4.3 WEATHER PREDICTION

OBJECTIVES

The students

- Describe daily and seasonal island wind patterns.
- Are introduced to the ideas of fronts and air pressure.
- Identify cultural knowledge used to predict weather.
- Determine if their island has Island Effect Winds.
- Predict short-term weather changes.

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.1 Climate is the description of the pattern of weather in an area over many years. Different locations on our planet have very different climates.
- 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.
- 3-5Systems.B.1 Indigenous cultures describe, explain and respect the connections among land, ocean, sky, and all organisms, including people. The Indigenous way of life is strongly connected with the local land, water, air and organisms.
- 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, water, and air.
- 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.
- 3-5Energy.B.4 Wind currents move heat energy and affect weather on the planet.

BACKGROUND

This activity introduces students to the idea of predicting weather. In most places on Earth this is done by studying weather maps, looking at the directions in which weather fronts are moving, changes in barometric pressure and other kinds of indicators. However, these indicators don't always apply in tropical locations near the Equator where the weather pattern is fairly consistent from day to day. There are of course occasional storms and even cyclones but the opportunity for watching a front move through is extremely rare.

Introducing Complex Weather Concepts

The goal of this activity is to introduce students to some weather ideas that they may come across in their research and study of weather. At grade four, an awareness of such ideas as *fronts* and *air pressure* is sufficient. Understanding requires knowledge of density and other difficult concepts that will be addressed in later grades. The focus here is on a brief introduction and description of these ideas, rather than explanations for them. For example if the students know that the *Coriolis Effect* has to do with the effect of Earth's rotation on global winds, they have met the goal. If they are aware that when a mass of cold air meets a mass of warm air, a cold front forms likely producing rain and stormy weather; again, the objective is met. If students are aware that as air pressure (highs and lows) changes, there may be a change in the weather and that a high pressure area has fair weather while a low is often rainy, enough!

Cold and Warm Fronts

A *cold front* occurs when a cold-air mass overtakes a warm-air mass. An increase in the wind speed is usually observed. *Nimbostratus* or *cumulonimbus* clouds are seen as the front approaches. Because the cold front hugs the ground, low-level rain (or snow) clouds often appear as the cold air lifts and cools the moisture-laden warm air. When differences in temperature are great, storms along such fronts can be violent. Cold fronts often pass rapidly. After the cold front passes, there is usually a lowering of the temperature, a reduction of the wind speed, and a change in wind direction. Weather that follows is often clear.

A *warm front* occurs when a warm-air mass overtakes a cold-air mass. The first observed change will usually be high-level (above 7 km), wispy *cirrus* clouds. These are followed by *cirrostratus* clouds. Because warm air is less dense and more moisture-laden than cold air, it will ride above the cold-air mass. As the front progresses, the warm air pushes lower into the middle altitude range (3–7 km) and *altostratus* clouds form. As warm air pushes into the lower range (below 3 km), *nimbostratus* clouds are likely to form, bringing precipitation. When the warm front has passed, the temperature rises, and the warm air mass brings *cumulus* clouds.

Occasionally the air along both cold and warm fronts will have little moisture content, and no precipitation will result. For various reasons, either warm or cold fronts can become stationary, and the weather may remain unchanged for up to a week.

Island Effect Winds

Even typical *island effect winds* are not always in evidence at latitudes very close to the Equator. Usually, the sun heats the land during the day causing onshore winds from the ocean to the land in the evening as the cooler air above the ocean moves toward the rising warmer air above the land. In the morning, after the air above the land has cooled during the night, offshore winds from the land to ocean are produced. Near the Equator, the ocean water is so warm that there is so little difference in temperature and such winds may not occur. However, this activity asks students to observe if island effect winds occur on their island.

Cultural Knowledge and Weather Prediction
Pacific Island people have a close relationship with their environment. They often have a wealth of knowledge about weather related events including predicting them. Students are asked to research and report on such knowledge, particularly weather prediction indicators.
Weather prediction has been greatly enhanced by technology. Such things as computer simulations and websites, weather satellites, radar and communication advancements now help to provide warning to island communities that allow them time to prepare for advancing storms. Agencies such as NOAA provide preparedness information and daily weather updates as well as warning of imminent storms and other dangers. Less than 100 years ago, the danger of approaching typhoons was a great problem. The typhoons would appear quickly, without warning and tens of thousands of people were killed.

