Chart.
     ✔ The three sets of data, morning, noon, and afternoon can be put on the same graph using different colors for each. Use SP 3.4B CM Grid.
     ✔ Blanks in the data will not affect the results. They will naturally exist over weekends and holidays.
6. **Ask the students if they have any other questions they would like to explore about outside temperature.**
   - Help them
   - Record their questions and ideas in the Wonder and Discover Book.
   - Periodically ask such questions as
     - Do any of your predictions seem to be right?
     - Have you been able to answer any of the questions you put in the Wonder and Discover Book about temperature?
     - Have you other questions you would like to add?

7. **Have the students write a working definition for temperature and record it in their Working Dictionary.**

8. **During the first monthly weather summary after the students begin recording daily temperature data, have the students analyze the morning, noon, and afternoon temperatures.**
   - Ask such questions as these:
     - What were your predictions about temperatures in the morning, at noon, and at the end of the school day?
     - Were your predictions correct?
     - Why do you think so?
     - Have the students look to see about what range most of the temperatures fall into. This is the easy way to finding a mathematical average and one they can more easily use.
     - How did your prediction about the temperature of sunny and cloudy days in fall turn out?
     - What was the highest temperature? Lowest? Average noon temperature?
     - Were your predictions correct? Why do you think so?
     - How do the temperatures at the beginning of the month compare with the temperatures in the middle of the month? At the end of the month?
     - What do you predict will happen to the temperatures next month. Record predictions on Student Page 3.6B Weather Predictions.

9. **Review the class graph of daily temperatures during the monthly weather summary. See Activity 3.6 Monthly Weather Summary.**

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**EXTENSION**
- Set up a temperature center and have the students report on their own investigations.
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OBJECTIVES
• Identify stratus and cumulus clouds.
• Estimate and record the daily amount of cloud cover.
• Hypothesize about temperature in a cloud’s shadow and in sunlight.
• Measure temperatures under cloud cover and in sunlight.
• Make hypotheses and generalizations about temperature and cloud cover.

CLIMATE EDUCATION FRAMEWORK
• 3-5Weather.A.1 By measuring weather conditions (temperature, amount and kind of precipitation, amount and kinds of clouds, wind direction and wind speed), scientists learn how the weather changes from day to day, month to month, and during the year.
• 3-5Energy.A.1 Whenever anything happens or changes, energy is involved. For example, whenever there is a change in an object’s motion or temperature, energy is involved in those changes.
• 3-5Energy.A.2 Light is a form of energy that moves from one place to another place.
• 3-5Energy.B.1 Energy from the Sun travels to the Earth as light. When this sunlight is absorbed, it warms Earth’s land, air, and water.

BACKGROUND
This activity introduces students to the role that clouds play in weather. Students observe that there are two general kinds of clouds, layered or stratus and heaped or cumulus. Within these two major categories there are several more kinds of clouds that are primarily dependent on altitude as well as combinations of different cloud types. These will be studied more in depth next year.

The second goal of the activity is for students to begin to estimate the amount of daily cloud cover. They begin with just three descriptions, clear (no clouds), partly cloudy (some clouds), and mostly cloud covered. They then begin to estimate the amount of cloud cover. It is suggested that percentages or fractions be used if students have been introduced to this concept in math. If not, use such terms as few clouds (up to ¼ or 25%), partly cloudy (around ½ or 50%), mostly cloudy (¾ or 75%), and totally cloud covered or overcast (100%).

The third focus of this activity is to help students become aware that there is a difference in temperature in sunlight and under cloud cover. They observe the capacity of clouds to block the sunlight. They hypothesize about the temperature difference between sunlit and shadowed areas and test their hypotheses.

STUDENT ROLE
Meteorologist
MATERIALS
Thermometers
Working Dictionary
Student Page 3.5 Daily Cloud Cover

PRODUCTS
Completed Student Pages

PROCEDURES
1. Help the students to make a class concept map about clouds to find out what they already know.

2. On a day when small clouds are passing overhead. Go outside with the students and have them observe the clouds.
   Ask such questions as
   • Are all the clouds the same?
   • How are they different?
   • Can you point to some clouds that are puffy and rounded?
     ✔ Introduce the term, cumulus, for these heaped clouds.
   • Can you point to some clouds that seem to have a flat, stretched shape?
     ✔ Introduce the name, stratus, for these layered clouds.
   • What other kinds of clouds do you see?
     ✔ Help them to see that most clouds seem to be cumulus, stratus, or a combination of these two.
   • Are all clouds the same color? How are they different?

3. Introduce the students to estimating the amount of cloud cover in the sky.
   Ask such questions as
   • Are there always clouds in the sky?
   • Can you describe how much of the sky is covered with clouds today?
   • Is the amount of cloud cover always the same? How is it different on other days?
     ✔ Introduce the ideas of clear (no clouds), partly cloudy (some clouds), and totally or mostly cloud covered (overcast).
   • How can you add this to the daily weather data collection.
     ✔ Help the students plan to do this. Add to the Responsibility Chart.
   Use SP 3.5 Daily Cloud Cover.
4. Go outside on a partly cloudy day and introduce the students to mathematically estimating the amount of cloud cover. Ask such questions as
   • Can you describe how much of the sky is covered with clouds today?
   • Is the amount of cloud cover always the same? How is it different on other days?
     Introduce such terms as clear (no clouds or 0%), few clouds (25% or about ¼), partly cloudy (around 50% or about ½), mostly cloudy (75% or about ¾), and totally cloud covered or overcast (100%). Use percentages, fractions, or just the words as is appropriate to student understanding and math experience.

5. Add this information to the monthly weather summary. See activity 3.6A Monthly Weather Summary.

6. On a day with a few small clouds have the students observe the shadows clouds make on the ocean or in an open area and what happens as clouds cover the sun.
   CAUTION: NEVER LOOK DIRECTLY AT THE SUN!
   Ask such questions as
   • What did you notice as a cloud moved overhead?
     ✔ Work toward the idea of it getting darker because there is less light
   • What happened to the light on the ground when the sun was blocked by the cloud?
     ✔ Work toward the idea of the ground getting darker.
   • Which is closer to you, the cloud or the sun? Why do you think so?
   • How do you make a shadow with your body?
     ✔ Work toward the idea that you make a shadow by blocking light.
   • Can you see your shadow in the dark? Why?
     ✔ Work toward the idea that there is no light to block so bodies are not outlined in light.
   • Can you see your own shadow when the sun is blocked by clouds? Why?
     ✔ When the clouds block the light there is no light to be blocked or light to make a shadow.
   • Can you see the shadow of trees, buildings, and other objects when the sun is blocked by clouds? Why?
     ✔ Work to the idea that shadows are produced by the blocking of the sun’s light. When the sun’s light is blocked by clouds there is no light for the trees and buildings to block.
   • Can you feel any difference when the sun is blocked and when there is sunlight?
     ✔ Work toward a difference in temperature.
   • How could you measure that difference?
7. Continue the discussion about the cloud passing and the sun coming back.
Ask such questions as these:
• What happens to the light on the ground when the sun reappeared?
• When the sun reappeared did you see your own shadow? Why?
  ✔ Work toward the idea that the sunlight is no longer blocked and that bodies could again block the sunlight.
• Can you see the shadow of trees, buildings, and other objects when the sun is out? Why?
• Can you feel any difference when there is sunlight and when the sun is blocked by clouds or other things like trees or buildings?
• Can you feel a difference on the back and front of your hand when you hold it in front of your face to block the sun?
• What do you think could cause these differences?
  ✔ Work toward the hypothesis that there seems to be a difference in temperature.
• How could you measure that difference?
  ✔ Work toward the idea of measuring the temperature.
• What questions do you have about clouds and sunlight?
  ✔ Have the students explore their questions while they are outside or record them in the Wonder and Discover Book to explore later.

8. Have the students continue their inquiry about clouds and sunlight.
Have them
• State or restate their hypotheses about temperature and shadows or other ideas.
• Design experiments to test their hypotheses.
  ✔ Work for experiments that measure the temperature in shadow and sunlight at the same time.
• Test their hypotheses.
• Interpret results and make generalizations.
• Share their results.

EXTENSION
• Have students research other kinds of clouds and try to identify them.
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3.6 MONTHLY WEATHER SUMMARY

OBJECTIVES
The students

• Collect and summarize monthly weather data about local weather conditions including wind speed and direction, rainfall, temperature, and cloud cover.
• Compare average monthly wind speed and direction.
• Identify the monthly prevailing wind direction.
• Compare the depth of rain falling in different months.
• Make generalizations about relative temperature for morning, noon, and afternoon.
• Make hypotheses and generalizations about temperature and months and seasons.
• Compare the amount of cloud cover in different months.
• Make predictions about future weather.
• Identify and describe local seasonal weather patterns.

CLIMATE EDUCATION FRAMEWORK

• 3-5Weather.A.1 By measuring weather conditions (temperature, amount and kind of precipitation, amount and kinds of clouds, wind direction and wind speed), scientists learn how the weather changes from day to day, month to month, and during the year.
• 3-5Weather.A.2 Scientists analyze records of the weather that has happened in different places in the different times of the year. There are patterns to the kinds of weather that happen in a place and at different times of the year.
• 3-5Weather.A.3 Scientists predict the weather that might happen in the next couple of days using measurements of the weather that is happening right now in a place and also about the weather patterns that happen in that place.
• 3-5Climate.A.2 Pacific islands that are near the equator have warm climates. The temperature does not change very much from day to night. Temperatures do not change very much from month to month over the course of a year.
• 3-5Climate.A.3 Many tropical Pacific islands have a wet season and a dry season.
BACKGROUND
In this activity the students summarize the daily weather data they have collected month by month. They will describe the monthly weather and look for patterns. It is suggested that the teacher work with the whole class to summarize the data the first month. After that, the students can be divided into groups as suggested in the first procedure. These monthly summaries also provide an opportunity to revise their working definitions as needed. As is appropriate to the local community the students can also summarize their data seasonally and make seasonal comparisons. At the end of the year the students will use these monthly summaries to analyze the weather throughout the school year. They will look for patterns and correlations between weather elements.

