What's With This Weather?

Understand the weather and climate in your school garden and choose crops that will thrive

Gardening Connection:
Temperature, precipitation, light, and wind affect the health of garden plants every day. It will be important for student gardeners to know what conditions are needed for various plants to not only survive, but to thrive.

Grade Level:

Middle School, High School

Time Required:

4 class periods

EDUCATOR NOTE:
This activity can be used in conjunction with the activity *Weather Faux Yoga and Other Moves* from the Kansas School Gardens Curriculum.

OBJECTIVES

Students will be able to:

1. Explain the role of weather and climate in the survival of garden plants
2. Measure and interpret weather and atmospheric data
3. Select garden crops appropriate for local climate conditions

Subjects

Math
Reading
Science

Vocabulary

Weather
Climate
Range
Plant Hardiness Zone
Phenology

Project Connections

WET – Incredible Journey
Water Models
PLT - The Global Climate
Water Wonders

BACKGROUND

Weather is the conditions and state of the atmosphere, or all the air around us and the earth, at a specific time. It affects life, choices, and activities for humans as well as impacting the health of your garden.

Weather is a snapshot of many things including temperature, cloud cover, the sun's brightness, wind, and precipitation (rain, snow). Meteorologists measure and study all of these factors to forecast weather and monitor weather systems. Weather systems are analyzed, recorded, and used as trends or predictions. The accumulation of weather data combines to describe climate for an area. **Climate** is a complex mix of types, occurrences, and amounts of precipitation; wind speeds and direction; seasonal storms; temperature extremes; and even topography and geography.

Climate has a significant impact on the **range** (geographical area where a species can be found) of plants. The United States Department of Agriculture developed a map of **plant hardiness zones** to help guide farmers and gardeners in crop selection and timing. Plant hardiness zones are geographically defined areas in which a specific category of plant life is capable of growing, as defined by climatic conditions (mostly a plant's ability to withstand the minimum temperatures of the zone). For example, a plant that is described as "hardy to zone 10" means that the plant can withstand a minimum temperature of 30°F. A more resilient plant that is "hardy to zone 9" can tolerate a minimum temperature of 20°F.

Kansas has three plant hardiness zones, stretching in bands from Southwest to Northeast across the state (see resources section for zone map and planting calendar). When purchasing seeds & plants for your garden, it's important to know what zone you live in and select plants that are appropriate for your zone. Seed manufacturers will often include a zone map on the seed packet, with specific planting instructions for each zone. For example, if you live in SE Kansas (Zone III) the average last frost

date is Mid-April, whereas in NW Kansas (Zone I), the last frost typically occurs in the last few days of April. You may grow the same kinds of lettuce in both zones, but if you live in Zone III may plant your lettuce seeds approximately two weeks earlier than Zone I.

While the extremes of winter cold measured in plant hardiness zones are a major factor in determining whether or not a plant can survive, several other factors must be considered. Wind, sunlight, humidity, daily temperature fluctuations, soil moisture and rainfall will also impact the growth of garden plants. Many of these factors are specific to your site, and some will vary even within your site. Tree cover, slope, and proximity to buildings & parking areas can affect a garden's exposure to wind, sunlight, daily temperature fluctuations, and rainfall.

MATERIALS

- Kid-friendly tropical fruit (bananas, oranges, mangos, etc.) to sample
- Seed packets for garden vegetables
- Thermometers
- Wind socks
- Rain gages

PROCEDURES

Engage
Bring in a bag of oranges, bunch of bananas, or other kid-friendly tropical fruit. Share samples you're your students, and discuss which fruits students like best.

Ask students if you should grow an orange tree (or whatever type of fruit you have brought) in your school garden. Listen to the various answers they may give. These may range from "YES!" to "It would be nice, but they won't grow."

Expand on the idea that as nice as it would be to have "x" kind of tropical plant in the school garden, it wouldn't do very well.

