Sky Detectives: Investigating Weather Patterns

Grade(s): 3rd grade
Lesson Duration: Class periods or minutes
Course Name(s): Design Lab
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BIG IDEAS

Science

- Earth's systems: Understanding the interactions between the atmosphere and hydrosphere
- Weather patterns and the water cycle
- Satellite technology and remote sensing for Earth observation

Technology

- Using NASA's online weather data tools and satellite imagery
- Analyzing and interpreting satellite data to understand Earth processes

Engineering

- Designing and creating models (e.g. playdough models of clouds and rainfall)

Art

- Visual representation of scientific concepts through drawing and modeling
- Interpreting and creating visual data displays (e.g. satellite imagery, graphs)

Mathematics

- Data analysis and representation
- Graphing and interpreting weather data
- Estimating and measuring changes in water amounts over time

EDUCATION STANDARDS

Science Performance Expectations (or state Science standard):
3-ESS2-1: Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.

Science and Engineering Practices: *(SEP elements connected to the PEs or standards)*	Disciplinary Core Ideas: *(DCI elements connected to the PEs or standards)*	Crosscutting Concepts: *(CC elements connected to the PEs or standards)*
Analyzing and Interpreting Data: Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships. (3-ESS2-1)	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)	Patterns: Patterns of change can be used to make predictions. (3-ESS2-1)

Common Core State Standards

Math:
MP.2 Reason abstractly and quantitatively. (3-ESS2-1)
MP.4 Model with mathematics. (3-ESS2-1)
3.MD.A.2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. (3-ESS2-1)

ELA/Literacy:
RI.3.7 Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur). (3-ESS2-1)

ITEEA Standards: *If applicable*

Other Standards:

National Visual Art Standards:
Creating:
VA:Cr1.2.3a: Apply knowledge of available resources, tools, and technologies to investigate personal ideas through the art-making process.

Responding:
VA:Re7.2.3a: Determine messages communicated by an image.

MEASURABLE STUDENT LEARNING OBJECTIVES

1. DOK 2 (Skill/Concept): Students will be able to interpret NASA satellite images to describe basic weather patterns and cloud formations.
2. DOK 2 (Skill/Concept): Students will be able to create accurate playdough models representing different types of clouds and rainfall patterns.
3. DOK 3 (Strategic Thinking): Students will be able to analyze weather data from NASA's online tools to describe typical weather conditions for a particular season.
4. DOK 3 (Strategic Thinking): Students will be able to construct a visual representation (drawing or diagram) explaining the movement of water between the atmosphere and hydrosphere.
5. DOK 3 (Strategic Thinking): Students will be able to compare and contrast weather patterns observed in satellite imagery with their local weather observations.
6. DOK 4 (Extended Thinking): Students will be able to synthesize information from multiple sources (satellite images, weather data, and models) to predict short-term weather changes in their local area.
7. DOK 4 (Extended Thinking): Students will be able to create a multimedia presentation that explains the relationship between the atmosphere and hydrosphere, incorporating their artwork, models, and data analysis.

MATERIALS NEEDED

Physical Materials

1. **Playdough**: Various colors for modeling clouds and rainfall.
2. **Drawing Paper**: For students to create visual representations of the water cycle.
3. **Markers/Crayons**: For illustrating concepts and creating diagrams.
4. **Rulers**: For measuring and creating graphs.
5. **Scissors**: For cutting paper and materials as needed.

Online Resources

1. **NASA Earth Observatory**: Access satellite images and data related to weather patterns.
    - NASA Earth Observatory
2. **NASA's Climate Kids**: Educational resources about weather, climate, and the water cycle.
    - NASA's Climate Kids
3. **NASA Image and Video Library**: A collection of NASA images that can be used for educational purposes.
    - NASA Image and Video Library
4. **NOAA Satellite Education Resources**: Additional educational materials focused on satellite data and weather.
    - NOAA Satellite Education Resources
5. **NASA's Scientific Visualization Studio**: Tools for visualizing scientific data, including atmospheric and hydrological data.
    - NASA Scientific Visualization Studio

ENGAGING CONTEXT/PHENOMENON

To engage my 3rd grade students in this lesson on the atmosphere and hydrosphere, I plan to start with a NASA satellite image of cloud formations, such as cloud streets over the Black Sea, sourced from the NASA Earth Observatory. I will present this image and prompt my students with questions like, "What do you see?" and "How do you think this picture was taken?" This phenomenon serves as an engaging hook by it utilizing a NASA resource, sparking curiosity about weather patterns and cloud formation while introducing the concept of viewing Earth from space. It encourages my students to engage in scientific inquiry through observation and questioning, setting the stage for subsequent activities like creating playdough models of clouds based on their observations. This engaging introduction aligns perfectly with the NGSS standard 3-ESS2-1, fostering a deeper understanding of weather patterns and the water cycle.

