Predicting Whether the Weather is Good for the Garden

Grade 4

Standards
GPS.S4E4 a,b,c,d
NGSS.4.ESS2.A; 3.ESS2.D

Time
4 hours over two weeks

Supplies
(per team of students)
• internet connected computer for access to EdHeads and Wind Maps

(per student or per pair)
Wind vane
• pencil • paper straw • hat pin • index card • paper plate • clay •
Barometer
• glass jar • rubber band • clay
• balloon • scissors • paper straw
Anemometer
• ping pong ball • ruler • tape
• thread or fishing line • protractor
• compass and level (on cell phone)
Wind sock
• long sleeve (silky or nylon fabric)
• ribbon or string • wire hanger
• tape • pliers • rock/washer (weight)
Rain Gauge
Thermometer (garden / outdoor)

Garden Connection
Students will monitor weather in the school garden, report precipitation, predict the frost-free planting day based on weather trends, and design and build a garden structure.

Overview
4th grade students will make and use weather instruments in the garden, collect and report weather data as part of a citizen science research project, predict weather patterns and the spring frost-free planting date, differentiate between weather and climate, and design a weather station or season-extending structure for the garden.

Engaging Students
Students will report and predict the weather three days in advance based on simulated weather fronts to the West, using the Predict-O-Matic software at the Edheads interactive web site.

Exploration
Students will make a working weather vane, a wind sock, an anemometer, and a barometer. Over a period of two weeks, students will collect weather data from these instruments and a thermometer, and use this data with wind maps to forecast the weather and see how accurate their predictions are.

Explanation
Teams of students will be able to articulate that weather is the result of different systems and uneven heating of the earth's surface, and that instruments can be used to make predictions, observe trends, and distinguish between weather and climate.

Environmental Stewardship
Students will use the information learned in this lesson about monitoring and predicting weather, observing seasonal changes and contributing to a national phenology database such as Project Budburst or Journey North, to accept an engineering design challenge to build a weather station in the garden or a structure to extend the growing season of tender plants or seeds.

Evaluation
Students will demonstrate mastery of Edheads weather prediction simulations at all three levels, collect weather data in the garden with home-made and commercial devices, record and interpret weather data, report precipitation to a citizen science research project, predict when it will be safe to plant seeds or transplant seedlings in spring, and build a project.

Standards

Georgia Performance Standards in Science

S4E4. Students will analyze weather charts/maps and collect weather data to predict weather events and infer patterns and seasonal changes.

a. Identify weather instruments and explain how each is used in gathering weather data and making forecasts (thermometer, rain gauge, barometer, wind vane, anemometer).

b. Using a weather map, identify the fronts, temperature, and precipitation and use the information to interpret the weather conditions.

c. Use observations and records of weather conditions to predict weather patterns throughout the year.

d. Differentiate between weather and climate.

Next Generation Science Standards

4.ESS2.A: Earth Materials and Systems

Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1)

3.ESS2.D: Weather and Climate

Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. (3-ESS2-1)

Background Information

- Recommendations for teaching Weather from AAAS: http://assessment.aaas.org/topics/WC#/
- Recommendations for teaching Climate and Seasons from AAAS: http://assessment.aaas.org/topics/CL#/
- Children's Misconceptions about Weather/ Tables 3 and 4: http://www.csulb.edu/~lhenriqu/NARST2000.htm
- Typical Weather Misconceptions of 4th Graders in Georgia: https://www.georgiastandards.org/Frameworks/GSO%20Frameworks/4%20Science%20Framework%20Weather.pdf
- Climate vs Weather: http://www.nasa.gov/mission_pages/noaa-n/climate/climate_weather.html#.U_sH9fldV8k

Teacher Preparation

Use the background information from AAAS to ask questions, assess understandings, review key concepts and correct misperceptions about weather and climate.

