Clouds Can Predict the Weather!
Grades K-3

Background:

By learning about the various cloud types and how clouds can predict the weather, students can better understand when severe weather may be in the forecast. In this lesson, students will put themselves in "the shoes of NASA's Cloudsat mission team as they are developing an important Earth-observing satellite." Students can ask questions and learn strategies for observing the weather around them in this lesson based on "The Sky and Dichotomous Key" from NASA's Jet Propulsion Laboratory.

The weather in Northern California is typically consistent except in the late winter or early spring when we can have severe weather like rain or wind storms. The sky is usually a beautiful blue so when we have clouds they are beautiful and very dramatic. If students learn to identify cloud types, they can better understand when severe weather may be coming and prepare for it. In my area, I would present this lesson in late winter or early spring. This would be a multi-day lesson with observations of clouds and weather going on for a month.

In the second part of the lesson, students will also identify areas at their school site that might be affected by inclement weather. Students will define the problem, brainstorm ideas to help ease the impact, write an informative paragraph about it and present their proposal to the administrator and custodian. If approved, students will build, test and redesign their ideas to solve the problem. At our school, right outside my classroom there is a drain for run-off that backs up during rainstorms and causes a huge "lake" students have to wade through to get across campus. This would be a fantastic opportunity for students to put their engineering skills to work and help solve our cold, soaking wet feet dilemma.

Standards:

NGSS

3-ESS3-1 Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.

K-ESS3-2 Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to severe weather.

K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

K-ESS2-1 Use and share observations of local weather conditions to describe patterns over time.

Science and Engineering Practices

Engaging in Argument from Evidence:

- Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).
- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (3-ESS3-1)

  Analyzing and Interpreting Data:

  Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.
- Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships. (3-ESS2-1)
- Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.

  Asking Questions and Defining Problems
- Asking questions and defining problems in grades K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.
- Ask questions based on observations to find more information about the designed world. (K-ESS3-2)
- Ask questions based on observations to find more information about the natural and/or designed world(s). (K-2-ETS1-1)
- Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2-ETS1-1)

Disciplinary Core Ideas

ESS3.B: Natural Hazards
- Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. (K-ESS3-2)

ETS1.A: Defining and Delimiting an Engineering Problem
- Asking questions, making observations, and gathering information are helpful in thinking about problems. *(secondary to K-ESS3-2)*

ETS1.A: Defining and Delimiting Engineering Problems
- A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1)
- Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1)
- Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)

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)

ESS3.B: Natural Hazards

- A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. (3-ESS3-1)

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified, tested, and used to explain change. (3-ESS3-1)
- Events have causes that generate observable patterns. (K-ESS3-2)

Patterns

- Patterns of change can be used to make predictions. (3-ESS2-1)
- Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (K-ESS2-1)

CCSS

Math:

MP.2 Reason abstractly and quantitatively (3-ESS3-1), (K-2-ETS1-1), (K-ESS2-1)
MP.4 Model with mathematics (3-ESS3-1), (K-ESS3-2), (K-2-ETS1-1), (K-ESS2-1)
MP.5 Use appropriate tools strategically. (K-2-ETS1-1)
K.CC Counting and Cardinality (K-ESS3-2)

ELA/Literacy:

W.3.1 Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-ESSS3-1)
W.3.7 Conduct short research projects that build knowledge about a topic. (3-ESS3-1)
W.3.2 Write informative/explanatory texts to examine a topic and convey ideas information.

Engaging Contexts:

Teacher:

Have you ever looked up in the sky and noticed there are different kinds of clouds? What do the different shapes and textures of the clouds tell us? Have you noticed that there is a particular cloud pattern when there is certain weather? Have you noticed that our weather can affect and cause difficulty here at our school? Wouldn't it be amazing if we put our heads together and solved the problem like actual engineers?

Justification:

By learning and identifying types of clouds and their corresponding weather, students understand that clouds can predict the weather. Students will collect authentic data and interpret the relationship between cloud patterns and weather. Students will learn how real-life NASA scientists collect data using a Dichotomous Key to identify objects. Students will also connect their research to a real-world issue by using engineering skills to design a solution to a problem at their school.