DATA INTEGRATION

This lesson integrates NASA data analysis with hands-on activities like creating playdough models of clouds, allowing students to connect abstract data with concrete representations..

1. NASA Earth Observatory satellite imagery: Students will analyze satellite images of cloud formations and weather patterns. This aligns with the "hook" of showing students a striking image of cloud streets over the Black Sea.
2. NASA's Climate Kids resources: This provides educational content about weather, climate, and the water cycle appropriate for 3rd grade students.
3. NASA's Earth System Data Explorer (ESDE): This tool allows students to generate plots, graphs, and other visualizations of Earth science data. Students will use this to analyze and interpret weather data.
4. NASA's Scientific Visualization Studio: This provides additional tools for visualizing scientific data related to atmospheric and hydrological processes.

Students are primarily analyzing existing NASA data rather than collecting their own. Their activities with the data include:

1. Interpreting satellite images to describe weather patterns and cloud formations
2. Using NASA's online tools to analyze weather data for different seasons
3. Creating visual representations (drawings, diagrams) based on their analysis of NASA data
4. Comparing satellite imagery with local weather observations
5. Using data from multiple NASA sources to make predictions about short-term weather changes

TEACHER BACKGROUND KNOWLEDGE

To effectively teach this lesson, I'll need a solid understanding of several key concepts and NASA resources:

1. Earth's Systems:
   I should have a good grasp of how the atmosphere and hydrosphere interact, including the water cycle, weather patterns, and climate.
2. Satellite Technology and Remote Sensing:
   Understanding how NASA uses satellites to observe Earth is crucial. The NASA Earth Observatory has great resources on this:
   https://earthobservatory.nasa.gov/features/RemoteSensing
3. Cloud Formation and Types:
   Knowledge of different cloud types and how they form will be important for the playdough modeling activity. NASA's S'COOL project offers helpful information:
   https://scool.larc.nasa.gov/
4. Weather Data Analysis:

Familiarity with reading and interpreting weather data is essential. NASA's My NASA Data project provides tools and tutorials:
https://mynasadata.larc.nasa.gov/

5. NASA's Earth Science Missions:
   An overview of NASA's current Earth observation missions will provide context. The NASA Earth Science Division website is a great resource:
   https://science.nasa.gov/earth-science/missions/

DIFFERENTIATION OF INSTRUCTION

1. Students with reading difficulties:
   - Provide simplified versions of written instructions
   - Use text-to-speech software for digital resources
   - Pair students for reading activities
2. English Language Learners:
   - Provide key vocabulary in multiple languages
   - Use visual aids alongside new terminology
   - Allow students to demonstrate understanding through drawings or their native language
3. Students with attention difficulties:
   - Break the lesson into shorter segments with frequent breaks
   - Provide fidget tools or standing desks as needed
   - Use timers for focused work periods
4. Gifted students:
   - Offer extension activities, such as researching specific weather phenomena
   - Encourage them to create more complex models or analyze additional data sets
   - Allow them to lead small group discussions or demonstrations
5. Students with physical disabilities:
   - Ensure all materials and workspaces are accessible
   - Provide adaptive tools as needed (e.g., larger playdough containers, ergonomic drawing tools)
   - Consider pairing students for activities that require fine motor skills

REAL-WORLD CONNECTIONS FOR STUDENTS

The lesson focuses on weather patterns, cloud formations, and the water cycle - phenomena that students experience in their daily lives. By analyzing satellite imagery and weather data, students can connect what they're learning to the weather they observe outside their windows. This makes the abstract concepts more tangible and relevant. To make the lesson more culturally responsive, I can use weather data and satellite imagery from the St. Louis area, or even from regions my students are from (such as Bosnia, Russia, Afghanistan, Iraq, and Vietnam) This allows students to see how global weather patterns relate to their own communities.

POSSIBLE PRIOR or MISCONCEPTIONS

Students may come to this lesson with a variety of ideas and misconceptions about the atmosphere, hydrosphere, and weather patterns. Many will likely recognize common weather conditions (sunny, rainy, cloudy) and have a basic understanding of the water cycle, though they may not fully grasp its stages or connections. They might identify different cloud types but may not know their names or formation processes. While students may associate specific weather patterns with seasons, they could mistakenly believe that weather is random and not influenced by larger systems. Personal experiences

with weather may connect to their daily lives, but they might not see the broader implications, such as climate change. Additionally, while some students may have heard about satellites, they might not understand how these technologies are used to observe Earth and collect data. To address these ideas, I plan to start with a brainstorming session to gauge prior knowledge, use visuals and hands-on activities to clarify misconceptions, relate the water cycle to everyday experiences, and encourage questions throughout the lesson to foster inquiry and deeper understanding.