- Weather is the result of several earth systems, and is interrelated and global, as well as local.
- Students can use instruments to collect and interpret weather data.
- Weather trends can be recognized by interpreting data over time. Climate is much longer-term trends than weather.
- Obtain supplies and materials for the lesson.
- ***Two weeks ahead of time,*** ask parents to contribute old jackets or shirts with long sleeves (nylon or silky fabrics best), wire hangers, and clean, empty salsa jars.
- Check out the Teacher Guide to Weather Predictions from EdHeads, before assigning this project to students: http://www.edheads.org/activities/weather/teacher.shtml
- Learn about contributing weather data through the CoCoRaHS or mPING citizen science programs
    - For best results, obtain high volume rain gauge and hail mats acceptable for CoCoRaHS weather reporting.
    - Register for CoCoRaHS program http://www.cocorahs.org/Application.aspx
    - Complete CoCoRaHS online training: http://www.cocorahs.org/Content.aspx?page=training_slideshows
    - Obtain a 4x4 post approximately 6 ft tall and bevel a 45 degree cut on top end
    - Dig a hole and bury the bottom two feet of a six foot post in ground; pour in 1 sack of dry quick concrete; level post; add some water.
    - Level and mount rain gauge after footing for post has set at least one day.

PROCEDURES FOR LESSON ACTIVITIES

Day 1

Engaging Students

Students will report and predict the weather three days in advance based on simulated weather fronts to the West, using Predict-O-Matic software at the Edheads interactive web site.

- Provide students with access to Internet connected computers and let them complete the Edheads weather reporting and prediction game: http://www.edheads.org/activities/weather/
- Students will demonstrate proficiency in weather prediction by mastering all three levels of the simulation.

Day 2

Exploration

Wind

Observe a current wind map

- Show the class this Wind Map online: http://hint.fm/wind/ with a smart board. It is updated throughout the day.
- Initiate a discussion about what causes wind (temperature differentials between land and water, and warm air rising).

Make a Wind Vane

- Provide students with materials for making wind vanes, including pencil, straw, hatpin, card stock and scissors.
- Wind vane directions: http://ciese.org/curriculum/weatherscope/docs/windvane/
- Using wind vanes: wind vanes point to the direction from which wind is blowing. Students can make a compass rose and record wind direction observations for two weeks to determine prevailing wind patterns at this time of year: https://www.aiaa.org/uploadedFiles/Education_and_Careers/STEM_K-12_Outreach/Kids_Place/Airplane_Activities/Wich%20Way%20Does%20the%20Wind%20Blow-Complete.pdf

Make a Wind Sock (optional)

- Provide students with the materials necessary to make a wind sock, including colorful, lightweight sleeves cut from shirts or jackets (nylon or silk best), untwisted wire hangers, weights, thread or fishing line, and duct tape.
- Modify the windsock directions by using tape for the hem of the wind sock instead of sewing it.
- Wind sock directions: http://familycrafts.about.com/od/gardendecor/ss/Shirt_Sleeve_Windsock_Craft.htm
- Using wind socks: tie wind socks to structures in the garden and record the direction and the strength of wind.

Make an Anemometer

- Provide students with materials to make an anemometer, including ping pong ball, protractor, thread, and tape.
- Anemometer directions: http://www.nauticus.org/activities/pon/pon_pingponganem.html
- Using anemometers: hold the protractor at shoulder height, pointing into the wind, and keep it level (parallel with the ground) while a partner reads the displacement at the bottom of the protractor. A conversion chart for degrees angle to miles per hour is provided. Note that most cell phones have built-in compass functionality and can download free apps for leveling, such as iHandy Level: https://itunes.apple.com/us/app/ihandy-level-free/id299852753?mt=8

Air pressure

Make a Barometer

- Ask students whether they think air has mass. Discuss air masses and weather fronts (the edge between an air mass of one temperature and one of a different temperature). Identify high pressure as indicative of fair (good) weather.
- Provide students with materials to make barometers, including glass jars, balloons, rubber bands, paper straws, glue, index card for manila folder, clay, and markers: http://ciese.org/curriculum/weatherscope/docs/barometer/
- Using barometers: high pressure makes the balloon dip and the straw go up: low pressure does the opposite.

