Weather Stations: Teaching Observation and Data Interpretation

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Grade Level

Fourth Grade

Unit Overview

In this unit, students will design an outdoor science station that can be used to measure and record weather data.

Through engaging in this challenge, students will learn the skills and tools needed to measure, discuss, analyze, and communicate weather and weather patterns. This unit meets the objectives of Standard 2 of the Utah 4th grade science core. Additional standards from other content areas of the Utah core addressed in this unit are listed below.

Standards

Utah Core Standard 2

Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.

Objective 1

Observe, measure, and record the basic elements of weather.

a) Identify basic cloud types (i.e., cumulus, cirrus, stratus clouds).
b) Observe, measure, and record data on the basic elements of weather over a period of time (i.e., precipitation, air temperature, wind speed and direction, and air pressure).
c) Investigate evidence that air is a substance (e.g., takes up space, moves as wind, temperature can be measured).

d) Compare the components of severe weather phenomena to normal weather conditions (e.g., thunderstorm with lightning and high winds compared to rainstorm with rain showers and breezes).

Objective 2

Interpret recorded weather data for simple patterns.

a) Observe and record effects of air temperature on precipitation (e.g., below freezing results in snow, above freezing results in rain).
b) Graph recorded data to show daily and seasonal patterns in weather.
c) Infer relationships between wind and weather change (e.g., windy days often precede changes in the weather; south winds in Utah often precede a cold front coming from the north).

Objective 3

Evaluate weather predictions based upon observational data.

a) Identify and use the tools of a meteorologist (e.g., measure rainfall using rain gauge, measure air pressure using barometer, measure temperature using a thermometer).
b) Describe how weather and forecasts affect people's lives.
c) Predict weather and justify prediction with observable evidence.
d) Evaluate the accuracy of student and professional weather forecasts.
e) Relate weather forecast accuracy to evidence or tools used to make the forecast (e.g., feels like rain vs. barometer is dropping).

Additional Standards Addressed: Many of the Utah Core speaking, listening and writing standards are addressed throughout the lessons and will vary depending on the extension activities you use.

Overview of Lessons

Section 1: Introduction to Weather

In this section of the unit, students are introduced to the vocabulary and tools of weather and weather investigation. Students will explore the concept of air as a substance and learn to identify common cloud types. This section is designed specifically to help build content vocabulary necessary for full participation in Sections 2 and 3 of this unit.

(Vocabulary activities will take more than one session. Links to additional online lesson resources are provided.)

Section 2: Building the Weather Station

In this section of the unit, students engage in the Design Thinking process as they work in teams to build a weather station that can be used to collect weather data at school. Their design challenge is to build a station that can be utilized by kindergarteners as well as by the fourth grade students.

(One extended project conducted in multiple sessions)

Section 3: Utilizing the Weather Station

Students will use the weather stations they created to conduct ongoing investigations into weather patterns. They will observe, record, and interpret weather data in science journals and conduct presentations on their analysis of the data collected.

(Multiple lessons and ongoing projects: journals, graphing and presentations, weather prediction and pattern analysis activities)

Lesson Procedures

Section 1: Exploring the Vocabulary of Weather

In this lesson, students become familiar with the tools and language needed to conduct weather investigations. This lesson makes the assumption that your students have science notebooks, but using the paper or graphic organizer of your choice will work out just fine.

Completing this lesson before teaching the lessons on air and clouds will give the students a great space for taking notes on the vocabulary specific to those lessons.

Following these activities, students will be able to match weather unit vocabulary words to their definitions and use them correctly in a sentence.

Based on Utah 4th grade Science Standard 2, students should be able to use the following words: *atmosphere, meteorologist, freezing, cumulus, stratus, cirrus, air pressure,*

thermometer, air temperature, wind speed, forecast, severe, phenomena, precipitation, seasonal, accuracy, barometer, rain gauge, components

Opening Activity: Read aloud the book *Cloudy with a Chance of Meatballs* by Judi Barrett, and have students take notes on the weather-related words used in the book that are also used to describe real weather. If you have the option of reading the text with a document camera or have other means of projecting the text as you read, that may assist students with taking notes. Follow the reading with a group word share. If you have the time, since the students are looking at a fabulous word bank, you might want to let them do a quick write on their own creative food-weather forecast.

Introduction: Explain to the students that it is useful when we have accurate shared understandings of the words used to make scientific observations, and for that reason, the class will be focusing on clarifying the vocabulary needed to succeed in the weather unit they are starting. Explain that the work they are completing is for their science journal (if you use them) and will be used as a reference material in future lessons.