LESSON PROCEDURE

5E	Details of 5E Lesson Implementation *(Visit BSCS to learn more about the 5E instructional model)*

Engage
Introduce the lesson with an anchoring phenomenon.
 	
Facilitate student questions, discussion, etc. as appropriate.
 	
Learn about what students already know and want to know.
	Lesson Objective:
	Students will be able to interpret NASA satellite images to describe basic weather patterns and cloud formations.
	
	Standards Addressed:
	NGSS 3-ESS2-1: Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
	Responding:
	VA:Re7.2.3a: Determine messages communicated by an image.
	
	Materials & Resources:
	• NASA Earth Observatory website: https://earthobservatory.nasa.gov/
	• Specific NASA satellite image of cloud streets over the Black Sea:
	• https://earthobservatory.nasa.gov/images/148742/cloud-streets-over-the-black-sea
	• iPad (for Seesaw science journal)
	
	Procedure:
	1. Display the NASA satellite image of cloud streets over the Black Sea on a large screen.
	2. Ask students to observe the image silently for 30 seconds, encouraging them to notice as many details as possible.
	3. Facilitate a class discussion using the following prompts:
	  • What do you see in this image?
	  • How do you think this picture was taken?
	  • What do you think causes these patterns in the clouds?
	4. Record student responses and questions on the board, categorizing them into "What We Know" and "What We Want to Know" columns.
	5. Explain that the image is from a NASA satellite orbiting Earth, introducing the concept of observing our planet from space.
	6. Have students draw what they think the clouds might look like from the ground in their science journals.
	7. Introduce the lesson's focus on exploring weather patterns and the interaction between air and water using NASA technology.

	Formative Assessment: Use a simple rubric to assess students' initial observations and questions: • 3 points: Detailed observation, thoughtful question • 2 points: Basic observation, relevant question • 1 point: Limited observation, off-topic question **Modifications:** • For ELL students: Use visual aids and gestures when explaining new vocabulary. • For advanced learners: Encourage them to hypothesize about the formation of the cloud patterns.
Explore *Plan for students to engage in hands-on activities that are designed to facilitate conceptual change.*	**Lesson Objective:** Students will be able to create accurate playdough models representing different types of clouds and rainfall patterns. **Standards Addressed:** NGSS 3-ESS2-1: Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. VA:Cr1.2.3a: Apply knowledge of available resources, tools, and technologies to investigate personal ideas through the art-making process. **Materials & Resources:** • Playdough in various colors • NASA's Climate Kids website: https://climatekids.nasa.gov/ • Cloud identification chart • Student science journals • **Procedure:** 1. Introduce different cloud types using the NASA Climate Kids website, focusing on how they relate to weather patterns. 2. Display a cloud identification chart and discuss the characteristics of each cloud type. 3. Divide students into small groups and provide each with playdough. 4. Challenge students to create models of different cloud types based on the information from NASA Climate Kids and the cloud chart. 5. As students work, circulate to ask guiding questions about cloud formation and characteristics. 6. Have groups present their cloud models, explaining how they represent real cloud types and associated weather patterns. 7. Extend the activity by having students create models showing rainfall patterns associated with their cloud types. **Formative Assessment:** Use a simple rubric to assess students' playdough models and explanations: • 3 points: Accurate representation, clear explanation of cloud

