Play Ball! – Or Not….

Making a Decision Using Weather Data

A lesson created by the Office of the New Jersey State Climatologist

Lesson Link: Office of the NJ State Climatologist (Outreach –> Education)
https://climate.rutgers.edu/stateclim/?section=outreach&target=education

Grade Levels:
Grades 6-12, with modifications

Lesson Summary:
In this lesson, students use micro-datasets of local weather data from the NJ WeatherNet to analyze a scenario. Students are scaffolded in their interpretation of the data to ensure they are interpreting the data correctly, and ultimately they synthesize the data from three locations to determine whether or not a town should call off a Little League baseball game, or what measures need to be taken while the game is played.

Student Learning Objectives:
Students will be able to analyze, interpret and synthesize data
Students will problem-solve while seeking information to make an informed decision

Lesson Format:
Data-driven interrupted case study where students analyze small pieces of data one at a time to solve the case while compiling the data.

Time:
One 60 minute class period or 10-15 minutes per class period over 4 days

NJ Science Content Standards / NGSS Connections:
The learning experiences in this lesson are helping the students develop their proficiencies necessary for the following NGSS components.

Middle School:

Performance Expectation:
MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [*Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.*]

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing & Interpreting Data • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.	**ESS2.C: The Roles of Water in Earth's Surface Processes** • The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5) **ESS2.D: Weather and Climate**	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5) **Scale Proportion, Quantity** • Proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities

• Distinguish between causal and correlational relationships in data. • Analyze and interpret data to provide evidence for phenomena. **Engaging in Argument from Evidence** • Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	• Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5)	provide information about the magnitude of properties and processes.

Common Core State Standards Connections:
ELA/Literacy:

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-5)
RST.6-8.9	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ESS2-5)
WHST.6-8.8	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ESS2-5)

Mathematics:

MP.2	Reason abstractly and quantitatively.
6.NS.C.5	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-ESS2-5)

High School:

The components listed above serve as a basis for the following high school DCIs:

- ESS2.C: The Roles of Water in Earth's Surface Processes - How do the properties and movements of water shape Earth's surface and affect its systems?
- ESS2.D: Weather and Climate - What regulates weather and climate?

Materials:

- Case study
- Datasets and graphs

Background Information:

Weather forecasters consider many parameters when they compile their forecasts. This data, which may include winds, pressure, temperature, atmospheric moisture is obtained from ground instruments, satellite instruments, and weather balloons. Computer models are also consulted along with the other data, and a forecast is borne. But when a local event is reliant on data that has been created for an area that's a larger scale (i.e. county-wide or larger), it pays to be weather-savvy – an ability to interpret the data as it may impact a local area. With practice, students can become weather-savvy which can help them make a safe decision in the case of an approaching storm. This interrupted case-study provides students with small sets of data from the NJ WeatherNet which they use to build their understanding of weather data, and to make a decision about whether to play a ballgame.

Prerequisite Knowledge:

The prerequisite knowledge needed to successfully complete this case is contingent upon when the case is used in instructional – pre-unit or post-unit. If it is used as a pre-unit case, students will need to be scaffolded in their understanding of the different weather parameters used in this case. In this case, you may choose to use the pieces of the case over a period of a few days as the parameters are discussed in class, with the closing of the case occurring at the end of the unit after students have built their knowledge over the length of their weather unit.

Procedures:

1. Preparation: Students will be working on the case step-by-step, and therefore, make separate copies of each of the four parts so that students are not looking ahead in the case. Decide if you want students to work off digital or paper copies of the data, and prepare accordingly. To orchestrate the case, you may want to put each figure on a presentation slide to facilitate a class discussion around the data.
2. Introduce the case by asking students if weather was ever a factor that affected the timing of an event in their lives. It should spark a lively conversation about personal experiences with weather. Next, mention to the students, that people are put into position to make a call to hold or cancel an event based on weather forecasts, and that they will be getting a chance to be one of those individuals who need to make a decision about whether or not to let a Little League program play a championship game.

3. Divide students into teams of two or 3 students, and distribute Part 1 materials. Point out the location of the ballgame on the map. Go over the introduction to the case, and ask students to answer the questions posed. After debriefing what the students wrote, distribute Part 2 and follow the above protocol. Follow this step-by-step process for Part 3 as well. Gauge your students understanding of the graphs and figures, and assist them as needed.

Note: The students will ask questions about the radar images noting that there is a lot of clutter in New Jersey while the storm is sitting off to the west. The clutter is interference, and is not related to the storm.

4. Here is the final outcome of the case to be shared with the students AFTER they complete Part 3.

6:40 Storm strikes with vivid lightning, winds gusting to 53 mph. Heavy rain falling
6:55 Temperature is 70°, wind continues to gust to 45 mph.
7:05 Rain is about to end with 0.49" having fallen in the past 25 minutes.
7:10 Game called: field has huge puddles, lightning is still seen to the east, AND power is out within the region. People are told to be careful heading home due to downed trees and power lines.

5. Distribute Part 4 which has the summary data for the event, and ask students (in teams or by themselves) to create a summary report for the National Weather Service.

Assessment:

This lesson may be used as a pre-unit lesson or post-unit lesson to assess students' understanding of weather phenomena. Their responses to the questions in each part can be assessed based on the evidence and explanations supporting their arguments.

Extension:

This is an example of a case study created from an actual weather event, although the ballgame scenario was fictitious. Interesting weather events occur all the time in New Jersey, and the associated weather data including weather station, radar and satellite data, and the National Weather Service forecasts may be acquired from the NJ WeatherNet as the events occur so you can create your case studies. (njweather.org)