STUDENT ROLES
Meteorologist

MATERIALS
Weather maps or SP 4.3A WEATHER MAP
SP 4.3B WEATHER FRONTS
Hot and ice cold water in containers—one set per group
Tiny breeze detectors—thread tied to a chopstick, 1 per group
Cardboard boxes or a breezeless classroom area

PRODUCTS
Beginning working definitions for warm fronts, cold fronts, and island effect winds
Barometers

PROCEDURES

1. **Introduce the students to the topic of predicting the weather.**
   Ask such questions as
   - What do you think the term *weather prediction* means?
     ✔Accept all ideas at this point.
   - What are some things weather predictions might include?
     ✔Help them to include such things as information about future changes in the kind of weather, temperatures, winds, cloud cover, approaching storms, etc.
   - How can you find out about what the weather will be tomorrow or even next week?
     ✔Help them to include such ideas as listening to TV or radio weather reports, checking the Internet, looking at weather maps in the newspaper, or whatever weather information sources are locally available.
   - Why do you think it is important to know what the coming weather will be?

2. **Show an example of a weather map. Have the students look at weather maps to identify the kinds of information provided. Use a local weather map or SP 4.3A Weather Map.**
   Ask such questions as
   - Does anyone know what this kind of map is called?
   - What is a weather map used for?
     ✔To describe the current weather.
     ✔It can also be used to help predict coming weather.
   - What kind of information do you see on the weather map?
     ✔Make a list of the things the students identify.
     ✔Help them include
       - Lines with darts on them (cold fronts)
       - Lines with have circles on them (warm fronts)
       - Hs (highs) and Ls (lows)
       - Other symbols may that appear on the map such as, lines with numbers (air pressure isobars), wind speed and direction flags, arrows that show the direction highs and lows are moving, stationary and occluded front symbols, temperature data including isotherms, station reports, and so forth.

3. **If possible, have the students collect or print out a series of weather maps each day for a week or more. Help them locate moving weather elements and any developing weather patterns.**

4. **Using the list of terms from the Procedure 2, have the students identify the words that are unfamiliar to them.**

5. **If front is identified as an unfamiliar idea, use SP 43B WEATHER FRONTS or similar illustrations to describe cold and warm fronts.**
   Include such ideas as
   - A mass of air is a place where the air is all about the same temperature.
   - *Fronts* are places where warm and cold air masses come together.
   - A *cold front* is the leading edge of a mass of cold air.
   - A *warm front* is at the leading edge of a warm air mass.
   - Changes in the kinds of clouds occur when fronts collide.
   - Storm activity is often found along the fronts or places where warm and cold air masses come together.

6. **If highs and lows, air pressure, isobar, barometer or other related terms are identified as unfamiliar, use Appendix D Air Pressure and Barometers to introduce these ideas.**

7. **Have the students write beginning working definitions for weather fronts and air pressure.**

