Weather Where We Live

Students predict, measure, and record components of weather on a regular basis over a few weeks to become familiar with measuring weather and recognizing local weather patterns. By comparing their data with official local weather reports and records, students begin to appreciate how long term monitoring of weather patterns aids in forecasting weather and determining the climate of a region. The concept of climate is connected to their weather monitoring experience, leading to an introduction of the issue of climate change.

Activity Time

- Warm-up: 30 minutes
- Activity: 5 - 10 minutes per weather observation, repeated 10 – 15 times
- Wrap-up: 45 - 60

Setting

- Schoolgrounds
- Classroom

Materials

- Thermometer, suitable for outdoors
- Rain gauge (purchased or see Black Line Master (BLM) for instructions on how to make a basic one)
- Meter Stick (for snow depth)
- Flip chart paper to create a Class Weather Data Chart
- Notebook or duotang with paper for each student to create a Weather Journal
- Official temperature and precipitation measurements for the same days students measure weather (*see **Activity: Setup** and **Resources***)
- Past local weather records, including climate normals (*see **Activity: Setup** and **Resources***)
- Optional: Instructions for building a rain gauge BLM
- Optional: Instructions how to make a pinwheel BLM

Note: Simple, non-electronic weather stations that include a thermometer and rain gauge can often be purchased at hardware or garden stores.

Subject Areas

- Science, Language Arts, Math

Keywords

- Weather, climate, climate change, temperature, precipitation, wind speed, wind direction, air pressure, thermometer, rain gauge, anemometer, weather vane, barometer

Prescribed Learning Outcomes (PLO) - Science

Earth & Space

- Measure weather in terms of temperature, precipitation, cloud cover, wind speed and direction

Process of Science

- Make predictions, supported by reasons and relevant to the content
- Use data from investigations to recognize patterns and relationships and reach conclusions

IRP Curriculum Organizers

Language Arts

- Oral Language
- Reading and Viewing
- Writing and Representing

Social Studies

- Human and Physical Environment

Mathematics

- Patterns and Relations
- Statistics and Probability

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Introduction and Background

The terms weather and climate are often used interchangeably, but it is important to distinguish between these terms so we can begin to understand what is meant by "climate change". **Weather** is our daily experience of the atmospheric conditions around us whereas **climate** is what we expect the weather to be each day. In other words, climate is the **average weather** over time, generally hundreds to thousands of years. We also expect predictable annual **weather patterns**, for example, seasons or the number of sunny days. **Climate change** is a shift in the average weather and weather patterns regionally or globally. Our current climate is changing - and this change is human induced.

Components of weather are: temperature, precipitation (e.g., rain or snow), cloud cover and type, wind speed and direction, and air pressure. An understanding of climate comes from observing and recording weather components over long periods of time and looking for patterns in the collected weather data that can be related to our knowledge of weather processes. An example of a weather pattern tied to climate is the annual seasonal changes in temperature and precipitation.

Meteorologists use the term "climate normals" to describe weather measurements that are averaged over 30 years. Normals are for a particular location and can be defined for a particular day, month, season, and year. There are normals for each component of weather that is measured at a particular site with a long enough observation record.

The weather is observed, measured and recorded by many people throughout BC. Officially, Environment Canada oversees a national multilayered network of weather monitoring stations in larger communities and at commercial airports that report weather measurements and observations multiple times every day. They also run an even larger network of climate monitoring stations that report information less frequently. The data from these stations feeds into large numerical models that produce our weather forecasts. The media, including the CBC, local radio and television stations, weather report websites (e.g., Weather Network), and newspapers, use this information for their weather reports and forecasts. They sometimes simplify or re-interpret this information before relaying it to the public. Many specialized users such as power companies; ministries of environment, forests, and transportation; universities; ski resorts; avalanche monitoring organizations etc. take their own weather measurements and observations. Often these are posted or made available to the public, so are a good alternative or additional source of weather information.

British Columbia has many regional climates due to its coastal location and diverse geography. Recognizing the complex interactions between BC's climate, geography, and biology, scientists have defined 14 **biogeoclimatic zones** for the province. Biogeoclimatic zones are regions that are distinctly identifiable based on the type of plants and animals (biological component of ecosystems), landforms (geography), and climate. This classification system emphasizes the important interplay between the climate, land, water, ocean, and the resulting ecosystems. Often, it is the plants and animals within these ecosystems that our lives and livelihoods depend upon. Changes to local climates can have positive or negative effects for the organisms that live there – including humans. *See the **Primer** for more information.*

Procedure

Set-Up

1 Gather the required weather instruments. Gaining experience measuring and recording temperature and precipitation over a period of time is the focus of this activity. If desired, other weather components such as cloud cover and type, air pressure, and/or wind speed and direction can be included as part of the regular weather observations and measurements.