Review with students what plants generally need to survive. Plants need water, nutrients, sunlight, and space. Remind students that while plants may all have the same basic needs, different types of plants need these things in varying amounts. So, the orange or banana tree you wish you could grow on the school grounds in Kansas simply won't survive. Why? Because the conditions that oranges need to grow include warm weather year-round and lots of precipitation.

Share with students that they are going to collect data on weather and atmospheric conditions – sunlight, temperatures and climate, rainfall (or precipitation), and wind – in their area. They will be able to use this data to determine which plants will thrive in their school garden and what additional care these garden crops will need to ensure a successful harvest.

Explore
Make a master list of the data the class plans to collect. The list may include high and low temperatures, temperatures at a specific time of day, cloud coverage, precipitation (daily or weekly), where and when sunlight falls on the garden site, wind direction and/or speed, and humidity.

From the list, select the atmospheric data that your class will collect. Discuss what tools are needed and available for collecting data, different procedure options for collecting the data, and the best ways to record and share the data. Will the group collect data everyday or at various intervals? Multiple times a day or some other schedule? For instance, the group may choose to collect data over a two week period, with sunlight coverage measurements conducted at 9:00 am, 12:00noon, and 2:00pm each day.

If your school does not have a weather station, you may need to make or purchase some simple tools. Thermometers are available at a minimal cost from hardware stores. Thermometers that record daily high and low temperatures can also be purchased. Wind socks can be made and interpreted using the Beaufort scale. Standard protocols can also be reviewed at www.globe.gov. Data can be recorded on this website and compared to other locations across the state, country, and world.

Sunlight Data:

One method for recording sunlight data utilizes the maps of the selected site created in the earlier Exploring Your Site: Map It Out activity. Make copies of the map to use when collecting sunlight data and overlay a grid of 20 equal squares onto the map.

Shade in the area that has sunlight when collecting data. The data can then easily be converted into a percentage. If 10 of the 20 squares in the grid overlaying the map of the garden were recorded to be receiving sunlight, then the garden has a coverage of 10/20 or 50% at the time the data was recorded.

At the end of the data collection time period, groups can organize their findings in data tables, compare results, and determine averages. (Students can also compare their data to on-line databases of atmospheric data for their area.)

Discuss the definitions of "full sun," "partial sun," and "shade." Develop a consensus regarding the sunlight category or categories for your garden site.

Seasonal Considerations:

If the data collection time was contained within one season, challenge students by asking them to predict what would happen if they were collecting the same data with the same protocol in three months? Six months? They should respond that there would be differences in the results. Ask students to share why they think there would be differences.

Because Kansas has four distinct seasons, students should know the weather and atmospheric conditions during the growing season. If the earlier investigations were not conducted during spring or summer, the investigation and data collection should be repeated during this time. The "growing season" has a large impact on what can grow and when in Kansas.

If students are unable to conduct or repeat the investigations during the growing season, have them use the internet and agricultural reference resources to obtain (average) historical data for the region. Compare this information to the data they collected.

Explain

During the period of data collection or after it is over, ask students to think of some ways the data could be used. Why would we want to know how much sunlight the garden gets each day? Or how much rain each week? Etc.

Students may share a variety of ideas. Expand upon those that relate to the school garden. Specifically, atmospheric data will affect what types of plants can be planted and grown, when they should be planted, how long their growing season is, and how well each type will grow.

Review with students the definitions of "full sun," "partial sun," and "shade." Ask students to identify which plant hardiness zone they live in on the Kansas planting zone map (see resources section). Have students work in groups. Provide each group with one or two seed packets for vegetables that may be grown in the school garden.

Have the groups read the information on each seed packet to determine if that plant could grow under the conditions that they recorded: Would there be enough sun or water? Would it be warm (or cool) enough? Is there a specific time of year that the seeds should be planted? Do they have enough information available to draw a conclusion or is more data needed? Students should consider the sun requirements of their plant as well as information such as drought tolerance, mature height and spread of plant, etc.