8. **Help the students begin to investigate *island effect winds*. See Background information. Organize observations to determine if your island has these winds. After the discussion and observation, have them write a descriptive working definition for island effect winds.**
Ask such questions as
- If there is some warm air and some cool air close to each other, do you think the warm air would move toward the cool air or the cool air would move toward the warm air? Or would they not move at all?
  ✔Do not ask why! Students are only at the observational level.
- How could your test your idea?
  ✔In a wind free area or in a cardboard box, place a container of hot water and a container of very cold water next to each other but not touching. The air above the containers will warm or cool. Hold a thread (tiny breeze detector) between the two air masses. Which way does the air move?
  ✔The thread should move toward the warm air. As the warm air rises, the cool air is pulled toward the warm side.
- What happens to the ground on our island on a hot, sunny day?
  ✔The land heats up.
- What do you think happens to the air above the hot ground.
  ✔It also heats up.
- Do you think the air above the ocean is hotter or colder than the air above the land? How could you find out?
  ✔This may be difficult to do but someone may have some experience to share. If not, provide the answer. The air above the ocean water will be cooler.
- Does anyone know what an onshore breeze or wind is?
  ✔Wind that blows from the ocean toward or *on*to the land.
- Do we experience afternoon winds that blow from the ocean onto land?
- Why would these occur in the afternoon?
- What happens to the temperature on land overnight?
  ✔It usually cools.
- Does anyone know what an offshore breeze or wind is?
  ✔Wind that blows from *or off* the land toward the ocean.
- When do you think these might occur? Why?
  ✔In the morning when the air above the land is cooler than the air above the ocean.
- Do these island effect winds always occur on our island? What might interfere with this process?
  ✔The temperature difference between the two air masses may not be sufficient to cause such winds.

9. **(Optional.) Show the students a map of global wind patterns.**
Ask them such questions as
- Where is our island located on this map?
- What is our island's prevailing wind direction in the winter? In summer?
- Do our island winds always come from the northeast?
- Why do you think our winds are different?
- Why do you think winds move in different directions in different places?

Continue to explore other information found on the map.

10. Have the students interview grandparents and others about local knowledge that helps them to predict the weather.
Ask such questions as
- Does anyone know what a ring around the moon predicts?
  ✔A storm may be coming.
- Do you know any other things that help predict local weather?
- How could you find out more?

11. Have the students report their findings. Make a class list of these. If desired share some of the ideas from Figure 1.

12. Have the students attempt to predict changes in the weather. Have them share the reasons for their predictions. Record their predictions and discuss if they were accurate.

EXTENSIONS
- Have students further research any of the new weather ideas encountered in this activity.
- Have students compare the information found on weather maps from different sources.
- Have the students investigate weather maps from other locations such as the continental US to see how fronts can be used to predict coming weather.
- Invite the local weather expert (NOAA) to talk about local island weather patterns.

Weather Prediction
A storm may be coming • There is a ring around the moon. • Cumulus clouds begin to change to cumulonimbus clouds. • High cirrus clouds are followed by thickening stratus clouds. • The sky in the direction the wind is coming from looks dark and stormy. • The barometer steadily drops (low pressure moving in). • The wind direction changes.
Weather is clearing • Barometer reading rise (high pressure moving in). • Winds direction changes.
Weather will remain clear • The sky is clear or there are numerous cumulus clouds. • The barometer stays steady.