Optional: Make rain gauges with your students using the provided Black Line Master. These simple rain gauges collect rain, hail or sleet in a container; precipitation is measured by directly determining the depth of water in the container. Note for this reason, small amounts of rain are difficult to measure accurately.

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2 Determine suitable, secure locations for the weather instruments and **install**. Locate the instruments where they are safe but easy to see in order to take measurements.

The thermometer should be in a shady location that allows for good airflow. Avoid sunny locations as the thermometer itself will heat up and give false measurements. Often a shady deciduous tree canopy or north-facing wall works well.

The **rain gauge** should be placed away from obstructions such as buildings and trees that could interfere with collecting precipitation. If students make rain gauges, they should install them by digging the container into the ground, placing in a weighted larger bucket, or attaching it to a stake to prevent it from blowing or falling over.

3 Decide upon the **frequency, timing,** and **duration** of the weather measurements to be made by students that best fits your classroom situation. For example, measurements could be taken daily, just as students come into class after lunch break, over a period of two weeks. Alternatively, in order for students to see more dramatic shifts in the weather patterns, the measurements could be taken once per week at 3:00 pm over a period of two to three months. Note temperature measurements taken in the afternoon will the most comparable to official weather reports of the daily maximum temperature.

4 Determine if the whole class will measure and record temperature and precipitation each day or if pairs of students will collect the data on a rotating basis. Create a roster, ensuring all students have an opportunity to measure and record weather data at least once.

5 Find a source of local official weather measurements (weather reports) for the same days students measure weather. Also find a source of past weather records and climate normals for your local area. Check local newspapers, radio stations, weather websites, and/or the Environment Canada website (http://www.climate.weatheroffice.ec.gc.ca/). If necessary, check for alternate sources of weather measurements, including regional or provincial government offices (e.g., park offices), recreational areas, university or colleges, etc. *See **Resources** below for additional suggestions.*

6 Create a **Class Weather Data Chart** for recording the **students'** weather measurements (precipitation and temperature, along with any others you decide to include). Also include columns for the official reported temperatures and precipitation measurements as well the climate normals (average over 30 years) for each observation date, if they are available for your local area.

For example, a Class Weather Data Chart could include the following column headings: Date, Time, Name(s) (of students collecting data), Temperature, Precipitation (note type), Official Temperature (Maximum), Official Precipitation, Normal Temperature, Normal Precipitation.

7 Have students create a **Weather Journal**.

Warm Up

1 Invite the students to imagine they are planning to go on a trip during one of their school breaks. Working in pairs or small groups, direct each pair to decide upon the destination/location and the season. Instruct each pair to make a simple packing list of the clothes and/or recreation gear they would take for their trip. Students should record this information in their Weather Journal.

Lead a brief class discussion by asking the students if the items on their packing list would be suitable for all the possible weather they might experience during their trip, or just the "typical" or "expected" weather (note: at this point don't use the term climate). Allow students to share their destinations, packing list and insights as to whether or not they were fully prepared. Record on the blackboard or on flip chart paper some examples of destination, what the students expected the weather to be, and what they could actually experience.

Alternatively, ask the students to recall trips they have taken. Ask if the weather they experienced matched what they had expected. Invite the students to verbally share their travel experiences with the class, focusing on the weather. Record on the blackboard or on flip chart paper some examples of location, what the expected weather was and what they actually experienced.

2 Introduce the definitions of weather and climate by connecting these terms with the above discussion. Explain **climate** is what you expect the "typical" weather of a region will be whereas **weather** is the atmospheric conditions you actually experience. Explore the concepts of weather and climate as they relate to your region. Ask the students probing questions such as, "What do you expect the weather to be like in the summer? Winter? What do you expect for this time of year? What are we actually experiencing? Did you wear the appropriate clothing for this time of year? Why or why not?"