	type and weather association • 2 points: Mostly accurate representation, basic explanation of cloud type • 1 point: Inaccurate representation, limited explanation **Modifications:** • For students with fine motor difficulties: Provide larger quantities of playdough or allow them to work with a partner. • For ELL students: Pair with a language buddy and provide a word bank of cloud types and characteristics. • For advanced learners: Challenge them to create more complex models showing multiple cloud types in a weather system.
Explain *Facilitate opportunities for students to explain their understanding of the concepts and processes and make sense of new concepts.*	**Lesson Objective:** Students will be able to analyze weather data from NASA's online tools to describe typical weather conditions for a particular season. **Standards Addressed:** NGSS 3-ESS2-1: Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. MP.4: Model with mathematics. **Materials & Resources:** • NASA's Earth System Data Explorer (ESDE): https://mynasadata.larc.nasa.gov/ • Ipads • Seesaw science journals • **Procedure:** 1. Introduce students to NASA's Earth System Data Explorer tool, demonstrating how to access and interpret weather data. 2. Guide students through the process of selecting a specific season and location to analyze weather patterns. 3. Have students work in pairs to use the ESDE tool to gather data on temperature, precipitation, and cloud cover for their chosen season and location. 4. Ask students to create simple graphs or charts in their science journals to represent the data they've collected. 5. Facilitate a class discussion where students share their findings and explain the weather patterns they've observed. 6. Encourage students to make connections between the cloud types they modeled in the Explore phase and the weather data they've analyzed. 7. Introduce relevant vocabulary (e.g., climate, weather patterns, seasonal changes) as students explain their understanding. **Formative Assessment:** Use a simple rubric to assess students' explanations and data representations: • 3 points: Clear explanation of weather patterns with accurate data representation • 2 points: Basic explanation with mostly accurate data

	representation • 1 point: Limited explanation with inaccurate or incomplete data representation Additionally, use strategic questioning during the class discussion to gauge understanding and address misconceptions. **Modifications:** • For students with reading difficulties: Provide a step-by-step guide with screenshots for using the ESDE tool. • For ELL students: Offer a word bank of weather-related terms and sentence starters for explanations. • For students who struggle with data analysis: Provide pre-made graph templates or partner them with a peer who excels in this area. • For advanced learners: Challenge them to compare data from multiple seasons or locations.
Elaborate *Provide applications of concepts and opportunities to challenge and deep ideas; build on or extend understanding and skills.*	**Lesson Objective:** Students will be able to construct a visual representation (drawing or diagram) explaining the movement of water between the atmosphere and hydrosphere. **Standards Addressed:** NGSS 3-ESS2-1: Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. VA:Cr1.2.3a: Apply knowledge of available resources, tools, and technologies to investigate personal ideas through the art-making process. **Materials & Resources:** • NASA's Climate Kids website: https://climatekids.nasa.gov/ • Drawing paper and art supplies (colored pencils, markers) • NASA Earth Observatory images of the water cycle • Student science journals **Procedure:** 1. Review the water cycle using NASA's Climate Kids resources, focusing on the interaction between the atmosphere and hydrosphere. 2. Show students various NASA Earth Observatory images depicting different stages of the water cycle. 3. Challenge students to create their own visual representation of the water cycle, emphasizing the movement of water between the atmosphere and hydrosphere. 4. Students may choose their medium (drawing, clipart representation, stop motion using playdough, collage, etc) 5. Encourage students to incorporate elements from their earlier cloud models and weather data analysis into their artwork. 6. As students work, circulate to ask probing questions about specific processes (e.g., evaporation, condensation,

	precipitation) and how they relate to weather patterns. **Formative Assessment:** Use a rubric to assess students' visual representations and explanations: • 3 points: Accurate depiction of water cycle processes, clear explanation of water movement between spheres • 2 points: Mostly accurate depiction, basic explanation of water movement • 1 point: Inaccurate depiction, limited explanation of processes Additionally, use strategic questioning during presentations to gauge understanding and address misconceptions. **Modifications:** • For students with artistic challenges: Students are able to choose the medium that will best serve their strengths • For ELL students: Offer a word bank of water cycle terms and encourage labeling in both English and their native language. • For advanced learners: Challenge them to include quantitative data (e.g., average rainfall amounts) in their representations.
Evaluate *Students are encouraged to assess their understanding and abilities. It also provides opportunities for teachers to evaluate their progress toward achieving the educational objectives of the lesson.*	**Lesson Objective:** Students will be able to construct a visual representation (drawing or diagram) explaining the movement of water between the atmosphere and hydrosphere, and use this to predict short-term weather changes in their local area. **Standards Addressed:** NGSS 3-ESS2-1: Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. VA:Cr1.2.3a: Apply knowledge of available resources, tools, and technologies to investigate personal ideas through the art-making process. MP.2: Reason abstractly and quantitatively. **Materials & Resources:** • NASA's Climate Kids website: https://climatekids.nasa.gov/ • NASA's Earth System Data Explorer (ESDE): https://mynasadata.larc.nasa.gov/ • Drawing paper and art supplies (colored pencils, markers) • Student science journals • Presentation rubric • Self-assessment checklist **Procedure:** 1. Students finalize their visual representations of the water cycle created during the Elaborate phase. 2. Have students use the ESDE tool to gather current weather data for their local area. 3. Ask students to annotate their water cycle diagrams with predictions about short-term weather changes based on their

understanding and the current data.