STUDENT ROLES
Meteorologist

MATERIALS
Chart paper and markers
Daily weather data on kind of weather, rainfall, temperature, wind speed and direction, and cloud cover
Working Dictionary
Connections Book
Student Page 3.6A Weather Summary
Student Page 3.6B Weather Predictions

PRODUCTS
Weather Prediction Chart
Working Definitions of weather related terms
Monthly weather data summaries and descriptions
Class Chart about Weather Data Comparisons
Completed Student Pages
PROCEDURES

1. At the end of each month have the students work in small groups to summarize the daily weather data collected for that month. Assign each group to a particular kind of data such as
   • Kinds of weather
   • Rainfall
   • Wind speed
   • Wind direction
   • Temperature
     ✔ This can be 2 or 3 groups, one for each time the temperature is recorded during the day.
   • Cloud cover
Have them collect the data requested on Student Page 3.6A WEATHER SUMMARY and record it on the class summary sheet.
   ✔ See specific directions and class discussion questions in the following procedures.
Keep a class summary for each month with the class weather data for future comparisons.

2. At the end of each month have the students summarize the kind of weather by counting the number of days with common weather conditions.
Discuss the monthly data using questions such as
   • What was the most common kind of weather this month?
   • What was the least common kind of weather?
   • What could you use as a general description of the weather for this month?
   • Is that the kind of weather you predicted for this month?
   • What do you think will be the most common kind of weather next month?
Record their ideas on SP 3.6B Weather Predictions.

3. At the end of each month review the wind speed and direction data with the students.
Ask such questions as
   • What was the fastest wind that you recorded? Slowest?
   • What was the speed of the wind most of the time?
   • What kind of weather do we have when the wind seems to be the fastest? When it blows slowly or not at all?
   • What direction does the wind seem to blow from most of the time?
   ✔ Introduce the term prevailing wind if applicable.
   • How does this month’s wind data compare with the predictions you made?
   • What do you think the wind will be like next month? Record their ideas on SP 3.6B Weather Predictions.
4. Use the class bar graph of the rainfall amounts for each week and the monthly summary data to discuss the monthly rainfall data. Ask such questions as
   • When was the heaviest rain?
   • How often did it rain?
   • How does this month’s rainfall compare with the predictions you made?
   • Do you predict that there will be more, less, or the same amount of rain next month? Record their ideas on SP 3.6B Weather Predictions.

5. During the first monthly weather summary after the students begin recording daily temperature data, have the students analyze the morning, noon, and afternoon temperatures using the questions in Procedure 8 in Activity 3.4 Temperature. After that use Procedure 6 below.

6. Review the class graph of daily temperatures during the monthly weather summary. Refer to their list of temperature predictions. Ask such questions as
   • What seems to be the hottest part of the day? Why do you think so?
   • Do any of your predictions seem to be right?
   • Have you been able to answer any of the questions you put in the Wonder and Discover Book about temperature?
   • How does this month’s temperature data compare with the predictions you made?
   • What do you predict the highest temperature will be next month? The lowest temperature? Record their ideas on SP 3.6B Weather Predictions.
   • What do you predict the average temperature will be in the morning for next month? At noon? In the afternoon? Record their ideas on SP 3.6B Weather Predictions.

7. Review the monthly cloud data. Compare average temperatures for cloudy days and clear days. Ask such questions as
   • Were there more cumulus or stratus clouds this month?
   • How did your predictions about the number of cloudy days, partly cloudy days, and clear days turn out?
   • Do sunny or clear days seem to be warmer or cooler than cloudy days? Why do you think this happens?
   • How does this month’s cloud data compare with the predictions you made?
   • Do you think there will be more or less cloudy days next month? Record their ideas on SP 3.6B Weather Predictions.
8. Have the students describe the weather for the month. They can do this as a class or in small groups. Record and save these monthly descriptions for comparison with future summaries.

9. Have the students create or refine their working definitions for weather, wind, rainfall, temperature, and clouds and record them in the Working Dictionary. See Appendices A-C for further information on working definitions.

10. Have the class record their ideas in the Connections Book. Ask such questions as
• Who needs to know about weather?
• Why is knowing about the weather important?
• How can you use weather information?
• Who else uses weather information? How do they use it?

11. Have the class describe seasonal weather conditions in the same way as described above for each month. Help them compare their seasonal descriptions. Use either locally defined seasons or the four astronomical seasons.
## MONTHLY WEATHER SUMMARY

**SP 3.6A**

**Name:**

**Date:**

**Month:**

<table>
<thead>
<tr>
<th>Weather Type</th>
<th>Number of Days</th>
<th>Weather Type</th>
<th>Number of Days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Wind Speed (Number of days)**

<table>
<thead>
<tr>
<th>Speed</th>
<th>Number of Days</th>
<th>Direction (Number of days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Calm:</td>
<td>4</td>
<td>North: NE:</td>
</tr>
<tr>
<td>1 Slight Breeze:</td>
<td>5</td>
<td>South: NW:</td>
</tr>
<tr>
<td>2 Gentle Breeze:</td>
<td>6</td>
<td>East: SE:</td>
</tr>
<tr>
<td>3 Moderate Breeze:</td>
<td>7</td>
<td>West: SW:</td>
</tr>
<tr>
<td>Average:</td>
<td></td>
<td>Mostly:</td>
</tr>
</tbody>
</table>

**Total Rainfall:**

**Severe Weather Events:**

**Highest Temperature:**

**Lowest Temperature:**

**Average Morning Temperature:**

**Average Noon Temperature:**

**Average Afternoon Temperature:**

**Cloud Cover (Number of Days):**

<table>
<thead>
<tr>
<th>Cover Type</th>
<th>Number of Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overcast:</td>
<td></td>
</tr>
<tr>
<td>Partly Cloudy:</td>
<td></td>
</tr>
<tr>
<td>Clear:</td>
<td></td>
</tr>
</tbody>
</table>

**Other weather observations:**

Describe the weather for this month.

---

**Description:**

- **Wind Speed:**
  - Calm: 4 days
  - Slight Breeze: 5 days
  - Gentle Breeze: 6 days
  - Moderate Breeze: 7 days
  - Average: Mostly

- **Total Rainfall:**

- **Severe Weather Events:**

- **Temperature:**
  - Highest: (value)
  - Lowest: (value)
  - Average Morning: (value)
  - Average Noon: (value)
  - Average Afternoon: (value)

- **Cloud Cover:**
  - Overcast: (value)
  - Partly Cloudy: (value)
  - Clear: (value)

- **Other weather observations:**

---

**Analysis:**

- The month had a variety of wind speeds and directions, with the most common being a Gentle Breeze.
- Total rainfall was recorded, but no severe weather events were noted.
- Temperature readings were consistent, with no significant deviations.
- Cloud cover was mostly clear with minimal overcast.

---

**Conclusion:**

The month was characterized by moderate wind conditions and clear skies, with no severe weather events reported.
<table>
<thead>
<tr>
<th>Weather predictions for:</th>
<th>(Month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most common kind of weather:</td>
<td></td>
</tr>
<tr>
<td>Wind speed:</td>
<td>Wind direction:</td>
</tr>
<tr>
<td>How much rainfall?</td>
<td></td>
</tr>
<tr>
<td>Highest temperature:</td>
<td>Lowest temperature:</td>
</tr>
<tr>
<td>Average morning temperature:</td>
<td>Average noon temperature:</td>
</tr>
<tr>
<td>Cloudy days:</td>
<td>Partly cloudy days:</td>
</tr>
</tbody>
</table>
3.7 SEVERE WEATHER EVENTS

OBJECTIVES
The students
- Report on local severe weather events.
- Review and discuss locally appropriate safety precautions and preparations for severe weather events.
- Connect the study of severe weather to their Pacific Island environment.

CLIMATE EDUCATION FRAMEWORK
- 3-5Climate.A.5 Extreme weather events (for example, tropical storms, typhoons, hurricanes, and long droughts) happen more in some places than in other places, and more in some times of the year than other times of the year.

BACKGROUND
This activity addresses the idea of severe weather events. It is suggested that the teacher keep the students focused on those sorts of events that occur in the Pacific Islands such as typhoons or hurricanes, severe droughts and tropical storms. Appropriate safety precautions and preparations are generally described by local authorities. These should be reviewed by the teacher and discussed with the students.
Students will often want to include tsunamis as severe weather when in fact these are the results of geological events, often earthquakes or submarine landslides. However, increased wave action and high surf often result from tropical storms.

STUDENT ROLE
Meteorologist

MATERIALS
poster making supplies
chart paper and markers
Working Dictionary
resources on severe weather and/or Internet access
SP 3.7 Severe Weather
PRODUCTS
Concept maps about severe weather
Posters about severe weather events
Working definition of severe weather

PROCEDURES

1. **Have the students work in small groups to make concept maps about kinds of severe weather.**
   Have them
   - Include different kinds of severe weather, effects of these events, and any other ideas they may suggest including safety issues and precautions.
     ✔See the Background if tsunamis are suggested. Ask students what causes them. Then ask how this is related to weather.
   - Identify the kinds of severe weather experienced locally.
   - Identify some kinds of severe weather experienced in other places.
     ✔Help them to identify where such events occur.
   - Share their group concept maps and then revise and add to them as they choose.

2. **Have the students work in groups or individually to make posters about kinds of severe weather that occur locally. Use SP 3.7 Severe Weather to help students with their research efforts before creating their posters.**
   Have them include
   - A description of the event.
   - Factual information they find in books, on the Internet, or from other resources, including local experts.
   - Drawings or other types of illustrations.
   - Potential effects of the particular severe weather event.
   - Locally appropriate safety and preparation information.

3. **Have the students share their posters and post them in the Weather Center or on a bulletin board.**

4. **Have the students write a Working Definition for severe weather. Put it in the Working Dictionary.**

EXTENSION

- Have students create posters about severe weather events found in other places.
<table>
<thead>
<tr>
<th>Kind of severe weather:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe the event:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Describe some possible effects from this weather:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Interesting facts:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Safety and preparation information:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Tell where you got your information from:</td>
</tr>
</tbody>
</table>
OBJECTIVES
The students
• Begin their study of water and the states of matter.
• Make a model the water cycle.
• Trace the flow of water through the environment.
• Connect the study of the water cycle to their Pacific Island environment.