Objectives:

Students will be able to:

- Identify and describe types of clouds using the S'COOL Cloud Identification Chart
- Observe and gather cloud data using a dichotomous key, thermometers
- Organize, represent and interpret data using the S'COOL Cloud Observations Report Form
- Show the data using a simple graph and interpret information
- Identify patterns in temperature, pressure or cloud types
- Explain how clouds can predict weather
- Connect types of clouds to types of weather patterns
- Compile information from multiple sources to address topic
- Design and conduct an experiment that will solve a problem
- Critique experimental designs
- Develop a logical argument using informative text
- Report solutions to peers and administrators

Materials Needed:

Cloud Vocabulary Handout

Dichotomous Key- https://www.jpl.nasa.gov/edu/pdfs/dichotomouskey_handout.pdf

Shapes in the Sky: A Book About Clouds by Josepha Sherman

DOK Question Stems on sentence strips

S'COOL Cloud Identification Chart or go to the online S'COOL Cloud Identification Chart- https://scool.larc.nasa.gov/cldchart.html

S'COOL Cloud Observation Report Form- https://www.globe.gov/documents/16792331/0/S%27COOL+GLOBE+Observation+Form+FINAL9sm.pdf/bf111e4a-7468-458b-9bd6-e463b98be61c

Cloud Identification Viewers printed on cardstock and glued to tongue depressors- http://fullofgreatideas.blogspot.com/2012/03/to-cloud-diy-cloud-identification-tool.html

Tongue depressors

Thermometers

Graph paper

Informative writing graphic organizer- https://s-media-cache-ak0.pinimg.com/736x/c9/f9/07/c9f907a46978c85d7522fe6e0f942973--problem-solution-graphic-organizer-problem-and-solution-anchor-chart.jpg

Lesson Plan:

Engage:

Gallery Walk- using phenomena (pictures of clouds from https://www.wired.com/2009/09/clouds/2/) students do a gallery walk and write down observations at each picture. Students come to carpet and have class discussion as students explain their observations using evidence. Depth of Knowledge (DOK) question stems can be used here to assess prior knowledge of concepts.
Teacher reads "Shapes in the Sky" to students. Use DOK question stems to check for understanding and encourage discussion.

Explore:

Back at their tables, students can explore and identify types of clouds and the weather associated with them using their Chromebooks at https://scool.larc.nasa.gov/cldchart.html or the printed S'COOL Cloud Identification Chart and the cloud vocabulary handout. Students sketch, color and label types of clouds and corresponding weather in their science journals. Teacher checks as students work. Students cut out a cloud identification viewer and glue to a tongue depressor.

Explain:

Teacher:

"We are going to observe clouds and record the outside temperature using our cloud viewers and thermometers for one month. We can make predictions about the type of weather we might be having by observing the various types of clouds."

Distribute how to use the Dichotomous Key Handout. Discuss the meaning and purpose of a dichotomous key as a tool that scientists use in many contexts.

Take students out to work in groups to begin cloud observations and temperature readings using cloud identification viewers and thermometers.

Complete S'COOL Cloud Observations Report Form as whole class and discuss findings based on observations.

Create a whole-class graph to display data on types of clouds, related weather and temperature. Identify if there are patterns in cloud type, temperature, weather patterns.

Extend:

Teacher:
"Using what you have learned about clouds and related weather, let's think of how our school might be affected by severe weather such as high wind, heavy rain intense heat or sun. Are there problems here at our school as a result of this weather? What can we do to help remedy the situation?"

Students work in collaborative teams and define a problem on the school campus that is a result of weather. Teams will follow the steps of the STEM engineering design process- research, design, build a prototype, test and improve. Students will tour the school, speak with the administrator or custodian and specify a problem that can be solved. For example: areas that flood, doors that swing open in the wind, or areas that could be shaded from intense sun or heat. Students can use the internet to research solutions to their dilemma. Students will collaborate, brainstorm and draw or sketch solutions using readily available materials found at school or home. Teams will build a model and test their solution. If needed, they will re-design and test their design again to improve its performance.

Extension activities to support ELD students would be:

Singing "Oh When the Clouds Go Floating By" -
http://www.teacherweb.com/NV/Batterman/Wolf/informative-explanatory-rubric.jpg

Using cotton balls to create cloud information sheet such as:
http://www.teachingmaddeness.com/2013/01/friday-flashback-linky-geometry.html

Students can work in teams and do the Make a Cloud in a Jar experiment.

Students can keep a weather journal and draw pictures of the weather from their observations outside.

Evaluate:

Teacher will provide on-going formative assessment through observations, group interactions, DOK questions, data reports, and science journals.

Summative assessments:
Students will use the informative text graphic organizer to write a informative paragraph explaining and developing a logical argument for their team's solution. Teacher will assess using the following rubric:
http://www.teacherweb.com/NV/Batterman/Wolf/informative-explanatory-rubric.jpg

Students will present their solution to their peers and to administrator and custodian, design, build a prototype, test, revise and implement their solution. Students will use a teamwork rubric to grade their group's performance.
https://drive.google.com/file/d/0BzuHAscuHKlWMXZacWxSZ1cyWjg/view

References

NASA Jet Propulsion Laboratory, California Institute of Technology. (n.d.). *Classroom activity: The sky and dichotomous key.* Retrieved from https://www.jpl.nasa.gov/edu/teach/activity/the-sky-and-dichotomous-key/