4. Students present their annotated diagrams to the class in video or live form, explaining:
    - The water cycle processes they've depicted
    - How these processes relate to current local weather conditions
    - Their predictions for short-term weather changes and the reasoning behind them
5. As students present, the teacher facilitates a Q&A session, encouraging peers to ask questions and provide constructive feedback.
6. After presentations, students complete a self-assessment checklist reflecting on their understanding and the process of creating their visual representation.

Formative/Summative Assessments:

1. Presentation Rubric (used by teacher during presentations, photo provided below table):
2. Self-Assessment Checklist (completed by students after presentations using the standards based progression photo below):
    - I can accurately describe the movement of water between the atmosphere and hydrosphere
    - I can explain how the water cycle influences weather patterns
    - I can use weather data to make reasonable short-term predictions
    - I can present my ideas clearly using a visual representation
3. Teacher observation and notes during presentations and Q&A sessions.

Modifications:

- For students with presentation anxiety: Allow them to record their explanation as a video or audio file instead of presenting live.
- For ELL students: Provide a word bank of key terms and allow use of visual aids during presentations.
- For advanced learners: Challenge them to include more complex weather phenomena in their predictions or to extend their predictions over a longer time frame.

For my rubric, I input my Standards Based Learning Progression and lesson objectives into Magic School AI to help create my rubric. My school district provides this resource for all educators. Please let me know if it is an issue using AI generated rubrics going forward, and I will refrain doing so. I have cited this source below.
I have also used my school districts Elementary Education Standards based learning progression. This is a poster we all have up in our classrooms, and students frequently use this to self evaluate.

STANDARDS BASED LEARNING PROGRESSION

Still Developing Essential Skills	Nearing Mastery of Essential Skills	Mastery of Essential Skills	Exceeding Expectations
			
SD	**NM**	**ME**	**EE**
I work with my teacher to accomplish the learning goal.	I sometimes need to go to my teacher to understand the learning goal.	I can complete the learning goal independently.	I can teach the learning goal to my classmates.

Criteria	Still Developing	Nearing Mastery	Mastery of Essential Skills	Exceeding Expectations
Understanding of Water Cycle	I can name some parts of the water cycle but don't explain how they work together.	I can describe the water cycle and how some parts relate to weather.	I can explain the water cycle and how it affects weather patterns.	I can explain the water cycle in detail and make connections to weather events.
Data Representation	I try to show data, but it is unclear or confusing.	I show some data, but it could be clearer or more detailed.	I represent data clearly and accurately in my visuals.	My visuals are detailed, creative, and enhance understanding of the data.
Weather Prediction	I guess about the weather without using data.	I make simple predictions based on some information.	I use data to make reasonable predictions about the weather.	My predictions are detailed, well-reasoned, and supported by clear data analysis.
Artistic Expression	My artwork is basic and does not connect to the science concepts.	My artwork shows some effort but lacks detail or connection to science.	My artwork clearly represents scientific ideas and shows effort.	My artwork is creative, detailed, and enhances understanding of scientific concepts.
Communication of Ideas	I struggle to explain my ideas clearly to others.	I explain my ideas but may leave out important details.	I communicate my ideas clearly and connect them well to the topic.	I communicate my ideas confidently and make insightful connections that deepen understanding.

REFERENCES

Magic School AI. (n.d.). Rubric Generator. https://www.magicschool.ai/tools/rubric-generator
NASA Earth Observatory. (n.d.). Cloud streets over the Black Sea. https://earthobservatory.nasa.gov/images/148742/cloud-streets-over-the-black-sea
NASA. (n.d.). Climate Kids. https://climatekids.nasa.gov/
NASA. (n.d.). Earth System Data Explorer. https://mynasadata.larc.nasa.gov/
NASA. (n.d.). Earth System Science. https://climate.nasa.gov/earth-system/

NASA. (n.d.). My NASA Data. https://mynasadata.larc.nasa.gov/
NASA. (n.d.). Remote sensing. https://earthobservatory.nasa.gov/features/RemoteSensing
NASA. (n.d.). S'COOL project. https://scool.larc.nasa.gov/
NASA. (n.d.). STEM engagement. https://www.nasa.gov/stem/
NASA Science. (n.d.). Earth science missions. https://science.nasa.gov/earth-science/missions/
National Art Education Association. (n.d.). National visual arts standards. https://www.arteducators.org/learn-tools/national-visual-arts-standards
Next Generation Science Standards. (n.d.). 3-ESS2-1 Earth's systems. https://www.nextgenscience.org/