CLIMATE EDUCATION FRAMEWORK
• 3-5Systems.A.1 A system is a group of interacting parts that form a whole. A system can be described in terms of its parts and their interactions.
• 3-5Systems.B.3 Earth system scientists investigate the solid, liquid, and gas parts of the Earth system. Solid matter includes rock, soil and sand. The main liquid matter is water. The main gases that make up the atmosphere are nitrogen and oxygen.
• 3-5Energy.A.1 Whenever anything happens or changes, energy is involved. For example, whenever there is a change in an object’s motion or temperature, energy is involved in those changes.
• 3-5Energy.B.1 Energy from the Sun travels to the Earth as light. When this sunlight is absorbed, it warms Earth’s land, air, and water.
• 3-5Energy.B.2 The ocean has a major influence on weather and climate because it absorbs and holds much of the sunlight energy that reaches Earth.
• 3-5Matter.A.2 Matter can generally be classified as being a solid, liquid or gas. Water is very unusual in that it exists as a solid (ice), liquid (liquid water) and gas (water vapor).
• 3-5Matter.B.1 Water is found almost everywhere on Earth. Nearly all of Earth’s water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. Water is also in the air in the form of a gas.
• 3-5Matter.B.2 The Sun provides the energy that powers the water cycle. The Sun’s energy evaporates the water. The energy from the Sun also causes the winds that move water in the air and in the ocean.
• 3-5Matter.B.3 The ocean has a major influence on weather and climate because it plays a major role in the water cycle. Most water in the air comes from the ocean. This water vapor in the air eventually cools, condenses into clouds, and returns to the ocean or the land as precipitation.
BACKGROUND
In this activity students begin with concept maps about water. They construct and discuss a very simple model of the water cycle. Then they work in small discussion groups to review and share what they know by using a diagram to trace the flow of water through the environment. They next play a game, included in this activity, which addresses the impact of weather and climate on the water cycle. They identify the local water system and relate it to the water cycle. To show what they have learned they illustrate the water cycle with a group project and are challenged to produce fresh water from salt water.

STUDENT ROLE
Meteorologist

MATERIALS
Water cycle model per group of 4-6 students: 1 quart glass or plastic jar (or cut the top off one liter plastic bottles), piece of clear plastic wrap or bag to cover the jar opening, 1 rubber band—optional, 1 cup of warm to hot water (sit in the sun to warm), 1 small piece of ice
SP 3.8 Water Cycle
Water cycle game
Chart paper and markers

PRODUCTS
Concept maps about water
Models of the water cycle
Water cycle projects
Water desalinization inventions

PROCEDURES
1. Have the students work in small groups to construct concept maps about water. Have them share their maps and then add to and revise them.
   To keep the focus on the forms and functions of water ask such questions as
   • Where can you find water?
   • How is water used?
   • Is water always a liquid? What else can it be?
   • What parts does water play in the weather?
2. **Have the students work in teams to construct the model shown in Figure 1.** The model can also be used as a demonstration with a larger scale model such that all students are able to observe the processes as they occur.

Help the students by

- Describing how to construct the model.
  - ✔ Pour the warm water in the jar.
  - ✔ Quickly cover the opening with clear plastic.
  - Option: secure the wrap with a rubber band.
  - Place the ice on top of the plastic.
  - ✔ An example of the set up may be helpful.

Have them

- Collect the materials needed for the model.
- Construct their models.
- Observe what happens in their models.

3. **Help the students discuss what happened in their water cycle models.** It will be helpful to have the models available for observation during the discussion.

Ask such questions as

- What seems to be happening to the plastic?
  - ✔ Water should collect on the underside.
- Where do you think the water came from?
  - ✔ Accept all ideas.
- How do you think the water got from the bottom of the jar to the top?
  - ✔ It moved through the air.
- What is this process called?
  - ✔ Supply the term *evaporation* if the students don’t already know it.
- Could you see the water moving from the bottom of the jar to the top?
- What do you think happened to the water?
  - ✔ It turned into a gas called water vapor.
- You used warm water. How do you think water gets warm enough to evaporate in the environment?
  - ✔ Usually from the sun.
- Does anything else in the environment help water to evaporate?
  - ✔ Work to include wind as one possibility.
- What seems to have happened when the water vapor reached the plastic wrap?
  - ✔ It turned back into water.
- Do you know what this process is called?
  - ✔ Supply the term *condensation* if necessary.
- Why do you think the ice was put on the plastic wrap?
  - ✔ Work toward the idea of simulating the cooler temperatures at higher altitudes.
  - ✔ An example of the difference between temperature at the beach and on a mountain or high hill may help if students have had this experience.
• Where do you think water vapor condenses in the environment? ✔Work toward the idea of clouds. ✔It may help to ask what often forms above mountain tops if students have observed this.
• Did anyone have drops of water fall back down to the bottom of their jar? What is this like in the environment? ✔Rain.
• Does water always return to earth in the form of rain? What are some other forms of precipitation? ✔Snow, sleet, hail for example.
• In the model, what forms of water did you observe? ✔Liquid, solid (ice), and gas (water vapor).
• What other liquids do you know? Solids? Gases?
• What gases are found in air? How could you find out? ✔Air is mostly nitrogen and oxygen.
• How does weather seem to affect the water cycle?

Figure 1 Model of the water cycle.
4. Have the students work in small groups to discuss the diagram found in the student pages. Have them trace the movement of water through the environment.

5. Have the students play the Water Cycle Game* in groups of 4-5. See directions and game parts at the end of this activity. (*This game is an adaptation of The Home Before It Rains Water Game found in the Foundational Approaches in Science Teaching (FAST 1): The Local Environment Teachers Guide.)

6. Have the students identify, describe and draw a diagram of the local fresh water system.
   Ask such questions as
   • How does our community get fresh water? How could you find out?
     ✔ This may require some research or a guest speaker.
   • How does our water supply depend on the water cycle?

7. Optional. Challenge the students to design a system that will produce fresh water from salt water using what they have learned about evaporation, condensation, and precipitation. Have them work in small groups to design and construct a working model of their system.

8. Have students work in groups to choose, construct and present one of the projects below (or others as preferred by the teacher) to show their understanding of the water cycle and the effects weather may have upon it. See Figure 2 below.

EXTENSIONS
• Have the students write beginning working definitions for water cycle, evaporation, condensation, precipitation and clouds.
  ✔ Remind them of their earlier work on clouds in activity 3.5 CLOUDS.
• Have students discuss the importance of knowing about the water cycle. Record their ideas in the Connections Book.
• Have the students write working definitions for solids, liquids and gases.
  ✔ This is more appropriate if the students have worked with these concepts in other science activities.
| A. | Write a story about several raindrop friends. Use one raindrop for each person in your group. Each raindrop takes a different path through the environment from the cloud where they started until they meet again in another rain cloud. Illustrate your story. Share it with the class. |
| B. | Create a skit that shows the flow of water through the water cycle. Perform your skit for the class. |
| C. | Write a group poem about the water cycle. Share it with the class. |
| D. | Make a collage using pictures you draw and from magazines and newspapers to show the water cycle. Label the parts of the water cycle. Share the collage with your class. |
| E. | Build a model of the water cycle. Use plants and soil in a closed environment. |
| F. | Find newspaper or internet articles about water issues where you live. Make a poster or bulletin board display. Share it with the class. There should be at least one article collected by each group member. |
| G. | Make a poster or model of the local water system. |
| H. | Other ideas as suggested by you or your teacher. |

**Figure 2 Project Ideas**
Trace the flow of water through the environment shown below.
DON'T GET WET
WATER CYCLE GAME

GAME DIRECTIONS

PLAYERS
2–4 players
1 judge

MATERIALS PER GROUPS
colored game marker for each player
one die
game board
set of question cards

RULES
1. Each player chooses a colored marker and places it near START on the game board.
2. Each player rolls the die. The player rolling the highest number goes first. Players take turns, rotating clockwise around the group.
3. Each player in turn rolls the die. The number on the die indicates the number of spaces the player may move.
4. HOWEVER, before a player moves, the judge will draw a question card from the deck and ask the question of the player. If the answer is correct, the player may move the number of spaces shown on the die. If the answer is incorrect, the player must remain on the same space until the next turn.
   THE JUDGE’S DECISIONS ARE FINAL.
5. If a player lands on one of the special spaces (see game board), the player must follow the directions given on the game board for that space.
6. The winning team is the first one to have all their groups players reach FINISH.
<p>| What is the name of the process that moves water from an ocean to a cloud? [Evaporation] | Name 2 things that can make water evaporate faster. [Sun, heat or hot temperatures, and wind] |
| Water evaporates at the same speed all the time. True or false? [False] | Deserts have a dry climate. This affects the water cycle. True or false? [True] |
| Water vapor is a gas. True or false? [True] | Water can be a liquid, a gas or a solid in the water cycle. True or false? [True] |
| As water moves through the water cycle it changes form. True or false? [True] | Name 2 kinds of precipitation. [Rain, snow, sleet, hail] |
| What is the name of the process that changes water vapor into liquid water? [Condensation] | How does water get from an ocean or lake into the air? [Evaporation] |
| Water evaporates from the leaves of green plants? True or false? [True] | There is water in clouds. True or false? [True] |
| What does water vapor need to condense? [Something cool] | Clouds form on mountain tops rather than on the beach. True or false? [True] |</p>
<table>
<thead>
<tr>
<th>Name 2 things that can happen to water after it falls as rain. [Soak into the ground, be used by plants, run into streams, etc.]</th>
<th>What do you call a process that repeats over and over? [A cycle]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is Earth mostly water or land? [Water]</td>
<td>Could the water you drink today be the same water that a dinosaur once used? [Yes]</td>
</tr>
<tr>
<td>Which is there more of on Earth, fresh water or salt water? [Salt water]</td>
<td>Humidity is the amount of water vapor in the air. True or false? [True]</td>
</tr>
<tr>
<td>Clouds are made of water vapor, water droplets, and sometimes ice crystals. True or false? [True]</td>
<td>Benjamin Franklin invented the water cycle. True or false? [False]</td>
</tr>
<tr>
<td>The dew on plants is an example of evaporation. True or false? [False]</td>
<td>The amount of water on Earth does not change. True or false? [True]</td>
</tr>
<tr>
<td>Water in oceans, streams, lakes, and ponds is the same as water in clouds. True or false? [True]</td>
<td>Name 3 weather things that affect the water cycle. [sun, wind, rain, temperature]</td>
</tr>
<tr>
<td>Climate describes the weather for each day. True or false? [False]</td>
<td>People cannot affect the water cycle. True or false? [False]</td>
</tr>
<tr>
<td>Weather and climate mean the same thing. True or false? [False]</td>
<td>The sun is a part of the water cycle. True or false? [True]</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Could it ever rain without evaporation taking place? [No]</td>
<td>Water evaporates faster in the shade than in the sun. True or false? [False]</td>
</tr>
<tr>
<td>Could it ever rain without condensation taking place? [No]</td>
<td>Fog is a cloud that is close to the ground. True or false? [True]</td>
</tr>
<tr>
<td>Most of the water in the air comes from the ocean. True or false? [True]</td>
<td>The water on the outside of a cold drink is an example of condensation. True or false? [True]</td>
</tr>
<tr>
<td>Wind has no effect on the water cycle. True or false? [False]</td>
<td>The water cycle does not happen at the North Pole. True or false? [False]</td>
</tr>
<tr>
<td>Global warming will have no effect on the water cycle. True or false? [False]</td>
<td>How does fresh water get to an island? [Mostly by rain.]</td>
</tr>
<tr>
<td>Name 2 ways water can get returned to the ocean. [rain, streams, canals, etc.]</td>
<td>Even an island could run out of fresh, clean water. True or false? [True]</td>
</tr>
</tbody>
</table>
31. Take another turn.