Temperature and Precipitation

- Thermometer: Install a large outdoor thermometer in the garden; monitor and record temperature over two weeks.
- Rain gauge: Select a CoCoRaHS-approved rain gauge and install in the garden, per directions in Teacher Preparations.
- Students will complete CoCoRaHS training http://www.cocorahs.org/Content.aspx?page=training_slideshows, practice using a high volume rain gauge, and contribute data to this citizen science research project.
- Students will collect data by 9:00 am on the morning following any precipitation in the previous 24 hours.

Day 3 and Ongoing . . .

Collecting, Recording and Interpreting Data

Alternative: students may prefer to join the mPING citizen science project, using an app instead of web-based reporting

- Provide students with a chance to collect and record weather data from all instruments every day for two weeks.
- Compare data from home-made instruments to that in the news or collected from commercially made instruments.
- Allow students to display data in any graphic form they choose. One possibility is a simple line plot such as this: http://illuminations.nctm.org/LessonDetail.aspx?id=L287
- Ask students to analyze trends in data collected, both short and long term
- Identify any variations as weather or climate.

Predicting Trends in Weather Data related to Seasonal Change and Spring Planting Weather

- Using a vegetable planting guide such as the one for Georgia: http://georgiaorganics.org/wpcontent/themes/GeorgiaOrganics/Downloads/SiteMoveOver/plantingcalendar.pdf (or this one: http://cmg.colostate.edu/garden- notes/720.pdf), as well as previous Georgia frost dates (http://www.caes.uga.edu/pub-lications/pubDetail.cfm?pk_id=7778) and a farmer's almanac (Customizable Gardener's Almanac: http://www.weather.com/activities/homeandgarden/garden/) for reference, students will predict the date when soil and air temperatures will be conducive to planting seeds and transplanting seedlings outside in spring.
- Discuss why is such an important date to estimate correctly? (planting too early could result in freeze-damaged plants; planting too late could fail to take advantage of the longest growing season possible).
- Based on their research and recent weather trends, have the class vote on the first date to plant in the school garden this spring and check later to see how this date compares to actual frost-free date.

Explanation

Divide class into teams of four to produce and film garden-oriented meteorological reports.
Provide each group with a weather map showing conditions to the west, as well as access to weather instruments.
In their broadcasts, students should divide responsibilities and cover the following:

- Report on current weather conditions, based on data from weather instruments
- Predict future weather conditions, based on weather to the west
- Predict frost free date for spring planting, based on old almanacs, weather data, and planting guides
- Feature a current weather trend and differentiate between weather and climate when discussing it
    - A current weather trend might include a pattern of drought, rain, cold, heat, or other conditions.

Students should argue from evidence and provide supporting data for their predictions and conclusions.
Classmates will challenge what they perceive to be unsupported conclusions and offer alternative evidence, as necessary

Environmental Stewardship

Using information learned in this lesson, students will take on one of the following projects:

Engineering Design Challenge #1: Make a Weather Station in the School Garden

- Challenge students to design and install a weather station in the school garden
- One possibility: install a section of prefab fencing and attach colorful, student-made weather instruments to it

Engineering Design Challenge #2: Extend the Growing Season for Tender Plants

- Challenge students to think of a way to extend the growing season of plants in the garden. For inspiration: http://webecoist.momtastic.com/2012/03/02/diy-greenhouses-10-structures-you-can-build-yourself/2/ and this: http://www.soyouthinkyourecrafty.com/cd-case-greenhouse-tutorial/
- Research the effectiveness of cold frames, low hoops, hoop houses and mini-greenhouses that enable plants to be outside earlier in the spring or stay outside later in the fall/winter.