3 Explain how weather is observed, measured, and recorded by many people and organizations, including Environment Canada, and has been done so for many years. Inform students how the collected weather data is used to determine weather patterns, forecast the weather, and create climate models. Describe climate normals as the average weather over thirty years. These are used as a basis of comparison to determine shifts in weather patterns and climate.

The Activity

1 Introduce the activity by asking the students what makes up "weather", drawing on what they have identified in previous discussions. Generate a list of all the weather components (atmospheric conditions). Introduce the instruments or techniques that are used to measure or observe these weather components and add these to the list. For example,

- Precipitation: Rain gauge (rain, sleet, hail) or meter stick (snow)
- Temperature: Thermometer
- Wind speed: Wind speed scale or wind gauge (anemometer)
- Wind direction: Weather vane or windsock
- Air pressure: Barometer
- Cloud cover: Estimate amount of sky covered by clouds
- Cloud type: Identify type of cloud observed.

2 Explain to the students that they will be predicting and measuring the local weather, focusing on temperature and precipitation. If you have decided to include other weather components, introduce these also.

Show the students the instruments and demonstrate how to use them to take measurements. Also, show them how to record the weather measurements in their Weather Journals and on the Class Weather Data Chart. Ensure units of measurement are included (i.e., "degrees Celsius" for temperature and "centimeters" for precipitation). Encourage all the students to practice using the instruments and recording the data. If need be, use a spray bottle to demonstrate how the rain gauge works.

3 Describe how often, when during the day, and for how long (i.e., the frequency, timing, and duration) the students will be taking weather measurements. Also assign who will be responsible for collecting weather data (taking measurements) and when. Either show the students the location of the previously installed instruments in the schoolyard or install them with the students.

4 In their Weather Journals, ask the students to predict (i.e., forecast) and record what they think the weather will be like on the day(s) they are responsible for collecting weather data and why. The predictions should mirror how the data will be recorded in the Class Weather Data Chart (e.g., 5 mm of rain).

Alternatively, every time after the weather has been measured and recorded, have all the students predict what the weather will be like on the next weather measurement day. Students should record their predictions and rationale.

5 Show the students how to access and read the official daily weather reports, using the local newspaper, website, etc. that you have already determined as suitable for this purpose (see Step 5 in Set-up). The same students who measured the weather should be responsible for finding and recording the official weather measurements as well as climate normals, if these are available for your local area, on the Class Weather Data Chart. Consider asking for parent assistance in helping students to find and record this information for the class.

6 Start collecting weather data! On each pre-determined day, monitor students to ensure weather measurements are made and recorded both in their Weather Journals and on the Class Weather Data Chart. Check to ensure the measurements are reasonably accurate. Also ensure official weather measurements and normals are recorded on the Class Weather Data Chart.

Note: Each day prior to taking weather measurements, the rain gauge should be emptied.

Wrap Up

1 Using the completed Class Weather Data Chart, ask the students to examine their collected weather data. Graph the students' temperature and precipitation measurements (the collected data) to help students to visually determine patterns over time. For example, graph temperature on the vertical axis and time on the horizontal axis. Do the same for precipitation. Note if both the time axes are the same size, students can make direct comparisons between the two graphs.

Direct the students to look for patterns in their weather data. Patterns may include gradual (or not so gradual!) increases or decreases in temperature and amount of precipitation. Explore how these patterns might reflect expected annual changes in weather, in other words, seasons, or unexpected events such as storms. Look for other patterns by asking the students probing questions such as "Was it generally hotter or cooler on days with precipitation compared to days with no precipitation?"

2 Look at similarities and differences between what the students measured and recorded and what was officially reported for those same days. If there are differences, ask the students to explain why. Help them to understand how temperature and precipitation can vary between two close locations; students may have experienced times when it is sunny in one area but raining a short distance away. Official temperature is reported as the maximum temperature recorded during the day; students may have measured temperature before or after the maximum temperature was reached. Differences may also reflect the level of accuracy of the instruments used. Discuss the challenges of adequately collecting and measuring small amounts of precipitation, especially with simple rain gauges.

3 Ask the students to compare the predictions they made prior to measuring the weather with the actual collected weather data. Determine the number of students whose prediction was close to the actual weather measured. Ask the students, "What did you use to make your predictions?" Lead a discussion regarding the challenges of making correct predictions (forecasting) based only on observing the current weather and personal experiences (remembered past history). Ensure students understand official weather forecasts are based on a large amount of weather data collected over many years and detailed knowledge of weather patterns and processes.