Students can also use KSU's Horticultural Report: Vegetable Garden Planting Guide (see resources section) for additional guidance on growing seasons and considerations specific to Kansas gardens.

Elaborate

Explore with students the section on Season Extension from the Kansas Gardening Guide. K-State Research & Extension. Charles W. Marr, Ted Carey, Raymond Cloyd, and Megan Kennelly, Kansas Garden Guide, Kansas State University, March 2010.
http://www.kansasgreenschools.org/files/Season%20Extension_0.pdf

Discuss as a class which of these extension ideas could be part of your garden plan (choosing crops, using transplants, prompt harvest, mulching, etc.)? Which of these extension ideas would require more planning and resources to accomplish (row covers, shade cloth, etc.)? Students may research options and cost of any of the season extension methods that interest them and develop a project plan and/or budget for implementing them in the school garden.

If season extension methods are implemented in the garden, use some of the methods from the Explore section to collect "before" and "after" data to measure any changes.

Evaluate

Make a variety of planting guides and resources available to students (such as the first 5 publications in the resources section). Ask students to brainstorm some of their favorite fruits, vegetables, and herbs that can be grown in Kansas. Allow each student to select one or two plants from the list.

Independently, students will research the needs of those plants, similar to the seed packet project in the Explain section. Have each student review the sunlight and temperature needs of their chosen plant and make a recommendation for adding it to the school garden. When and where should the crop be planted? What kind of care will the crop need to ensure plant health and harvest?

Extension Ideas

Phenology is a segment of ecology focusing on the study of periodic plant and animal life-cycle events that are influenced by climate and seasonal change in the environment. Phenology can be used as a tool to chart weather patterns for agricultural purposes, as well as animal behaviors and the life cycles of wild plants.

Ask students how farmers knew when to plant before databases could be searched for average temperatures and other data? Scientists and naturalists used phenology to track events and changes in nature. Even with more sophisticated technology available to monitor such changes, phenology still provides modern scientists with a great deal of knowledge about changes in ecosystems and climate. By observing and recording the time and order of natural events (first frost, blooming of red bud, geese migrating overhead, ripening of sumac berries, birds arriving at the feeder, etc.) on school grounds, students can use phenology to make observations and track data in both quantitative and qualitative formats.

Have students begin a phenology blog in conjunction with their garden project. Explain that this is not a project that they will finish during that school year. In fact, it is not a project that they will finish. The purpose of recording phonological data is to track patterns over many years. Where this class leaves off, next year's class will pick up.

Using the atmospheric data collection as a starting point, consider if there is additional data that should be documented. Students may want to include sightings of migrating birds or emerging insects, first and last frost of the season, when buds appear on the trees in local parks, etc.

In addition to a blog or electronic recording of the data, students could use traditional journaling methods and include their own observations and drawings. To ensure that the information is passed on to future classes, the original or at least one copy of the phenology project should be kept in the class or somewhere in the school for future students to add to it.

Resources:

K-State Research & Extension Vegetable Garden Planting Guide
http://www.ksre.ksu.edu/library/hort2/mf315.pdf

K-State Research & Extension Kansas planting zone map
http://www.kansasgreenschools.org/files/zones.pdf

K-State Research & Extension Kansas planting calendar
http://www.kansasgreenschools.org/files/calendar.pdf

K-State Research & Extension Vegetable Varieties List
http://www.kansasgreenschools.org/files/vegetable%20crops.pdf

K-State Research & Extension Vegetable crop requirements
http://www.kansasgreenschools.org/files/Vegetable%20Crops%20At-a-Glance.pdf

Student research protocols for weather & climate data
http://globe.gov/scrc

CoCoRaHS resources for school precipitation tracking & reporting
http://www.cocorahs.org/

Beaufort scale for wind measurement
http://www.unc.edu/~rowlett/units/scales/beaufort.html

Aldo Leopold and Phenology
http://aldoleopold.org/Programs/phenology.shtml