30. Evaporation

29. Condensation

28. Precipitation

27. Go back 3 spaces.

26. Roll again. Go ahead that amount.

25. Roll again. Go ahead that amount.

24. Roll again. Go ahead that amount.

23. Roll again. Go ahead that amount.

22. Roll again. Go ahead that amount.


20. Roll again. Go ahead that amount.

19. Roll again. Go back that amount.

18. Roll again. Go ahead that amount.

17. Roll again. Go ahead that amount.

16. Roll again. Go ahead that amount.

15. Roll again. Go back that amount.


13. Roll again. Go ahead that amount.

12. Roll again. Go ahead that amount.

11. Roll again. Go ahead that amount.

10. Roll again. Go ahead that amount.

9. Roll again. Go back that amount.

8. Roll again. Go ahead that amount.

7. Roll again. Go ahead that amount.

6. Roll again. Go ahead that amount.

5. Roll again. Go ahead that amount.

4. Roll again. Go ahead that amount.

3. Roll again. Go ahead that amount.

2. Roll again. Go ahead that amount.

1. Roll again. Go ahead that amount.

Start

1. Don’t Get Wet (Water Cycle Game)

FINISHERS

Weather

Climate

Water Vapor
OBJECTIVES
The students
• Listen to a description of the formation of volcanic islands, fringing reefs, barrier reefs, and atolls.
• Observe and participate in a simulation of this four-stage process.
• Identify the development stage of their home island.

CLIMATE EDUCATION FRAMEWORK
• 3-5Climate.A.4 Many tropical Pacific islands that have at least one high mountain have one part of the island that gets a lot of rain, and other areas that get very little rain.
• 3-5Systems.B.8 Earth is shaped like a huge ball. Things on or near the Earth are pulled towards Earth’s center by gravity.
• 3-5Impacts.A.1 Erosion is the movement of Earth materials (such as coastal land) by forces such as moving water (waves, currents, floods) and wind. Erosion and floods threaten homes, roads and other coastal development.

BACKGROUND
In this activity the students explore how a volcanic island over a very long period of time evolves into a coral atoll through a four-stage process. Pacific Islands are at different stages. The teacher is encouraged to tell the story as the simulation is constructed (and destructed) with the help of the students.

Some History and Other Notes
Charles Darwin first suggested the following theory of how coral atolls are formed. His theory has since been validated by scientists who drilled deep holes into atolls and discovered the same sequence of rock layers as Darwin had predicted. Coral reefs are only found near the equator. The reason for this is that coral only grows in warm water. This makes a good topic for research. This geological process occurs over millions of years. Students are not likely to comprehend the enormity of such a time span. It is fine to just stress that it took a very, very long time.

Gravity plays an important role in this process. If student understanding of gravity is minimal, consider using Appendix E GRAVITY to develop this concept. The Hawaiian Islands are unique in that all four stages are represented from one end of the island chain to the other. At the old, northwest end of the chain is Kure Atoll. Loihi at the new, opposite end, is an active volcano that has not yet reached the surface to become an island. It is currently a developing seamount. If it erupts at the same rate as the volcanoes on the big island, it will reach sea level in a few tens of thousands of years.
Stage 1
The Pacific Islands were all originally high, volcanic islands. These were formed when undersea volcanoes broke through the surface of the ocean shooting up lava that eventually created the islands. Once an island is formed, coral begins to grow around its edges forming a fringing reef.

- This activity is probably best done at the beach. To begin the simulation scoop out a shallow depression in the sand about a meter in diameter. This will be the ocean. Build a mound of sand in the middle about 25-cm high and 25-50-cm in diameter. This is the volcanic island coming up from the ocean floor. Use a sheet of plastic to cover the island and line the depression. Fill the plastic-lined depression with water to a depth of 10-cm or so. Build a fringing reef around the island with pieces of dead coral collected on the beach. The coral pieces need to reach all the way to the outer edges of the depression. They don’t need to reach the surface of the water. A large dishpan or similar may also be used if a field trip to the beach is not possible.

Stage 2
Millions of years went by. Gravity caused the island to very slowly sink back into the ocean. Wind, water and wave erosion also played a part in this process. As the distance between the shrinking, sinking island grew, the fringe reef got further away from the island's shore. Water filled in the space between what was left of the island and the original fringe reef so that it eventually became the barrier reef.

- Gently push on the sand island causing it to slowly sink under the plastic. You may need to push more on the outer edges of the mound to be sure to decrease not only the height but also the diameter. As the mound of sand goes down a space should form between the island and the fringing reef. Water should flow into this space to create a barrier reef around the island.

Stage 3
More time passed during which the volcanic island evolved into a small island in the middle of the lagoon.

- Continue to push on the sand mound until there is just a small, low pile of sand with water all around. Push the coral out a bit to build up the outer barrier reef—the coral keeps growing.

Stage 4
The island continued to sink and the waves eventually washed it away until all that was left was the outer barrier reef or coral atoll. In the case of the Northwest Hawaiian Islands and Majuro, sufficient sedimentation and other soil forming processes occurred (erosion and decomposition for example) such that the coral atolls became able to sustain life.

- Push the sand island down below the water surface and sprinkle some sand (soil) on the coral atoll. Once the island sinks below the surface of the water you may need to add water to fill the lagoon—as the ocean fills the lagoon through breaks in the reef.

STUDENT ROLE
Geologist
MATERIALS
Beach Simulation
- sand (beach)
- coral pieces
- water containers
- shovels (optional)
- water
- plastic sheeting such as a tarp or shower curtain about 2-m (6 ft) by 2-m (6 ft)

Classroom Simulation
- large dishpan or small plastic wading pool
- large plastic garbage bag
- sand
- coral pieces

PRODUCTS
Model of process
Working definition of system

PROCEDURES

1. **Have the students help prepare for the simulation.**
   Help them
   - Review beach and ocean safety rules.
   - Assemble necessary equipment.
     ✓ Include containers for carrying water, a plastic shower curtain or similar, and shovels (optional).
   - Collect pieces of dead coral from the beach.

2. **Help the students set up Stage 1 of the simulation.**
   Have them
   - Dig a shallow depression in the sand about one meter in diameter.
     ✓ This will represent the ocean.
   - Build a mound of sand in the center of the depression about 25-cm high and 25-50-cm at the base.
     ✓ This represents the volcanic island.
   - Cover the island and depression with the plastic sheet.
     ✓ Be careful not to flatten the island.
   - Fill the depression around the island with water to a depth of 10-cm or so at the deepest point.
3. **Begin Stage 1 of the simulation.**
   - Tell the story using something like the following
     The Pacific Islands were originally high, volcanic islands. These were formed when undersea volcanoes broke through the surface of the ocean shooting up lava that eventually created islands. This is one such volcanic island. As soon as the island was formed, coral began to grow around the shores of the island creating a fringing reef.
   - Have the students place pieces of coral around the island all the way to the outer edge of the depression.

4. **Continue with Stage 2 of the simulation.**
   - Continue the story with something like the following
     Millions of years passed. The island very slowly sank back into the ocean. Wind, rain, and wave erosion also played a part in this process. The distance from the shores of the shrinking, sinking island grew further and further from the fringe reef. Water began to fill in the space between what is left of the island and the original fringe reef so that eventually the fringe reef became a barrier reef.
   - Gently push down the island around the sides and from the top to decrease its diameter and height of the island.
     ✔ You may need to push the coral a bit toward the outer edges to produce the proper effect of the water coming between the reef and the island.

5. **Continue with Stage 3 of the simulation.**
   - Continue the story with something like the following
     Still more time passes. The wind blows, the rain washes away the soil, the waves erode the shore of the island. Gravity does its work. The once majestic island continues to sink ever so slowly into the sea until all that remains of the once tall volcanic island is a small flat island in the middle of a large lagoon enclosed by an outer barrier reef.
   - Keep gently pushing on the sand mound as described above until just a small island remains above the water.

6. **Complete Stage 4 of the simulation.**
   - Finish the story with something like this
     The island continues to sink to the bottom of the lagoon and the waves eventually washed it completely away. All that remains now is the outer barrier reef or coral atoll. In the case of Majuro for example, sufficient sedimentation and other soil forming processes occurred so that the coral atolls became able to sustain life.
   - Push the sand island down below the water surface and sprinkle some sand (soil) on the remaining coral atoll. Add a small plant if available.
     ✔ Once the island sinks below the surface of the water you may need to have the students add more water to fill the lagoon.
7. **Have the students discuss the simulation.**
   Ask such questions as these
   - Where did the land for the island come from?
     ✔ The lava from undersea volcano that grew until it got taller than the ocean was deep.
   - Does anyone know of any undersea volcanoes that are now starting to make new islands?
     ✔ One example is Loihi off the coast of Hawaii’s Big (and youngest) Island. It will be tens of thousands of years before it gets to the ocean’s surface if it ever does.
   - Where does a fringing reef grow?
   - What is a fringing reef made of?
     ✔ Live and dead corals.
   - What caused the island to shrink and sink?
     ✔ Gravity and wave, water, and wind erosion.
   - How was the lagoon formed?
   - How does water get into the lagoon?
     ✔ Through a break in the barrier reef.
   - Where is the island now?
     ✔ At the bottom of the lagoon.