4 Now ask the students to compare their collected weather data and the climate normals for temperature and precipitation for each day. Remind the students the climate normals are an indication of the local climate as they are the average weather over the past thirty years (if desired, explain how an average is obtained mathematically, e.g., sum of all the temperatures recorded for that date, divided by the number of years). Review how weather is what happens while climate is what is expected; ensure students can clearly distinguish between weather and climate. Also ensure students understand there are expected annual changes in weather patterns, for example seasons.

5 Briefly introduce how British Columbia has many regional climates, identified as biogeoclimatic zones. Highlight how climate and geography influences the type of plants and animals in an area.

6 Wrap-up by asking the students what they think the term "climate change" means. Most likely, students will have heard the term climate change (and/or global warming) and have formed an impression as to what it is. Allow the students to share their understandings. Summarize the discussion by defining climate change as a shift in the in the average weather that a region experiences. Briefly explain how scientists (climatologists) use the extensive data-base of recorded weather and computer models to detect climate change by tracking variations in weather and comparing them to all that is known about existing weather and climate patterns.

Assessment

1 Ask students to look back in their Weather Journals to the trip they had planned (Warm up activity). Have students create a weather forecast for the one of the days of their planned trip. The forecast should include the temperature during the day and the amount and form of precipitation, if any, as well as any other weather component they wish to include. Based on their forecast, invite them to add anything to their packing list that might now be needed, for example umbrella or raincoat, heavy sweater, or sunscreen and hat. Look for evidence of understanding of the difference between weather and climate. For example, the student should clearly indicate that the forecast is a prediction of what the weather might be like on that day, but is not necessarily what is "typical" for the area and season (climate).

2 Review the students' Weather Journals. Assess the journals for completeness, reasonable prediction of weather, and the clarity and accuracy of temperature and precipitation measurements.

3 Using the collected data, ask students to make and present a "weather report" for one day. They can choose the media format (e.g., newspaper, radio, TV, or website). The students should include details from the Class Weather Data Chart such as the measured temperature and precipitation for the chosen day, official reported weather, as well as the temperature and precipitation normals. Look for evidence that the student is able to correctly interpret data from their recorded measurements, as well as the official weather measurements.

4 If students built their own rain gauges, ask students to write or draw their suggestions as to how to improve the design of the rain gauge. Look for evidence that the student understands the purpose of the weather instrument and how it measures precipitation in the suggested improvements by making appropriate design alterations.

Extensions

1 To better understand that various regions have different climates, partner with another class in BC and compare the local weather in each area. Alternatively, have the students compare their class weather data with the data collected by one school in Victoria who are part of the University of Victoria's School-Based Weather Station Network (www.victoriaweather.ca).

2 Build a pinwheel as a possible anemometer (see BLM). Challenge your students to determine if this would be a good method to measure wind speed. Discuss why or why not.

3 Discuss other components of weather e.g., wind direction, air pressure, cloud cover. Find or build instruments to measure these components.

4 Show the students a map of the biogeoclimatic zones of BC (see **Resources**) and identify the zone in which they live. Identify the major landforms (geography) that influence your local weather patterns. For example, air moving over the ocean and onto the land plays a significant role in coastal communities by keeping the air moist and cool, resulting in moderate temperatures and high rainfall throughout the year. The mountains, valleys, and extensive

land areas throughout BC cause more dramatic seasonal changes in the temperature and precipitation patterns as air generally moves from west to east and the moderating effect of the ocean is diminished. Also, identify the main plant and animal species that characterize your biogeoclimatic zone. Note how these organisms have adapted to the climate of that particular zone.

Resources

Current Weather Reports

http://www.weatheroffice.gc.ca/forecast/canada/index_e.html?id=BC

Look up your community for current weather using the map of BC; for smaller communities or areas that are not identified on the map use the "choose a location option" to see your area's current weather. Explore the drop-down menus and links on this page to find many other sources for current weather data.

Climate Normals

http://www.climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html

This links you to stations having climate normal data and extreme or record data and the year the record occurred in presented in the form of a table. You can search by provincial map or by location name.

http://scitech.pyr.ec.gc.ca/climhydro/mainContent/main_e.asp?province=bc

For climate normal station searches by map – allows you to see where old and current weather and climate stations are located and presents graphed temperature and precipitation normal data for stations that have a long enough record.