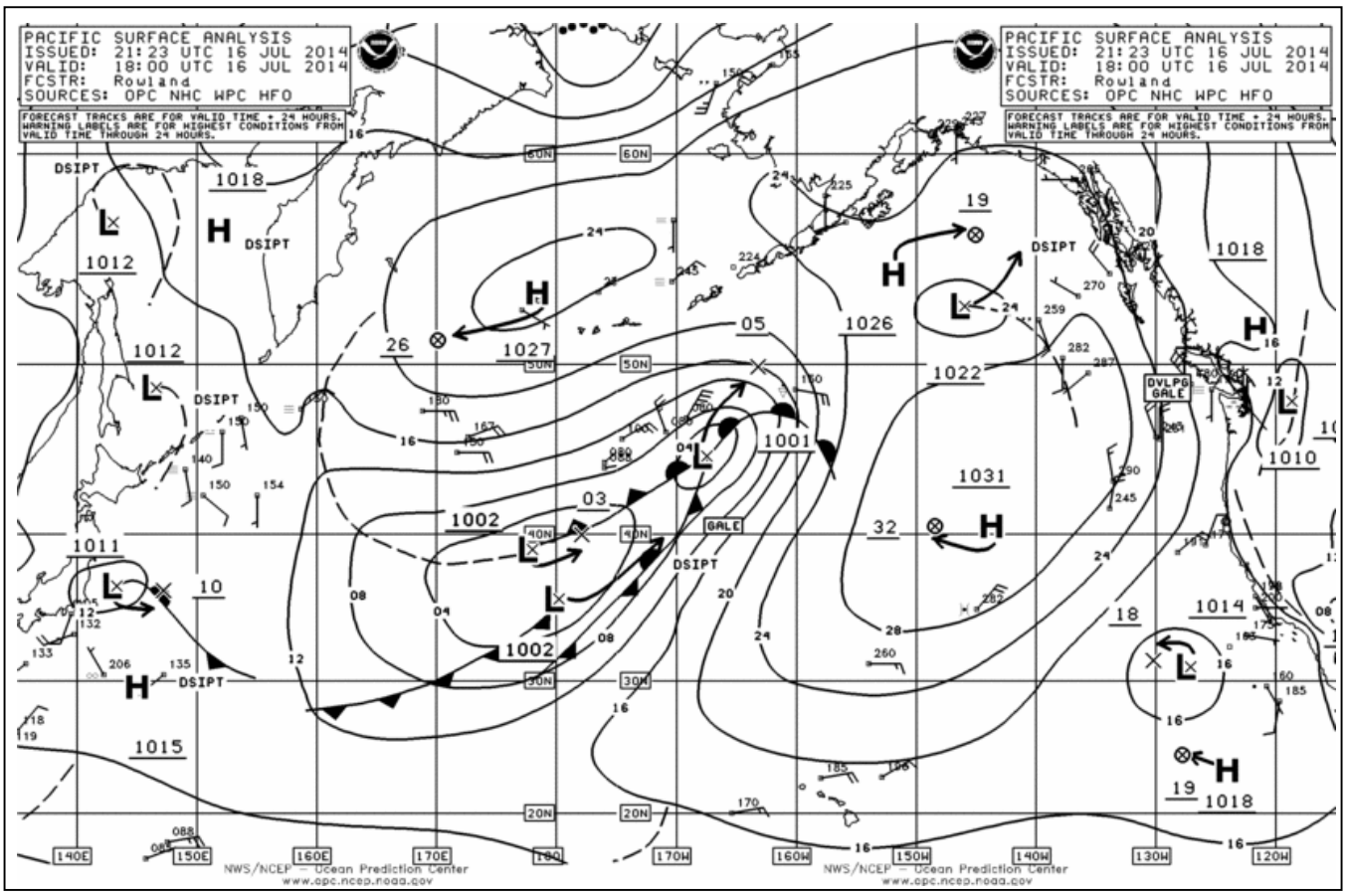
Figure 1. Weather prediction signs.

WEATHER MAP
SP 4.3A

Name:_____

Date:_____

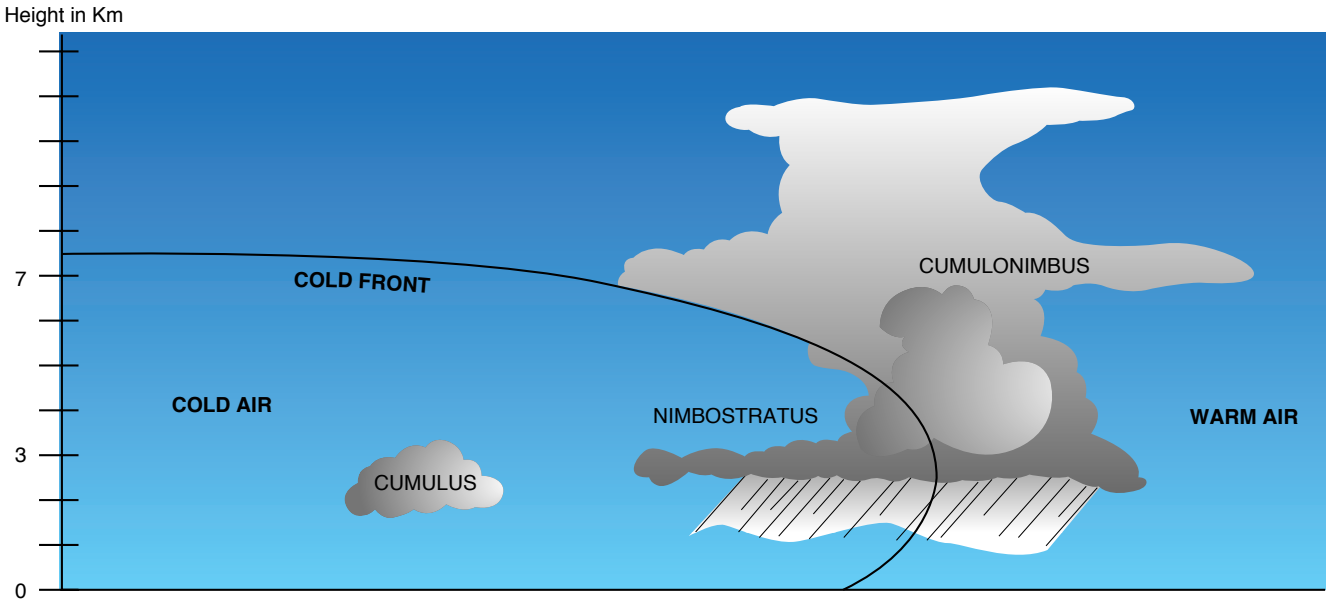
What kinds of weather symbols can you find on this weather map?