Option #3: Citizen Science Project in Phenology

- Students may contribute data on the first appearance of spring to a citizen science project such as Journey North http://www.learner.org/jnorth/pde/PhenDataAbout.html or Project Budburst http://neoninc.org/budburst/.

Extensions

Make DIY Thermometers

- Clarify what thermometers measure? (temperature) And what temperature indicates? (heat level).
- Provide supplies and directions for making a thermometer:
    - 11 oz plastic soft drink bottle
    - rubbing alcohol
    - red food coloring
    - modeling clay or blue / yellow tac
    - clear straw
- Directions
    - Fill bottom third of bottle w alcohol and color the liquid red with food coloring
    - Insert a clear straw in bottle
    - Completely seal around the straw at the top of the bottle, using non-porous clay such as blue tac
    - Red liquid will climb in bottle as temperature increases. Hold bottle in both hands to test. If red column of liquid does not rise, the clay seal has probably failed.
    - Detailed directions: http://www.weatherwizkids.com/experiments-thermometer.htm

Alternative / Additional Weather Instrument Directions

http://www.nsta.org/elementaryschool/connections/201004DIYVersusProfessionalWeatherStationDirections.pdf

Mythbusters Wind and Rain activities

http://www.mythbusterstheexhibition.com/assets/documents/uploads/06-MBedudoc-Wind-03.pdf

Weather Monitoring Lab Report

Name: _____

Dates

M	T	W	Th	F	M	T	W	T	F

Temperature (circle one: F or C)