Both the above links will allow access to climate normal data in your area (you may have to use a nearby station if there isn't data exactly for your area).

This site also indicates where weather station data is available on request (note charges apply).

Climate Data

http://www.climate.weatheroffice.ec.gc.ca/climateData/canada_e.html

Climate Data On-line link – this allows you to search through Environment Canada's records (either by a listing of communities, or proximity to a particular location (via names or latitude/longitude)), for climate records from that area.

Non-Environment Canada Weather Data Sources

The Weather Network

http://www.theweathernetwork.com/

- reports weather for major Canadian centers

University of Victoria School-Based Weather Station Network

www.victoriaweather.ca

- includes detailed weather information and teacher resources.

University of Northern BC Roof-top Weather Station

http://weather.unbc.ca/wx/index.html

- graphed and numerical data available for previous 5 days for a number of weather components. Note no precipitation data is reported here.

BC Ministry of Forests: Fire Weather

http://www.bcwildfire.ca/Weather/

- shows fire weather maps of precipitation and temperature for all of BC

http://www.bcwildfire.ca/Weather/stations.htm

- shows a map of where fire weather stations are located

BC Ministry of Transportation Weather Stations

http://www.th.gov.bc.ca/weather/text_version.asp

- go down the page to see links to the Ministry of Transportation's web sites listed by region (the top of the page only has links to Environment Canada data).

Mountain Equipment Coop's Recreational Information and Avalanche Weather

http://www.mec.ca/Main/content_text.jsp?FOLDER%3C%3Efolder_id=2534374302881863&bmUID=1218431398573

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- gives links to many other mountain weather information sites.

Other sites can be found by Googling key words such as "BC weather station"

Educational Resources

Environment Canada
http://www.weatheroffice.gc.ca/canada_e.html
http://www.msc-smc.ec.gc.ca/education/index_e.cfm

- Besides weather reports follow the Educational Resources links on the first site for much more weather information

Ecokids *Canada's environmental destination for kids*
http://www.ecokidsonline.com/pub/index.cfm

- includes information on weather and climate in both the games and activities and homework help sections; includes teacher resources

Weather Wiz Kids
http://www.weatherwizkids.com/index.htm

BBC Weather
http://www.bbc.co.uk/weather/weatherwise/activities/weatherstation/

- includes a definition of each weather component, how to measure, what to use, and activities

Biogeoclimatic Zones of BC
http://www.for.gov.bc.ca/hfd/library/documents/treebook/biogeo/biogeo.htm