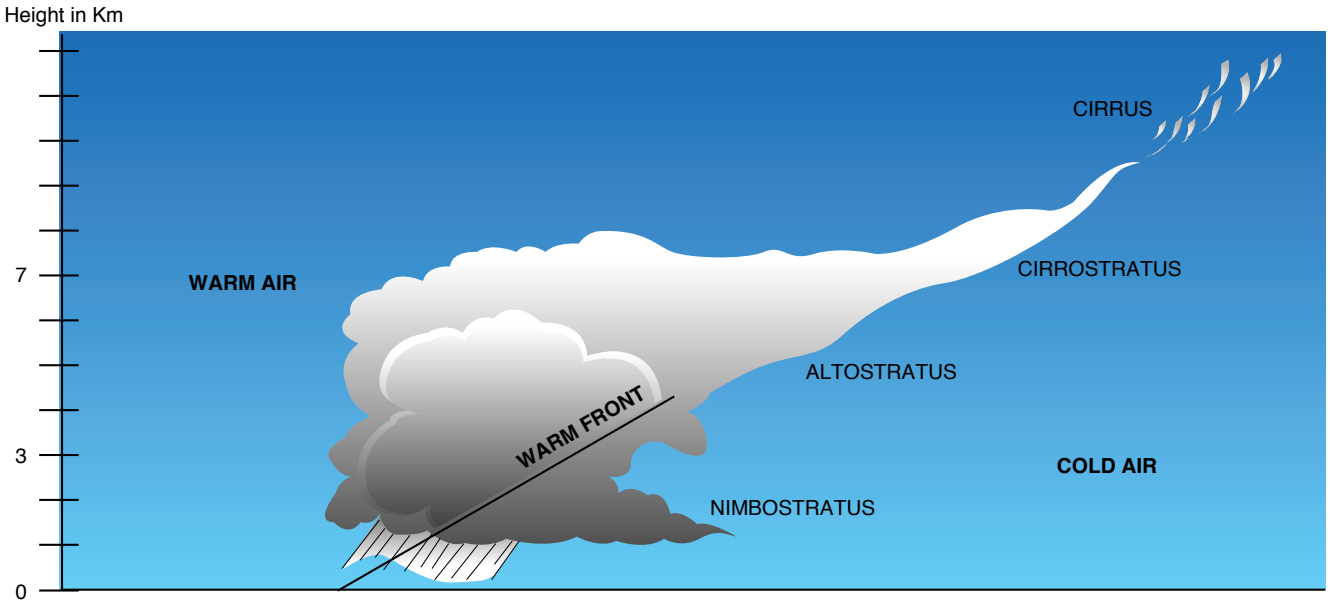
WEATHER FRONTS
SP 4.3B

Name:_____

Date:_____



Cold front overtaking a mass of warm air.



Warm front overtaking a mass of cold air.