Fluid Streams Affecting Weather

An original lesson by Melissa Arroyo, Kyle Clark, P.J. Maccio, Carey Potter-Whiting, Stephanie Robinson, Diana Sayers

Focus on Inquiry

The student will complete a series of stations in order to explain how jet streams and ocean currents influence local weather.

Lesson Content Overview

Students will rotate through six stations in order to gain background knowledge about jet streams and ocean currents. The students will also answer questions at each station to elaborate their understanding of jet streams and ocean currents and how they affect local weather. After the stations are completed, the teacher will lead a whole group discussion to connect the student's learning to the big ideas of the lesson.

Duration	Setting	Grouping	PTI Inquiry Subskills
5 days	Classroom	2-4 students	1.3, 2.1, 3.1, 3.3, 3.6, 3.7, 4.2, 4.3, 5.1, 5.2, 5.3, 5.4, 5.5, 5.7, 5.8, 5.9, 6.1, 6.2, 7.1, 7.2

Lesson Components	Estimated Time		Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage	5-10 min	Day 1	1.3, 2.1, 3.1, 3.6, 4.3, 5.2, 5.3, 5.4, 6.1, 6.2, 7.1, 7.2	Fan/hair dryer	3	Students will watch a volunteer and the teacher demonstrate how the airflow of a concentrated air source affects the velocity of a paper/balsa airplane.
Explore/Explain	90 min	Day 1-3	3.3, 3.6, 3.7, 4.2, 5.2, 5.3, 5.4, 5.9	Computer, i-Pad, Laptop	3	Students will describe how global patterns such as jet stream and ocean currents influence local weather through investigations at 7 stations.
Expand/Elaborate	15 min.	Day 3	5.2, 5.3	None	3	Students will broaden their knowledge through a whole group discussion applying their learning from the stations.
Evaluate	20 min.	Day 3	7.1, 7.2	None	2	Students will apply their knowledge from their learning journey to a formal evaluation.

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

Next Generation Science Standards – Inquiry

NGSS Practice 1: Identify Inquiry Questions
NGSS Practice 2: Design Scientific Investigations
NGSS Practice 3: Planning and Carrying Out Investigations
NGSS Practice 4: Analyzing and Interpreting Data
NGSS Practice 5: Explain Results and Draw Conclusions
NGSS Practice 6: Constructing explanations
NGSS Practice 7: Communicate Scientific Procedures and Explanations

Florida Science Standards – Nature of Science

SC.6.N.1.1 Define a problem from the sixth grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as

systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

Florida Science Standards – Earth Science

SC.6.E.7.3 Describe how global patterns such as the jet stream and ocean currents influence local weather in measurable terms such as temperature, air pressure, wind direction and speed, and humidity and precipitation.

Materials and Advance Preparation

Materials List

Class set:

- Blackline Master 1: Student WS
- Blackline Master 2: Student Assessment

Student materials:

- Pen or pencil
- Red and blue colored pencils or crayons
- 2 Globes
- Scotch tape
- Blue string/yarn
- Arrows (from blackline master)
- Colored arrows in blue and red (arrows from blackline master)
- Paper airplane or cardboard plane
- Hair dryer/small electric fan

Blackline Masters

1. **Blackline Master 1 Student WS for Stations**
2. **Blackline Master 2 Student Assessment**

Advance Preparation

1. Prepare the stations #1-6

Lesson Information

Learning Objectives

1. The student will be able to collect data, analyze data, collaborate and discuss their findings, compare their findings to one another, make a claim, provide evidence and justification to support their claim, and apply their findings to unknowns.
2. The student will be able to describe how global patterns such as the jet stream and ocean currents influence local weather.

Prior Knowledge Needed by the Students

- Items may require the student to apply knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge from SC3.E.6.1 (Demonstrate that radiant energy from the Sun can heat objects and when the Sun is not present, heat may be lost)
- Students should understand the concepts of temperature, air pressure, humidity, and convection in fluids.

Background Information

- Jet streams are fast flowing, narrow, meandering air currents found in the upper atmosphere or troposphere of some planets, including Earth. The main focus of this lesson is on the Polar jet stream. Which travels in a circular patter around the North Pole. An ocean current is any continuously directed movement of ocean water that flows in one of the Earth's oceans. The currents are generated from the forces acting upon the water like the earth's rotation, the wind and convection. The main focus of this lesson is the Gulf Stream. This originates near the

equator in the Gulf of Mexico and travels North up the East Coast of the United States and across the Atlantic Ocean, which we then call it the North Atlantic.

Lesson Procedure

Engage

1. Students will watch a student volunteer and the teacher demonstrate how the airflow of a concentrated air source affects the velocity of a paper/balsa airplane.
    a. Student volunteer holds a concentrated air source (hair dryer or a small hand-held fan turned on high) facing the teacher.
    b. Have the students hypothesize how far the plane will travel when thrown in the direction of the fan. Average the answers. **Possible student answer is: 2 meters.**
    c. The teacher will throw the plan towards the fan.
    d. Record the distance to the nearest cm.
    e. Ask the students to hypothesize how far the plane will travel when thrown in the direction away from the fan. Average the answers. **Possible student answer is: Less than a meter.**
    f. Record the distance to the nearest cm.
    g. **If time permits**- the teacher **may** wish to repeat the experiment three times to emphasize how repetition increases validity.
2. Students will discuss with their face partner the differences between the two flights.
    a. What was the original hypothesis (average) for the flight towards the fan? **Possible student answer is: 2 meters; check the average from the board**
    b. What was the original hypothesis (average) for the flight away from the fan? **Possible student answer is: Less than a meter; check the average from the board**
    c. Was there a difference in the answers? **Possible student answer is: 2 meters – 1 meter (subtract the smaller number form the larger number).**
    d. Which flight actually went further – the one towards the fan or the one away from the fan? **Possible student answer is: The flight in the direction away from the fan should be the one that went the furthest distance.**
    e. What do you think was the reason for the difference? **Possible student answer is: The concentrated air (tailwind) helped to push the plane further. A misconception might be the force of thrust, or other extraneous variable is the cause.**
    f. What do you think the concentrated air source represents? **The (upper air; polar) jet stream.**