- Map of the biogeoclimatic zones of BC

Print Resources

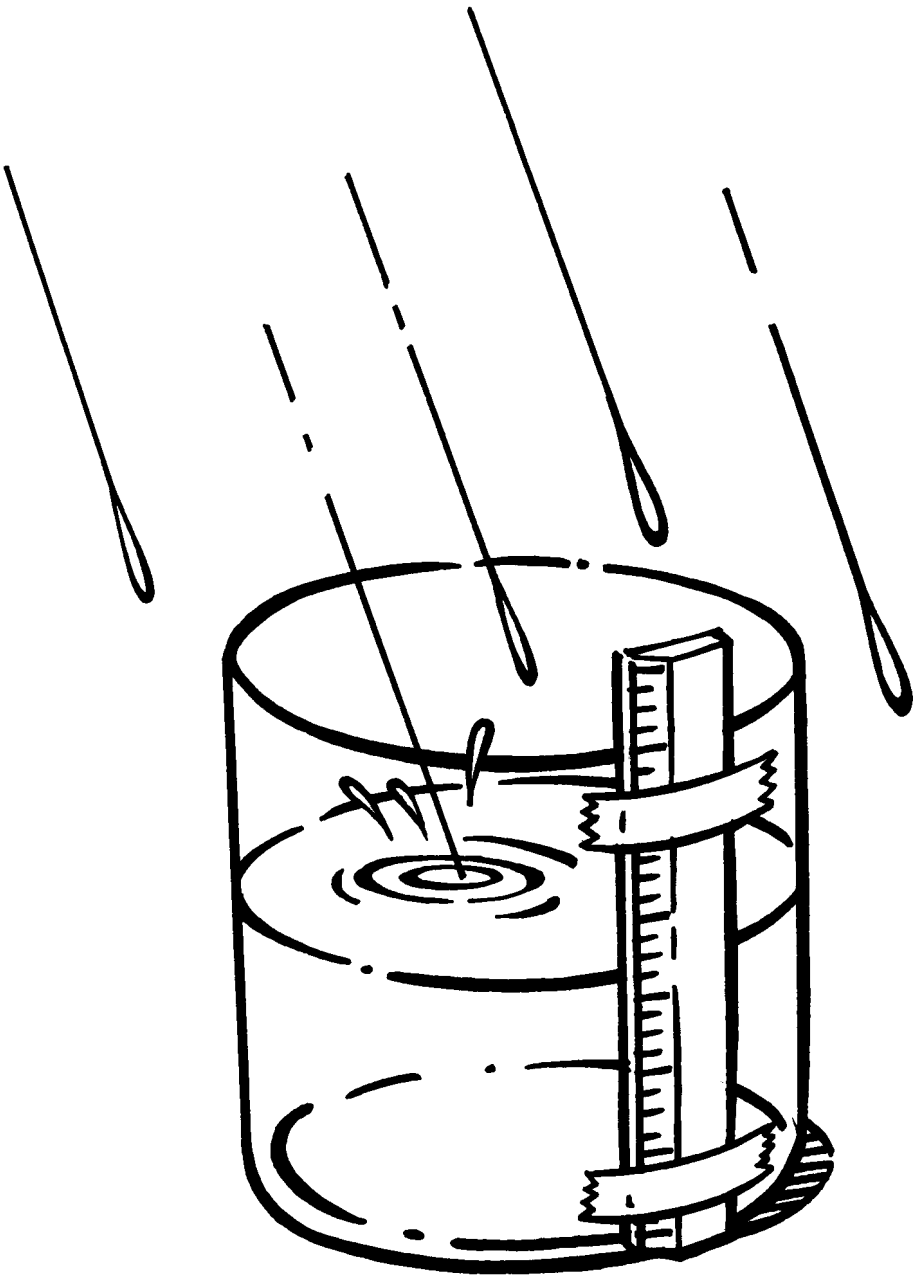
Destination Discovery: The Weather Zone: A Science Teaching Kit. 2005. Toleikis, Steven and Andrew Weaver. BC: KnowledgeQuest Associates. www.discoverysciencelearning.com

Handmade Science: Make a Weather Station, Create a Weather Network! 2007. Toleikis, Steven and Andrew Weaver. BC: KnowledgeQuest Associates. www.discoverysciencelearning.com

Wind Speed Scale*

Wind Speed (km per hour)	Description	What you see (land conditions)
Below 1	Calm	Smokes rises straight up and tree leaves don't move
1 – 5	Light Air	Smoke drifts in wind direction, wind vane does not move
6 – 11	Light breeze	Wind on face, leaves rustle, wind vane moves
12 –19	Gentle breeze	Leaves and twigs move continuously, small flags fly straight out
20 – 28	Moderate breeze	Small branches move and wind raises loose paper and dust off ground
29- 38	Fresh breeze	Small trees sway and medium branches are in motion
39 – 49	Strong breeze	Large branches move, wind whistles in wires, umbrellas are hard to use
50 – 61	Near gale	Whole trees in motion and it is hard to walk

* Wind Speed Scale based on the Beaufort Scale.



How to make

Find a wide mouth, flat-bottomed container such as a clear plastic jar or can.

Attach a plastic ruler to the side of the container or mark measuring lines directly onto the container using a permanent marker. Ensure the bottom of the container is the "zero" mark. You now have a rain gauge!

Tips for using your rain gauge

- Set your rain gauge in a location that is not sheltered by trees, shrubs, or buildings. Try to find a place where it is unlikely to be disturbed.
- To prevent the rain gauge from being knocked or blown over, tie it to a short, sturdy stake in the ground using long twist ties. Alternatively, dig a small depression in the ground that it can sit in snuggly. Remember that you will need to be able to empty the rain gauge regularly.
- To measure rainfall, determine the depth of water in the rain gauge using the ruler or measuring lines on the rain gauge.
- Record the depth in your Weather Journal.
- Pour out the water and replace the rain gauge.

For alternate designs, Google "Instructions for making a rain gauge" or similar search words.