8. **Help the students identify and discuss at which stage their local island environment is in this process.**
   Ask such questions as
   - At what stage do you think our Pacific island home is in this geologic process?
   - Why do you think so?
   - What evidence do you have?
   - How could you find out if you are correct?
OBJECTIVES
The students

- Summarize monthly and seasonal weather data about local weather conditions including wind speed and direction, rainfall, temperature, and cloud cover.
- Compare average monthly wind speed and direction.
- Identify the prevailing wind direction(s) for different seasons.
- Compare the depth of rain falling in different months and seasons.
- Make generalizations about relative temperature for morning, noon, and afternoon.
- Make hypotheses and generalizations about temperature and months and seasons.
- Compare the amount of cloud cover in different months and seasons.
- Identify and describe local seasonal weather patterns.

CLIMATE EDUCATION FRAMEWORK

- **3-5Weather.A.1** By measuring weather conditions (temperature, amount and kind of precipitation, amount and kinds of clouds, wind direction and wind speed), scientists learn how the weather changes from day to day, month to month, and during the year.

- **3-5Weather.A.2** Scientists analyze records of the weather that has happened in different places in the different times of the year. There are patterns to the kinds of weather that happen in a place and at different times of the year.

- **3-5Climate.A.2** Pacific islands that are near the equator have warm climates. The temperature does not change very much from day to night. Temperatures do not change very much from month to month over the course of a year.

- **3-5Climate.A.3** Many tropical Pacific islands have a wet season and a dry season.

BACKGROUND
In this activity the students summarize the weather data they have collected during the school year. They use their monthly summaries to analyze the weather throughout the year. They look for correlations between the various weather elements.

Use either seasons appropriate to the local community or the astronomical seasons as the students summarize their data and make comparisons. They look for patterns to describe the seasonal weather. It is suggested that the teacher work with the whole class to summarize the data.
This year-end summary lays the foundation for understanding local climate. It provides a final opportunity to revise their working definitions as needed. A final activity is a discussion about the importance of studying and knowing about weather. Student ideas are recorded in the Connections Book.

STUDENT ROLES
Meteorologist

MATERIALS
Chart paper and markers
Monthly weather data on kind of weather, rainfall, temperature, wind speed and direction, and cloud cover.
Student Page 3.10 Seasonal Weather
Working Dictionary
Wonder and Discover Book
Connections Book

PRODUCTS
Year-end weather data summary
Seasonal weather descriptions
Class Chart about Weather Data Comparisons
Weather Prediction Chart
Working Definitions of weather related terms

PROCEDURES
1. At the end of the school year have the students compare their monthly and seasonal kinds of weather data. Make a class chart, Weather Data Comparisons, to record and compare this information. See Figure 1 for an example.
   Ask such questions as
   • Which month had the most sunny days? Fewest sunny days? Season?
   • Which month had the most rainy days? Fewest rainy days? Season?
   • Which month had the most cloudy days? Fewest cloudy days? Season?
     ✔ Ask about other types of weather conditions as appropriate to the local environment.
   • How do you predict the weather in the coming (summer) months will compare with other months (seasons)?
     ✔ Optional: Make a class chart about weather predictions. Record their predictions from the following procedures about the coming summer weather on the chart.
2. **At the end of the school year have the students compare their monthly and seasonal wind data. Record their ideas on the class chart, Weather Data Comparisons.**
   Ask such questions as
   - Which month(s) was the windiest? Season?
   - Which month(s) had the least amount of wind? Season?
   - Do the winds seem to come mostly from certain directions? What are they?
   - Do the winds mostly come from one direction in certain months? Seasons?
     ✔ Have students identify this information.
   - Are the winds stronger when they come from one direction than from others?
     ✔ Have students identify this information.
   - How do you predict the wind speed and direction in the coming (summer) months will compare with other months (seasons)?

3. **At the end of the school year have the students compare their monthly and seasonal rainfall data. Record their ideas on the class chart, Weather Data Comparisons.**
   Ask such questions as
   - What was the wettest month? Season?
   - What was the driest month? Season?
   - How do you predict the rainfall in the coming (summer) months will compare with other months (seasons)?

4. **At the end of the school year have the students compare their monthly and seasonal cloud data. Record their ideas on the class chart, Weather Data Comparisons.**
   Ask such questions as
   - What was the cloudiest month? Season?
   - What was the month with the most clear days? Season?
   - Do you see any connections between cloudy months and rainy months?
   - Do you see any connections between clear months and dry months?
   - What do you think causes this?
   - How do you predict the cloud cover in the coming (summer) months will compare with other months (seasons)?

5. **At the end of the school year have the students compare their monthly and seasonal temperature data. Record their ideas on the class chart, Weather Data Comparisons.**
   Ask such questions as
   - Which months had the hottest temperatures? Season?
   - Which months had the coolest temperatures? Season?
   - Do you see any connections between clear weather months and temperatures? Rainy months? Cloudy months?
   - How do you predict the temperatures in the coming (summer) months will compare with other months (seasons)?
6. **At the end of the year have the students correlate temperature with time of day, seasons, and amount of cloud cover and shadow.**

   Ask such questions as
   - How does the amount of cloud cover seem to affect temperature? Why might this be?
   - How does the time of day seem to affect temperature? Why might this be?
   - How does temperature relate to seasons?

7. **Have the students describe the weather for each season.** Use either locally defined seasons or the four astronomical seasons. Have them include statements about the most likely kind(s) of weather, wind speed(s) and direction(s), rainfall, temperature range (high and low), and cloud cover. Use Student Page 3.10 if desired.

8. **Have the students revise their working definitions for weather words including weather, wind, rain, temperature and clouds.**

9. **Have the students review their questions in the Wonder and Discover Book and answer any they now have new information about. Any remaining unanswered questions can be passed on to next year’s teacher.**

10. **Have the class record their ideas in the Connections Book.**

    Ask such questions as
    - Who needs to know about weather?
    - Why is knowing about the weather important?
    - How can you use weather information?
    - Who else uses weather information? How do they use it?

---

**Weather Data Comparisons**

<table>
<thead>
<tr>
<th>Weather Data</th>
<th>Month</th>
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Figure 1. Example of a class chart for comparing weather data.
Describe the weather for each season. Include the usual kind or kinds of weather, wind speed and direction, amount of rainfall, high and low temperatures, and cloud cover you would expect during each season.

<table>
<thead>
<tr>
<th>Season</th>
<th>Months</th>
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3.11 EVALUATION:
CONCEPT AND SKILL INVENTORY

OBJECTIVES
The students
• Assess their own understanding of weather and climate concepts.
• Assess their own ability to perform the skills taught.
• Describe, demonstrate, or teach their knowledge of concepts.
• Demonstrate their ability to perform or teach skills.

BACKGROUND
This activity is a unique evaluation component that is designed to engage the students in becoming aware of the concepts they understand and the skills they have mastered. The instrument used is called a Concept and Skill Inventory.

In DASH the term concept includes a whole array of connections and ideas associated with a particular word or phrase. The term skill means the ability to do something. Concepts and skills develop with the student. A third grader's concept of weather will be far broader than that of a kindergartner. Likewise, a fifth grader's skill in measuring temperature will exceed that of a third grader.

The students distinguish four levels of understanding with teaching as the highest level of achievement.

- **0** No understanding of the concept or ability to do the skill
- **1** Beginning to understand the concept or beginning ability to do the skill
- **2** Good understanding of the concept or good ability to do the skill
- **3** Can teach someone else the concept or skill

It is suggested that first the teacher independently rate each student's mastery. After the teacher and the students have completed their ratings, the teacher can resolve discrepancies by discussing them with the students. At the level of understanding the students can be asked what they know about a concept. At the teaching level they can be asked to teach the teacher the concept. In DASH teaching is seen as the highest level of achievement. The students should be constantly striving to gain the capacity to teach someone else both concepts and skills. In the case of skills, the students' ability to perform or carry out a given skill can be directly tested by giving them a task involving the skill.

The Concept and Skill Inventory, the Suggested Script, and the Teacher Evaluation appear in the Teacher's Guide following this activity. Each student will need a copy of the Inventory. Make enough copies of the Teacher Evaluation to accommodate the number of students in the class. The Concept and Skill Inventory can be used as a reporting mechanism for parents but some communication should accompany the inventory describing how it should be interpreted. The concepts and skills listed in the
instrument are but a suggestion. The teacher may make additions, substitutions, or deletions as needed.

**STUDENT ROLE**
Evaluator

**MATERIALS**
Suggested script for administering the Concept and Skill Inventory
Teacher evaluation
Student Concept and Skill Inventory

**PRODUCTS**
Completed Concept and Skill Inventories

**PROCEDURES**

1. **Explain the purpose of the Concept and Skill Inventory to the students.**
   Include such things as the evaluation
   • Allows students to tell what they think they know.
   • Allows teachers to check their observations with what students think.
   • Shows what yet needs to be mastered or understood.

2. **Go over examples of what is meant by each level of the Inventory.** Read the concepts and skills where necessary and have the students check their level of understanding and mastery.

3. **Discuss with individuals differences in teacher and student perception of mastery and understandings.**

**SUGGESTED SCRIPT**

*Climate Education Grade Three Concept and Skill Inventory*

There are four possible answers to each of the following questions: **No**, I cannot do that. **Begin**, I am beginning to be able to do that. **Good**, I can do that. And, I can **teach** a friend who cannot do this how to do it. Please check only ONE answer only: **no, begin, good, or teach**.