Word Sort: Begin by reading the list of vocabulary words to the students (no explanations or definitions yet) and then have students cut out their word sort and sort the words into three piles: Words they know well, words they might know but aren't sure, and words that they do not know. Have them take notes in three columns in their science notebooks, example below:

Weather Unit Vocabulary Self-Assessment		
Words I know well	Words I know a little bit	Words I don't know
• Word • Word • Word	• Word • Word • Word	• Word • Word • Word

Weather Glossary: Sort the words alphabetically and glue them into their science notebooks with room to write a definition for each word (This will require some modeling! Alternately, you could create a graphic organizer). Extra space between words is always easier to work with than too little! I like to remind students that once they have a word glued into their science notebooks, they are responsible for spelling it correctly for the rest of their lives, no excuses!

Using partner talk as much as possible, work together as a class to create a kid-friendly definition for the following vocabulary words: *meteorologist*, *freezing*, *forecast*, *severe*, *phenomena*, *seasonal*, *accuracy*, *rain gauge*, *components* (add or delete words as needed for your standards).

Note: Words specific to the clouds and air lessons are left out and defined and included in the glossary during those lessons and will be defined later.

Words used in clouds lessons: *cumulus, stratus, cirrus, precipitation*

Words used in air lessons: *atmosphere, air temperature, wind speed, wind speed, barometer, thermometer*

As you define each word, have students copy the definition into their glossary. Then, using sentence stems and partners as needed, have students write and share sentences with their new science words.

Assessment: Student science journal work can be reviewed for quality and completeness. Additionally, you can use student whiteboards for a quick assessment: read or show the definition of a vocabulary word that has been studied, have students write which word matches the definition on their whiteboard to show you. A more formal quiz could also be used, although it would be appropriate to wait until the end of the unit when students have had more time to practice using the words before giving them a comprehensive formal assessment.

This lesson can be followed with selected lessons from the UEN on air and clouds:

- **Everyone Knows It's Windy** http://www.uen.org/Lessonplan/preview?LPid=11087
- **Measuring Wind Speed** http://www.uen.org/Lessonplan/preview?LPid=2454
- **Thermometers** http://www.uen.org/Lessonplan/preview?LPid=9840
- **Air Pressure & Barometers** http://www.uen.org/Lessonplan/preview?LPid=9843
- **Clouds** http://www.uen.org/Lessonplan/preview?LPid=10089

Any cloud lesson can be followed by an outdoor exploration session (or sessions) with cloud viewers and science journals so that students can practice their cloud ID skills. There are many cloud viewers online that you can download for free. An example is: **https://www.eol.ucar.edu/system/files/cloud_viewer_web.pdf**

Section 2: Weather Station Design

This lesson group makes use of a class of kindergarteners because my class participates in an upper/lower grades “science buddies” arrangement. If your class does not have access to or desire to work with younger grades, you could also have the students interview other students from their own class and create their design for use by their own grade level.

Introduction:

Open the lesson by showing students a short video clip or slide presentation of research and weather stations in various climates. Conduct a short discussion comparing and contrasting the stations and taking note of the tools that were present or that the students might imagine are needed in a research station, perhaps making a list on the board.

Empathy Phase 1: Since the fourth grade students will also be users, the teacher will conduct an interview with the class and create an empathy map that outlines the needs of the class in regards to the creation and use of a functional weather station. Discuss the map with the class. This gives the students experience with the interview and mapping process as well.

Empathy Phase 2: Explain that as a component of our own weather investigations, the class will be working with kindergarten science buddies to help them learn about weather as well and that we will be designing outdoor weather research stations that both classes can use.

Prepare students for the interview process by discussing the empathy component of the design process and modeling good and bad interviewing. Discuss ways that kindergarteners might share their ideas (words, pictures, acting something out), what background knowledge they have based on their unit of weather study, and how the interviewing students might take notes.

Conduct interviews with kindergarten science buddies and develop empathy maps.

Define: Hang both the kindergarten and fourth grade empathy maps in a place where they will be visible during the rest of the design process. Work together as a class to create needs statements for both users.

Ideate: Assign students to design teams of 3-5 students using the grouping method of your choice. Using sticky notes, chart paper, or the materials of your choice, lead students through a brainstorming session to develop ideas for the creation of a weather station that meets the needs of both classes.

Prototyping: Having students work in the same teams you formed for the Ideate session, have students work together to select their best ideas and begin looking for ways to fit those pieces together. If you have tools that were created in the cloud and air investigations in section one of this unit, you might want to remind students that those are available to use and incorporate into their designs.

Using varied materials, have students work in teams to prototype a weather station that can be used by both classes.

Feedback: Have students present their prototypes to the class for feedback. (If you have a science buddies arrangement, this would be a great time to ask the teacher or para-pro from that class to come in and give feedback as well!)

It is useful to establish clear guidelines for feedback before the session starts. Modeling and creating sentence stems for warm and cool feedback (and posting them in a visible place) will provide some needed scaffolding for this exercise. If you have one, a presentation feedback rubric and/or self-assessment will help to keep all of the students focused.