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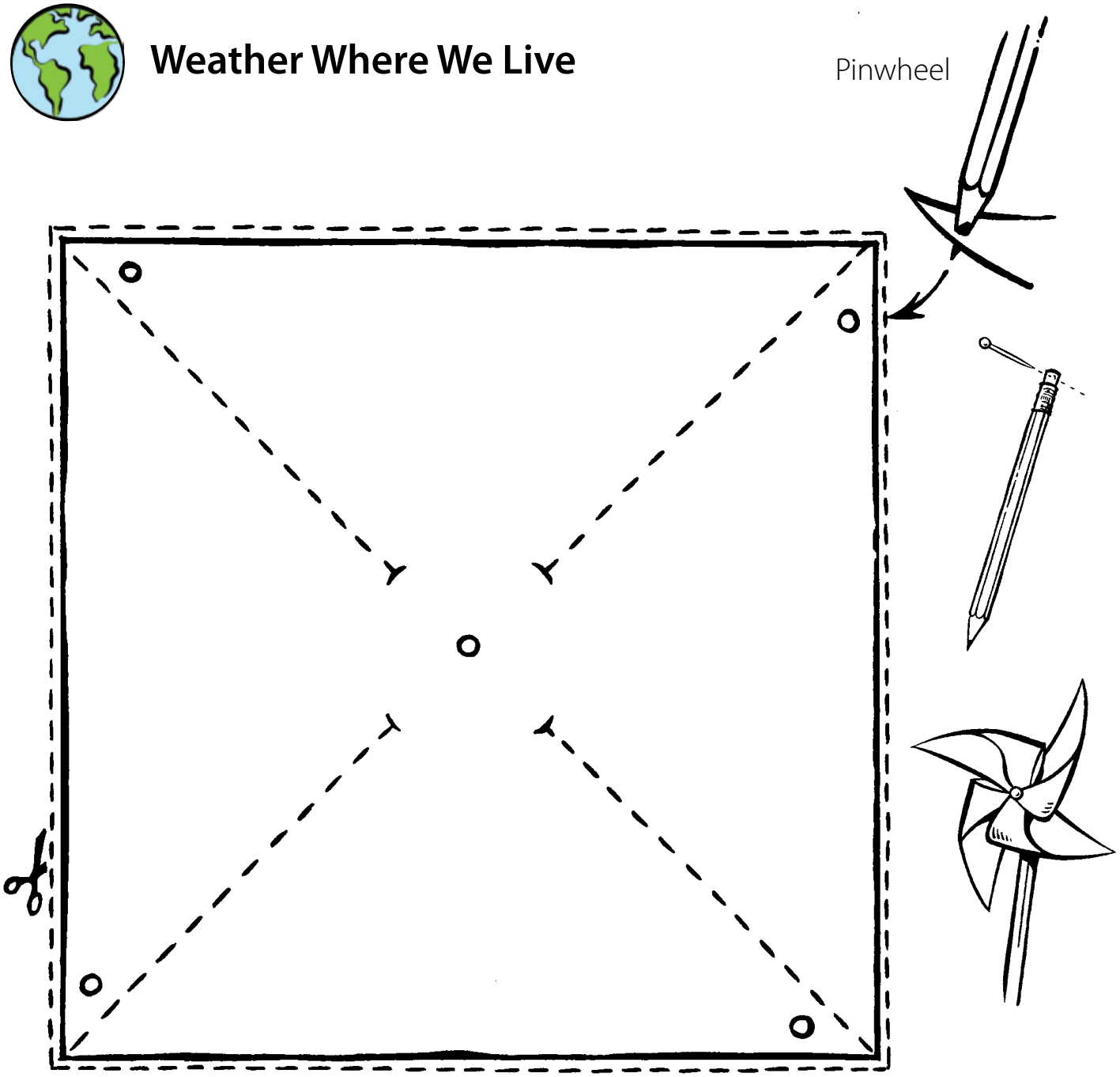
Pinwheel



How to make:

- Print or copy the pinwheel pattern onto 11 x 8.5 paper.
- Cut along the outside lines only and decorate both sides of the pinwheel pattern.
- Cut along the dotted lines from each corner towards the center.
- Use a sharpened pencil to carefully poke a tiny hole through each of the five circles at the corners and center of the pattern.
- Bend (do not fold!) the corners with the holes so they meet at the center hole.
- Put the pin through the corner holes and then the center hole, add one or two small beads, and push the pin loosely into the eraser on the pencil.
- Fold a piece of tape over the sharp end of the pin.
- Test out your pinwheel in the wind!