1. Can you describe the weather? ...**NO**, I do not know what weather is; **BEGIN**, I know some things about the weather; **GOOD**, I can describe the weather; or, I can **TEACH** a someone what weather is so they can describe it. Put a check under the answer that best describes what you can do.
2. Do you know how to measure rainfall? Continue as above until all the students understand the pattern.
### KEY:

1. **No** I have no understanding of the concept or I cannot do this.

2. **Begin** I am beginning to understand the concept or I am beginning to do this.

3. **Good** I have a good understanding of the concept or I can do this.

4. **Teach** I can teach someone else to understand the concept or to do this.

<table>
<thead>
<tr>
<th>1. Describe the weather</th>
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<tbody>
<tr>
<td>2. Measure rainfall</td>
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<tr>
<td>3. Name some kinds of precipitation</td>
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<tr>
<td>4. Measure wind speed</td>
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<td>5. Find wind direction</td>
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<td>6. Measure the temperature</td>
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<td>7. Describe the difference in temperatures in the sun and in the shade at the same time</td>
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<td>8. Identify the usual hottest part of the day</td>
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<td>9. Describe two kinds of clouds</td>
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<td>10. Describe the amount of cloud cover</td>
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<td>11. Describe some kinds of severe weather</td>
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<td>12. Describe what happens to water when it evaporates</td>
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<td>13. Tell what condensation means</td>
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<td>14. Give examples of solids, liquids and gases</td>
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<td>15. Tell how islands are formed and change into atolls</td>
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<td>16. Describe local weather for different seasons</td>
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Grade 3 Climate Education
Concept and Skill Inventory

There are four possible responses to each of the following:
- No: I have no understanding of the concept or I cannot do this.
- Begin: I am beginning to understand the concept or I am beginning to do this.
- Good: I have a good understanding of the concept or I can do this.
- Teach: I can teach someone else to understand the concept or to do this.

Check ONE response.

<table>
<thead>
<tr>
<th>Concept or Skill</th>
<th>No</th>
<th>Begin</th>
<th>Good</th>
<th>Teach</th>
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APPENDIX A
PRACTICES (GRADES 3–5)

Ask Questions and Define Problems
• Identify scientific (testable) and non-scientific (non-testable) questions.
• Ask questions based on careful observations of phenomena and information.
• Ask questions based on cause and effect relationships to clarify ideas or request evidence.
• Ask questions that relate one variable to another variable.
• Ask questions that can be investigated about weather, climate or an impact of climate change.

Develop and Use Models
• Explain how a model related to weather, climate, or an impact of climate change represents relationships or processes.
• Use simple models to describe phenomena and test cause and effect relationships concerning the functioning of a natural or designed system.
• Use models to share findings or solutions in an oral or written presentation or in a group discussion.
• Identify limitations of models in terms of how useful and accurate they are.

Plan and Carry Out Investigations
• Collaboratively plan and carry out simple investigations using fair tests in which variables are controlled and the number of trials considered.
• Demonstrate values and attitudes that are important in working together as a team.
• Demonstrate knowledge of safety and ethical considerations in planning and carrying out an investigation.
• Evaluate appropriate methods and tools for collecting data.
• Use standard units to measure area, volume, weight, and temperature.
• Make observations and/or measurements, collect appropriate data, and identify patterns that provide evidence to explain a phenomenon or test a design solution.

Analyze and Interpret Data
• Display data in tables and graphs, using digital tools when feasible, to reveal patterns that indicate relationships.
• Use data to evaluate claims about cause and effect.
• Compare data collected by different groups in order to discuss similarities and differences in their findings.
• Use data to evaluate and refine design solutions.
Construct Explanations and Design Solutions

- Construct explanations of observed quantitative relationships (e.g., the numbers of different kinds of organisms in a location).
- Use evidence (e.g., measurements, observations, patterns) to construct a scientific explanation or design a solution to a problem.
- Identify the evidence that supports particular points in an explanation.
- Distinguish whether an explanation relies on facts, reasoned judgments based on research findings, or on unsupported speculation.
- Apply scientific knowledge to solve design problems.

Analyze and Investigate Environmental Issues

- Respectfully gather local indigenous knowledge related to an environmental issue.
- Collaboratively develop simple explanations in response to questions they have formed about the environment.
- Locate, collect and organize simple information on nature, communities and environmental topics.
- Communicate information obtained from reliable source about potential solutions to an environmental issue.

Decide and Act

- Decide and act with the understanding that Indigenous beliefs and values are based on the idea and experience that all living and non-living things remain in balance for continued existence.
- Understand that people can act as individuals but that the community influences and is affected by individual actions.
- Understand the importance of sharing ideas, hearing other points of view, and honoring community values.
- Explain that people and nature are connected at many levels, including the global level.
- Have age appropriate and realistic self confidence in their effectiveness and role as citizens.
OBJECTIVES
The students
• Use their senses to describe selected objects.
• Identify the different senses used in collecting the information.
• Relate physical properties of things to senses.
• Classify a collection of items according to their similarities and differences.
• Are introduced to two category classification or dichotomous classification.
• Classify objects by their physical properties.
• Identify both similarities and differences in functions of items.
• Classify items by their functions.

BACKGROUND
This start-up activity is designed to introduce students new to DASH to the fundamental science concept and skill of classification. The teacher will need to adapt and modify the suggested procedures depending on the previous experience and developmental level of the students.

Senses and properties
The students first make a concept map about the senses of sight, hearing, touch, smell, and taste. They associate these senses with their sensing organs—eyes, ears, skin, nose, and tongue and identify the properties of objects that can be sensed—color, sound, texture, temperature, odor, flavor, and so forth.

Same and Different game
The students next play the Same and Different game in which they sort items into six or more different major categories. Each major category is made up of some set of common classroom items such as paper clips, books, pencils and so forth. Objects in a category have the same form and function. The form of an object refers to its physical properties, what it is made of, and its parts and their organization. The function of an objects refers to what it does or is used for.

Kinds of things or categories
The teacher and students work together to create category names such as pencils, rulers, paper clips and so forth as two or three different kinds of things or items are drawn from a container holding a Master Collection. The students then match other items with existing categories or create new categories when different kinds of items are presented. The students can also invent logos to represent each category—example, a picture of a pencil or a ruler.

Building a Master Collection
Most of the procedures in this activity use a master collection of items. It needs to be large enough so there is at least one item per student. Needed for the master collection are 6 or more major categories, each with two subcategories. One of the two subcategories has items that all look the same. The other subcategory has the same kind of items but they look different from all other items. For
example, the major category pencils could have a same pencils subcategory—
two brand new white pencils and a different pencils subcategory —four to eight
used, different colored pencils. See Figure SU.1(1) for some suggestions for a
master collection.

<table>
<thead>
<tr>
<th>Category: Pencils</th>
<th>Category: Paper Clips</th>
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</thead>
<tbody>
<tr>
<td>Subcategories:</td>
<td>Subcategories:</td>
</tr>
<tr>
<td>2 New pencils that look the same.</td>
<td>2 New paper clips that look the same.</td>
</tr>
<tr>
<td>4-8 Used pencils, each different from all other pencils.</td>
<td>4-8 Paper clips, each different from all other paper clips</td>
</tr>
<tr>
<td>(e.g. different colors, lengths)</td>
<td>(e.g. different colors, sizes)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category: Books</th>
<th>Category: Rulers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subcategories:</td>
<td>Subcategories:</td>
</tr>
<tr>
<td>2 New books that have the same title.</td>
<td>2 New rulers that look the same.</td>
</tr>
<tr>
<td>4-8 Used books, each with a different title.</td>
<td>4-8 Used rulers, each different from all other rulers</td>
</tr>
<tr>
<td></td>
<td>(e.g. different colors, materials)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category: Paper</th>
<th>Category: Crayons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subcategories:</td>
<td>Subcategories:</td>
</tr>
<tr>
<td>2 New sheets of paper that look the same.</td>
<td>2 New crayons that look the same and have the same color.</td>
</tr>
<tr>
<td>4-8 Used sheets of paper, each different from all other sheets of paper.</td>
<td>4-8 Used crayons, each different from all other crayons.</td>
</tr>
<tr>
<td>(e.g. different colors, sizes)</td>
<td>(e.g. different colors, lengths)</td>
</tr>
</tbody>
</table>

Figure SU.1(1) Six possible categories of game items for a master collection.

**Physical properties and two category classification**

Next the students use the physical properties of size, shape, and other visual and
tactical characteristics to separate items into subcategories. To do this they are
first introduced to a two category or dichotomous system for sorting or classifying
items. Scientists use a simple two category or dichotomous system to sort or
classify things. They take a collection of items, inspect it, and divide the collection
into two different categories. One category has a distinct characteristic and the
other does not have that characteristic.

**Name Game**

To get a feeling for the dichotomous classification system, start with the Name
Game. Select four or five students and group them in the inclusive category All
Students. For example, All Students might be Jan, Jack, Jill, Jo, and Jim. Then
divide All Students into two categories—Girls and Not Girls. Next divide Girls into
two more categories—Jan and Not Jan. Continue the process with the Not Girls
until Jo, Jack and Jim have their own separate categories. See Fig. SU.1(2).
Classification game

Use the items from the Master Collection for the classification game. Have the students classify the objects by their physical properties or forms. First the students work with the teacher on one of the major categories such as pencils. Together they successively divide the items in the major category into pairs of sub-categories using differentiating physical properties. After the students have worked through classification of one major category, have them work in small groups to classify other major categories.

Follow the process used in the Name Game. On a table or the floor put all of the items in a single major category. All pencils are shown in the example in Fig. SU.1(3). The first two subcategories of All Pencils are White pencils and Not white pencils. Then the Not white pencils are divided into two subcategories—Yellow pencils and Not yellow pencils. Again the division continues until the items can no longer be separated. Here the pencils were separated by the physical property of color. Multiple physical properties such as color and length, can be used within the same category classification as desired.

Fig. SU.1(2) A classification tree sorting five students in the Name Game using a two category or dichotomous system.
All Pencils
(2 white, 1 red, 1 blue, 1 green)

/               \
White pencils   Not white pencils
(1 red, 1 blue, 1 green)

/               \
Red pencil      Not red pencils
(1 blue, 1 green)

/               \ 
Blue pencil     Not blue pencil
(green pencil)

Fig. SU.1(3) Classification of pencils using a two category or dichotomous system and a classification tree.