Design Revisions: Set aside time for the students to have a work session in which they can incorporate the feedback they received into a revised weather station design.

Building Functional Weather Stations: Depending on the resources you have available, you may wish to have the class create multiple weather stations or create one station based on commonalities in the prototypes. If you plan to have multiple groups out collecting data at the same time or wish to compare data from different locations on your school campus, there may some advantages to having multiple stations. If you plan to use the station less actively, plan to give students access to the station in shifts, or want to have a couple of students collect data and report back to the class, you could get by with only building one station.

Writing extension: Students could write a short information piece describing the purpose of the weather station as well as the components used. You could also bring back some of that core vocabulary they began working with in Section 1 and use that to create a word bank. My prompt for the students might look something like the following:

Word Bank: (Write on board or poster paper)

General Guidelines: We are writing an informational piece that describes our weather station to the reader.

Introduction: We made a _____ that will help us to _____. It was important to my team that _____. The main components of our design are _____.

Detail/Component 1: What is it, what does it tell you, how does it work?

Detail/Component 2: What is it, what does it tell you, how does it work?

Detail/Component 3: What is it, what does it tell you, how does it work?

Closing: (Tell the reader again what your weather station will help students to accomplish at school).

Section 3: Utilizing the Weather Station

In this section, students will use the weather stations they created to conduct ongoing investigations into weather patterns. They will observe, record, and interpret weather data in science journals and conduct presentations on their analysis of the data collected.

There is a lot of variability in this section of the unit to make it easy to tailor to your teaching needs. My class keeps science journals and also works with kindergarten science buddies, but those components should be easy to edit out if needed.

Project 1: Weather Journals

Utilizing weather journals is a great way for students to watch patterns emerge over time. There are graphic organizers that you can download online if you want to use something more structured, or you could just have the students draw up a simple organizer in their science journals. I might ask students to use a blank piece of paper from their journals to record the following data (having them draw it out before they head out to the weather station or meet with their science buddies is strongly recommended), or print out a few pages with the following table (or something similar) for them.

Date, Time, and Location:	Barometric Pressure:
Cloud Cover: Cloud Type:	Wind Direction:
Temperature:	Wind Speed:
Precipitation:	Notes:

The frequency with which students collect data really depends on what you want them to explore. Changes and patterns over the course of a day, week, or month could all be graphed and discussed. *It might be useful to look at temperature changes over the course of one day as an opening to a class discussion as to whether it is important to collect data at the same time every day for week or month-long investigations.*

If you are working with younger kids or science buddies during your visits to the weather station, remind your class ahead of time of the skills most kindergarteners possess and remind them to model and assist with writing numbers, etc.

Project 2: Graphing and Presentations

I like to create graphs as a class, but also have students include small versions of those graphs in their notebooks. Heavy scaffolding up front will help your students to gradually become more accustomed to generating simple graphs on their own. This is a great way to tie science into your math lessons. Suggestions for graphing topics: temperature (daily, weekly, monthly), precipitation and barometric pressure (monthly), wind or cloud data, wind direction and speed. Looking at various combinations or having the students put their data on a transparent material that allows you to overlay the graphs to look for patterns could be especially powerful.

Presenting graphs to the class is one way that students can demonstrate their understanding of the data they have collected as well as practice their speaking and listening skills. Use the participation/feedback/self-assessment rubrics of your choice to structure the presentations.

Once students have presented their graphs, hang them in a visible and accessible place so that students can reference them during weather predictions and analysis projects.

Project 3: Weather Predictions and Analysis

Once your class has had the chance to collect weather data a few times, it is time to start looking at the relationship between different trends. Setting up a space on your science wall where patterns and relationships can be noted will provide a reminder to students that looking for relationships is important, and they can also keep a record of simple weather patterns in their notebooks. Use prompts as needed to open students' thinking to the possibility of relationships in the data. Examples might be:

- In what way might temperature and precipitation be connected?
- What do you notice about barometric pressure and precipitation?
- How might wind direction be related to temperature or precipitation?
- What weather extremes have we recorded?

Writing Extension: Have students write down the weather connections that they uncover and then 'prove' their discovery by citing evidence from the class weather graphs or other sources to support their conclusions.

Other Resources:

- Interactive Weather Maker: http://teacher.scholastic.com/activities/wwatch/sim/game.htm
- Weather Prediction Website: http://edheads.org/activities/weather/frame_loader.htm
- Additional lessons available online through the Utah Educator's Network include:
    - Collecting Weather Data: http://www.uen.org/Lessonplan/preview?LPid=10092
    - Weather Forecasting: http://www.uen.org/Lessonplan/preview?LPid=10120
    - Forecasts: http://www.uen.org/Lessonplan/preview?LPid=10122