Air Pressure

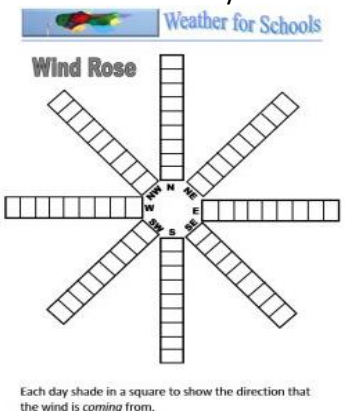
Wind Direction

Wind Speed

Precipitation

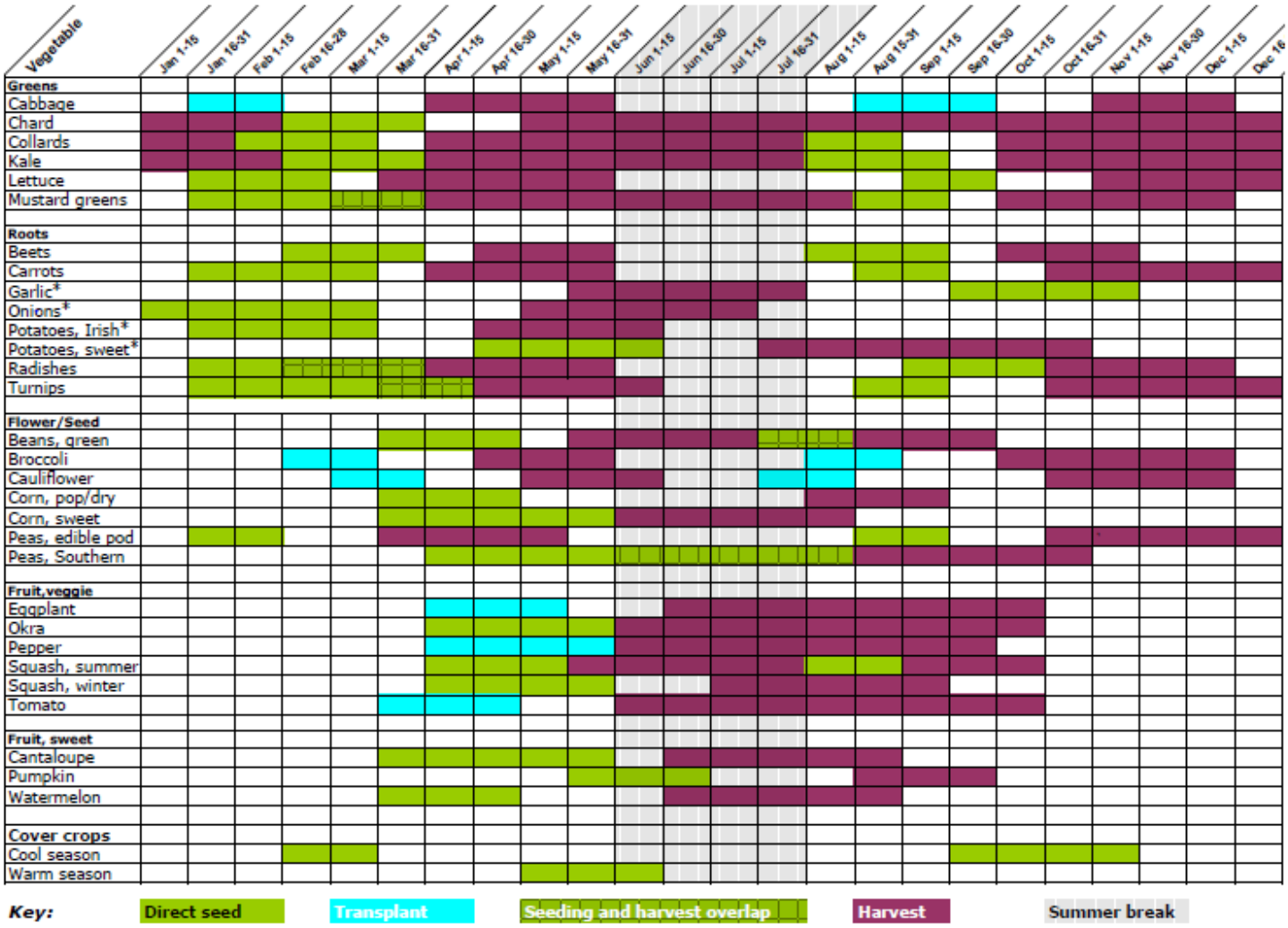
Observations (clear or cloudy; humid or dry; etc.)

Wind Rose courtesy of www.WeatherforSchools.me.us/html/contents.html



Make a wind rose by coloring in one square every day the wind is out of that direction.

Planting Calendar for Atlanta Area



Assessment for Whether the Weather is Good for the Garden

Student Name(s): _____ **Date:** _____

Level of Mastery → ↓ **Benchmark or Performance Measure**	**Emerging**  1 point	**Competent**  4 points	**Proficient**  5 points	Total Points
EdHeads Weather Prediction Simulation	Completed and mastered one level of the simulation.	Completed and mastered two levels of the simulation.	Completed and mastered all three levels of the simulation.	
Weather Instrument making and data collection	Built one or two weather instruments but they are not functional.	Built fewer than five weather instruments. Collected and recorded weather data for two weeks.	Built at least three working weather instruments including wind vane, anemometer, barometer. Collected and recorded weather data for two weeks. Analyzed data for trends.	
Weather Monitoring on Lab Report form	Collected and recorded data for less than two weeks.	Collected and recorded some data for entire two week period.	Collected and recorded all data for entire two week period.	
Frost Free Prediction	Prediction made without reference to any research or recent weather trends.	Predicted frost free planting date for school, based on recent weather and/or personal recollection of past years.	Predicted frost free planting date for school, based on research into previous frost free dates and recent weather trends.	
Contributed to phenology project or engineering design challenge (weather station or season extender)	Student participated in design (preparation or monitoring) and execution of plan.	Student can articulate purpose of project and participates fully.	Student can explain design process, what worked or didn't work in plan execution, what s/he would design or do differently next time, and why.	
Weather Report / Broadcast	Reported data with little analysis or interpretation.	Reported data with some analysis and citing of evidence.	Provided analysis of weather and backed up forecasts with data and trends.	