Showing steps in the classification
The students are then asked to help draw a diagram showing the steps they went through to identify different objects as in Figures. SU.1(1–2). This creates a classification tree by connecting the words or boxes with lines to show the division of categories. The students record their categorization on a class chart. Then they work in small groups to classify other major categories and record their work on SP SU.1 CLASSIFICATION TREE. Trees and collections can be traded between groups as a skill assessment.

Function classification game
Next the students are introduced to classification by function. First they work with the teacher to classify items and to get an idea of the meaning of the function of a thing or what it does or is used for. Then they work in small groups to classify sets of items by function.

Function game
The function game is played with one item from each of four of the major categories from the master collection. These are put on the table and the students find a functional category name that will fit them all. For example, for a collection of a pencil, ruler, crayons, and a piece of paper, the functional category could be Things used in drawing or Classroom tools. The students then classify the set into a pair of function subcategories labeling the function of one item and labeling the other as not having that function. For example; Thing used in measuring (ruler) and Things not used in measuring (all other items). Words or logos are used to identify the function categories. Figure SU.1(4) shows some possible functions for items in the master collection. With the teacher, the students separate the remaining three items into functional subcategories. For example: Things used to write on (paper) and Things not used to write on (crayons and pencils). See Figure SU.1(5).
<table>
<thead>
<tr>
<th>Item</th>
<th>Possible Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Book</td>
<td>Items used to read, to hold printed words and pictures, to press flowers, etc.</td>
</tr>
<tr>
<td>Crayon</td>
<td>Items used to color paper, to batik, to color candles, etc.</td>
</tr>
<tr>
<td>Paper</td>
<td>Items used to write on, to make airplanes or spitballs, etc.</td>
</tr>
<tr>
<td>Paper clip</td>
<td>Items used to hold papers together, to release computer disks, etc.</td>
</tr>
<tr>
<td>Pencil</td>
<td>Items used to write on paper, to poke holes, to hold doors open, etc.</td>
</tr>
<tr>
<td>Ruler</td>
<td>Items used to measure distance, to draw straight lines, to make ramps for marbles, etc.</td>
</tr>
</tbody>
</table>

Figure SU.1(4) A list of some possible functions for the master collection.

---

Fig. SU.1(5) A classification tree using function.

To mockup:

```
Tools used in class work (ruler, crayon, pencil, paper)
/   \
Tools used to measure (ruler)   Tools not used to measure (crayon, pencil, paper)
/   \
Tools used to write on (paper)   Tools not used to write on (crayon, pencil)
/   \
Tools used to color (crayon)   Tools not used to color (pencil)
```
STUDENT ROLES
Observer
Classifier
Taxonomist

MATERIALS
chart paper
markers
items for the master collection

PRODUCTS
Class charts of classification using form and function
Completed Student Pages

PROCEDURES

1. **Have the students construct a concept map about physical properties and the senses.**

   Help them to include such ideas as these by asking questions about:
   - The sense of sight.
     ✔ Work to the idea that the eyes provide the sense of sight.
     ✔ Include sight associated physical properties such as color, size, shape, pattern and so forth.
   - The sense of hearing.
     ✔ Work to the idea that you hear things with your ears.
     ✔ Include hearing associated physical properties such as pitch (high/low), intensity or amount (soft/loud/painful), beat (fast/slow), and so forth.
   - The sense of touch.
     ✔ Work to the idea that you feel things with the skin.
     ✔ Include touch associated physical properties such as feeling texture (rough/smooth, soft/hard, sharp/dull, others), pressure (heavy/light/pain), temperature (hot/cold), and so forth.
   - The sense of smell.
     ✔ Work to the idea that you smell things with the nose.
     ✔ Smells are described as being like something known—like fruit, perfume, or foul odors.
   - The sense of taste.
     ✔ Work to the idea that you taste things with the tongue.
     ✔ Include touch associated physical properties such as sweet, sour, bitter, and salty.
     ✔ CAUTION: Remind students that it is dangerous to taste things that are not foods.
2. Introduce the Same and Different game using items from the master collection. See Background. Keep items in a container so that they are seen only when pulled out. Have the students focus on the major category names (pencils, paper clips, paper, and so forth). Do not worry about subcategory differences at this time.

- Pull an item from the container and ask the students to give it a name.
  ✔ Ask, What is this? or what do we call this? The name they suggest will usually tell what kind of thing the item is and be its category name.
- Draw a box or circle on chart paper and put the item in it. Label the box with the category name.
- Show the students another item and ask them if it is the same or different from the one already out in the circle or box.
  ✔ Start using the term *category* to describe the box or circle and the items in it.
- If different, draw and place it in a different box or circle. Label the box with the new category name.
- If it is the same, place it in the box with the similar object.
  ✔ Start using the term *category* to describe the box or circle and the items in it.
- Ask why they put the item where they did?
  ✔ Usually students will say they look alike or do the same things.
- Ask why they didn't put the items in some other category?
- Continue until the students are reasonably fluent with the ideas of same, different, and category.
- Summarize the activity by asking what they mean when they say something is in a *category*. Ask them to give examples of categories and things that could be included in them.
  ✔ Work to such things as new, old, and used pencils are in the category pencils; new, old, and beat-up cars are all in the category cars. In each case members of the category share some properties and do the same thing.
- Help the students to understand the importance of knowing about physical properties by asking them how they tell one object from another.
  ✔ Work to describing the physical properties of the objects.
3. **Introduce the students to playing a Name Game. See Figure SU.1(2).**
   - Draw a large circle on chart paper and give it the name *All Students*.
     - ✔ Ask for volunteers and select 4-6.
     - ✔ Have the students write their initials in the circle.
     - ✔ Announce that this is the *All Students* circle and label it.
   - Draw another circle outside the big circle. Put the initials of Student #1 in the circle.
     - ✔ Announce this is *Student #1’s* circle. Label it.
     - ✔ Ask if the big circle still has the correct name now that Student #1 is not in it.
     - ✔ Work to the idea that they need a new circle that does *not* include Student #1.
   - Draw a *Not Student #1* circle at the side of the *Student #1* circle. Have the remaining students put their initials in the new circle. Ask what a name for the circle might be.
     - ✔ Work to the response the *Not Student #1* circle. Label it.
   - Draw another circle below the *Not Student #1* circle. Put the initials of Student #2 in the circle.
     - ✔ Announce this is *Student #2’s* circle. Label it.
     - ✔ Ask if the *Not Student #1* circle still has the right initials now that Student #2 is not in it.
     - ✔ Work to the idea they need a new circle that does *not* include Student #2.
   - Draw a *Not Student #2* circle at the side of the *Student #2* circle. Have the remaining workers put their initials in the new circle. Then ask the students to name the circle and label it.
     - ✔ Work to the response the *Not Student #2* circle.
   - Draw another circle below the *Not Student #2* circle. Put the initials of Student #3 in the circle.
     - ✔ Announce this is *Student #3’s* circle.
     - ✔ Ask if the *Not Student #2* circle still has the right name now that Student #3 is not in it.
     - ✔ Work to the idea they need a new circle that does *not* include Student #3.
   - Draw a *Not Student #3* circle at the side of the *Student #3* circle. Have the remaining student put initials in the new circle.
     - ✔ Ask if is it fair to call this circle *Not Student #3* since all other students have their own circle.
     - ✔ Work to the response that since only *Student #4* is in the circle it could also be called *Student #4’s* circle.
   - Continue with student # 5 and/or student #6 if appropriate.
   - Help the students add connecting lines to the chart to show how the classification of students was accomplished. Introduce the term *classification tree* for this type of chart.
   - Ask the students to tell what they think a classification tree tells them.
     - ✔ Work to the idea that it shows how you think as you make selections of things or people.
4. Use the items from one of the major categories in the Master Collection and introduce the Classification Game. See Figure SU.1(3) for an example with pencils. Place all items on a piece of chart paper on a table or the floor and go through their classification with the students.

Ask such questions as these:
• What is the name of the category?
  ✔ Write the name of the category in a box or circle containing all items.
• Can you divide these things into two categories so that things in one category will have a property and all the things in the other category will not have that property?
  ✔ Draw boxes or circle around the subcategories and help the students identify them with labels.
  ✔ The same name or logo is used for pairs of categories. Run a diagonal line through the not logo.
  ✔ Continue the subdivision and labeling as far as possible.
  ✔ Post the drawing showing the steps in subdivision.
• What did you use to separate one category of things from another?
  ✔ Work to the idea of using different properties of items.
• What kinds of properties did you use?
  ✔ Get at such things as differences in shape, color, materials, weight, size, and others.
  ✔ Give these things the names physical properties and form.
• How is this classification similar to the Name Game?
  ✔ Get at the idea that they are the same only one used people and the other objects.

5. Organize the class into teams of 4–5 students. Give each team one of the major categories of things from the master collection. Have them classify the items, recording the steps and categories on a classification tree.

Have the students
• Divide their major categories into two subcategories so that things in one subcategory have a property and things in the other category do not have the property.
• Draw boxes, connecting lines to show steps, and create identifying names or logos.
• Continue the subdivision as far as possible.
• Exchange classification sets and repeat the process.

6. Use the master collection of items and introduce the Function Game to the class. Put four items from four different major categories on chart paper on a table or the floor. See Figure SU.1(5).

Ask such questions as these:
• What do you use these things for?
  ✔ Get at such things as using them as classroom tools, using them to do work at school, or using them as tools in an office.
• Does anyone know a word for the uses of things?
  ✔ Get students suggestions and home in on function.
  ✔ Draw a box or circle around the items and label the collective function category.
• Can you divide these things into two categories so that things in one category have a special function and things in the other category do not have that function?
  ✔ Discuss possible divisions. If the students do not come up with an idea suggest one yourself. See Figure SU.1(4).
  ✔ Draw boxes or circles around the subcategories and help the students identify them with function names.
  ✔ Continue the subdivision as far as possible.
• Can someone draw lines to show the steps used in the classification?
  ✔ Help the volunteer draw lines between the boxes or circles.
  ✔ Post the chart showing the steps in subdivision using function.

7. Organize the class into teams of 4–5 students. Give each team four to six items from the different groups and a sheet of paper on which to draw their classification steps or tree. Have them play the Function Game.
  • Help them give their total collection a category name based on function.
    ✔ It can be the same as the one used in the introduction.
  • Help the students divide their categories into two subcategories so that things in one subcategory have a function and things in the other category do not have that function.
  • Help them draw boxes or circles, connect lines to show steps, and create identifying names as needed.
  • Help the students continue the subdivision until each item has its own functional subcategory.
  • Summarize the game.
    ✔ Ask if they have seen other trees like the one from the Function Game. Bring out the Name Game and physical properties classification trees.
    ✔ Ask how the trees are alike. Get at the idea that they are all used to sort and classify.
    ✔ Ask them what is meant by category. Form. Function.
  • Summarize the importance of knowing about form and function.
    ✔ Ask the students how they use function in making their selection of items needed to go back to school. Work for selecting items to write with such as pens and pencils, things to write on such as paper and notebooks, and so forth.
    ✔ Ask the students how they use form in making their selection of items needed to go back to school. Work for selecting colors of pens, shapes of erasers, sizes of paper, and so forth.
APPENDIX C
WORKING DEFINITIONS

OBJECTIVES
The students
- Review the components of a working definition—form, function, and category.
- Practice making working definitions.
- Start to compile a working dictionary.

BACKGROUND
In this activity students review the concepts of form, function and category introduced in Appendix C Classification. They then use these ideas to identify the components in working definitions and to write some of their own.

Working definitions
Scientific progress relies on working definitions or operational definitions that describe the current understanding of a concept or term. These definitions are called working because they allow the work of science to go on, understanding that the definition may be changed or modified in the future.

Students’ definitions
Research on children’s development of definition indicates that the ideas they have about the world are constantly changed or modified by experience. DASH has called on these findings for guidance and therefore uses working definitions to support the students’ continual shaping and reshaping of concepts and ideas.

A record of working definitions gives the students a way to keep track of their evolving thinking and learning. Working definitions provide teachers a window into the student’s or the class’s grasp of ideas. There should be a review of previous definitions whenever an already-defined concept re-emerges. When reviewed, a definition can be added to or changed.

Evolving definitions
A beginning working definition may include only a category name and the thing’s functions. For example: A living thing grows, reproduces, and is a user of water. Just as common a beginning working definition may include only a category name and the thing’s forms. For example: A living thing is made of wood or meat. A more advanced working definition would join these pieces. A living thing (category name) is made of wood or meat (forms) and grows, reproduces, and needs water (functions). Beyond this simple model, a maturing working definition may also include examples, synonyms, pictures or diagrams, and other information. Pictures and drawings in particular greatly enhance deeper understanding of a working definition.
The Working Dictionary
The Working Dictionary is most often a book with blank pages, frequently loose leafed or a big book format, used to keep a record of definitions. It is suggested that a single page be devoted to each concept or term defined so that ideas can be added or changed. Entries should be dated. Initials of major student contributors can be added to help the teacher in assessment of student understanding. Working definitions can include incorrect information since definitions will undergo regular re-evaluation at which time corrections can be made. This is how science operates—it is always changing, growing, and refining.

STUDENT ROLE
Lexicographer

MATERIALS
master collection from Appendix C CLASSIFICATION
chart paper
markers

PRODUCTS
Working definitions

PROCEDURES
1. **Review the ideas developed in Appendix C CLASSIFICATION with the students.**
   Ask such questions as these:
   • What does *category* mean? Can you give some examples.
     ✔ Work for the name for the group to which something belongs.
     ✔ Use the master collection from Appendix B to help students come up with concrete examples.
   • What is meant by *form*? Can you give some examples?
     ✔ Work for the physical characteristics of the thing, the materials from which it is made, and the parts of which it is made up.
   • What is meant by *function*? Can you give some examples?
     ✔ Work for the use of the thing or what it does.
2. Introduce the students to the idea of a working definition by reading some and having them identify the three parts. Working definitions include a category or name; a function or what the thing does or how it is used; and its form or physical properties, materials it is made of, and its parts or components. Use such definitions as these:

- A refrigerator is an appliance used for keeping things cold and making ice. It is usually box-shaped, comes in many colors, has a door with a handle and shelves, and needs electricity to operate.
- Markers are writing tools that come in many colors. They have different sized tips and usually look like pens. They can be washable or permanent and often have special smells. They can be used for writing or drawing on all sorts of things such as paper, clothing, and people.
- Spoons are kitchen utensils used for eating, serving, measuring and stirring. They can usually be held in one hand. They are made from metals, ceramic materials and plastic. They usually have a handle to hold on to with a bowl-shaped part at one end.

3. Help the students write a working definitions for one of the items in the master collection from Appendix C CLASSIFICATION. Record their definition on chart paper. Have them identify the category, form, and function by circling each in a different color.

4. Have the students work in small groups to write working definitions for other items in the master collection from Appendix C CLASSIFICATION. Have the groups exchange papers and identify the category, form, and function in the other group’s definition by circling each in a different color.

5. Introduce the Working Dictionary to the students when writing class working definitions.

6. At the end of the school year store the Working Dictionary for the students to build on the next year.
APPENDIX D

GRAVITY

OBJECTIVES
The students
• Develop a concept map and definition of the term gravity.
• Invent a way to compare the energy of falling objects.
• Discover that speed (height) and mass determine the energy in falling objects.

CLIMATE EDUCATION FRAMEWORK
• 3-5Systems.B.8 Earth is shaped like a huge ball. Things on or near the Earth are pulled towards Earth’s center by gravity.

BACKGROUND
In this activity the students come up with a definition of gravity. Gravity is the force (or pull) exerted on objects created by the Earth’s gigantic mass. Earth’s gravity attracts objects (including the moon) toward its center without touching them. It even exerts this force through other objects such as a book on a table. The students investigate the effects of gravity in terms of the energy of motion. They invent ways of comparing the energy of motion produced by falling objects.

The students invent different ways to compare the energy of motion. Several suggestions are shown in the Figure. Control the invention by the supplies you provide. Small stones or balls can be used as falling objects.

The mechanical energy, or energy of motion, of an object is determined by the mass of an object and its speed. When an object such as a stone falls, it gains speed as it gets closer and closer to the floor or ground. The higher it was when it was dropped, the greater its speed when it hits and the greater the energy it delivers to whatever it hits. Examples are numerous. Massive stones falling off a truck can mash cars while small pebbles dropping off the same truck will simply bounce away. However, a fast-moving pebble can break a windshield.

Generalizations
Three generalizations flow out of this activity. The first is that gravity causes things to fall toward the center of the Earth. The second is that the faster a falling object moves, the greater the energy it has. The second is that of two objects falling at the same speed the one with the greater mass will have the greater energy.

Real and Ideal Worlds
There are some subtleties in this observation that need to be recognized. In the ideal world of a vacuum a sheet of paper and a ball made of the same amount paper will fall to the ground at the same speed when dropped from the same height. In the real world students will find that the crumpled sheet of paper will fall faster than an uncrumpled sheet. Air resistance makes the difference. In fact, in air objects dropped from great height reach a certain speed beyond which they can go no faster. This is called terminal velocity. These exceptions aside, the generalization about mass and speed to produce increased energy in falling objects will flow out of this inquiry.
SOME SUGGESTED MATERIALS
Marbles (different sizes)
Base ball and a tennis ball
Golf ball and a ping-pong ball
Rulers and meter sticks
Tuna cans
Large cans of sand
Water
Platform spring scales
Small stones
Styrofoam
Wood blocks
Modeling clay
Pencil
Plastic bowls

PROCEDURES

1. Develop a concept map of the term *gravity* with the class.
   Include such ideas as
   - Gravity is a *force* or the pull of the Earth on objects.
   - Gravity causes things to fall.
     ✔ Ask for examples.
   - Things fall toward the Earth
     ✔ They actually fall toward the Earth’s *center*.
     ✔ A globe could be used to illustrate this.
   - Gravity is caused by the Earth’s mass.
     ✔ If this idea does not emerge, include it as a question to be investigated.

2. Help the students establish that a falling object has energy of motion and can make other things move.
   Use a game format. Ask how they could show that a falling ball moves
   - Another ball.
   - A mound of sand.
   - A stick in the sand.
   - A teeter-totter.
   - Water.
3. **Have the students invent a way to measure the energy of two falling stones or balls of different masses but similar sizes.** Have them drop the two objects from the same height.

   Assist the invention with probing questions such as
   - If a tennis ball and a baseball of the same size were dropped from the same height, would they have the same energy?
   - Which will make something move more?
   - How can you measure the difference in movement?

   ✔ Anything that will move on being hit will work—a pool of water, a pile of salt or dry sand, another ball, and so forth.

4. **Have the students explore what seems to determine how much energy objects have when they fall from the same height.**

   Ask such questions as
   - Did the falling objects of different mass have the same energy when they fell from the same height?
     ✔ Get agreement that the more massive object had the greater energy. It made something else move more.
   - How could you make falling objects of different mass have the same energy?
     ✔ Get at the idea that the objects might move faster or slower.
   - What seems to determine the energy in the fallen object?
     ✔ Get agreement that mass seems to be important.
     ✔ Accept speed and volume if the students suggest these properties.

5. **Have the students explore what happens to the amount of energy from the same falling object when it is dropped from different heights.**

   Ask such questions as
   - What happens to the energy as you change height.
     ✔ Get agreement that as one increases the height of the drop, the amount of energy in the object increases.
   - What happens to the speed of the object as it is dropped from ever higher positions?
     ✔ Work toward the idea that as its height increases, its speed increases.

6. **Summarize the activity. Help the students use the concept map and the activities above to write a working definition for the term gravity.**

   Ask such questions as
   - What can you say about mass and the energy of moving or falling objects?
     ✔ Get agreement that the greater the mass of similar objects moving at the same speed, the greater the energy.
   - What can you say about the effect of height and energy?
     As the height is increased, the energy is increased.
   - What can you say about the speed of an object and its energy?
     ✔ Get agreement the faster the object goes, the greater the energy.
   - How are height and speed of a falling object related?
     ✔ Get agreement that the longer an object falls, the faster it travels.
   - What seems to cause objects to fall? What is gravity?
   - What role does gravity play as islands change into atolls?
Figure: Devices to measure the relative amount of energy of falling objects