Explore/Explain

1. Students will describe how global patterns such as jet stream and ocean currents influence local weather through investigations at 7 stations.
    a. Station 1: Jet Stream Picture
        i. Based on the given diagram, students will make observations and answer the following questions on their recording sheet:
            1. What do you think you are looking at in this picture? **Possible student response is: A map with numbers, arrows, and a darker shaded area, or jet stream.**
            2. What do you think the numbers represent? **Wind speed in knots.**
            3. What do you think the arrows represent? **Wind direction moving from west to east.**
            4. What do you think the shaded area on the map represents? **Jet stream.**
            5. What do you think would happen if an airplane flew through the shaded area? **Possible student response is: The plan will move faster when moving in the direction of the arrows (east) and slower when going against the arrows (west).**

    b. Station 2: Jet Stream Around the Globe

i. Students will take the blue string (one on each side) and move hands up and down to see how it reacts. Students should recognize that the jet stream works in this manner, with constant bumps and dips.
ii. Wrap the blue string around the globe so that the string goes directly through the United States. Create one wave that goes through the United States. Create four more waves all around the globe and connect the two ends of the string with tape.
iii. Take the four arrows at the station and place them on the polar jet stream in the direction it is flowing.
iv. Then the students will answer the following questions on their recording sheet:
    1. What do the arrows represent? **The arrows represent the direction the polar jet stream is moving.**
    2. Which direction do the arrows flow? **Students may say left to right. Remind them it is west to east.**
    3. How are the temperatures above the jet stream different from below the jet stream? **The jet stream would have cooler temperatures above and warmer temperatures below.**
    4. Predict what would happen if the jet stream reversed directions? **Different parts of the world would experience a changing in their local weather.**

c. Station 3: Jet Stream Comparison
    i. The students will be looking at four screen shots/images from "The Weather Channel" website. The four screen shots/images come from three different days of the week.
    ii. Then the students will answer the following questions on their recording sheet:
        1. Look at all four images. What is similar in each of these pictures? **Lines, states, colors.**
        2. Look at all four images. What is different in each of these pictures? **Where the lines are dipping or located.**
        3. Which direction are the arrows pointing in all of the images? **From west to east.**
        4. Areas of low pressure are usually warm and humid weather areas. What color represents the lowest pressure conditions? **Purplish pink.**
        5. High pressure is followed by cool, dryer weather. What color represents the highest pressure on the map? **Green on map, red/burgundy on the key.**
        6. Looking at Map C, which area of the country would be having the highest pressure? **Southwest and Northeast.**
        7. The lines that travel through both Montana and Michigan, where do they originate from? **Northwest.**
        8. Where do the lines that travel along California and Florida originate from? **Southwest.**
        9. Look at the map of the world, what can you infer about the lines? **Possible student response is: they go across the entire planet.**
        10. If the lines are representing the wind in a fast moving stream, which day would be best to fly from Montana to Florida? Why? **Sunday because the wind is heading southeast.**

d. Station 4: Ocean Currents Videos
    i. Using computers, laptops, i-Pads, etc., the students will watch the videos located on the NASA Aquarius Satellite website: http://svs.gsfc.nasa.gov/cgi-bin/details.cgi?aid=3829
    ii. Students will need to read each of the captions underneath the videos before watching them; the captions give important information about each video.

iii. After watching each of the 6 videos, the students will answer the following questions on their recording sheet:
   1. What relationships did you notice between the ocean current movement and the wind movements? (video 1) **Possible student response is: They move in similar directions. Ocean currents move from warm water areas (near equator), to the west and north to cooler water areas (near the North Pole). Winds move from west to east and south to north from warmer areas to cooler areas.**
   2. How can you distinguish between the warm ocean water and the cold ocean water? (video 2) **Possible student response is: The orange and yellow are warmer waters and the white is cooler waters.**
   3. Can you recognize any patterns that occur in global winds? (video 4) **Possible student response is: The global winds move in similar patterns of the jet stream.**
   4. How would the movement of ocean currents affect weather on land? (video 1, 2, 5, and 6) **Possible student response is: As ocean currents move warmer water from the equator up to cooler areas it will cause the surrounding areas to warm as well.**
   5. What do you hypothesize would happen if ocean currents reversed direction? **Possible student response is: If ocean currents reversed direction, then global and local weather will dramatically change. Warm would become cold and cold would become warm.**

e. Station 5: Ocean Currents Map
   i. Referring to the student textbook (Pearson SuccessNet Florida Earth and Space Science Interactive Science pg. 547), students will color the warm currents that come from the equatorial region RED and the cold water currents from the polar regions BLUE.
   ii. Based on the colored map, the students will answer the following questions on their recording sheet:
      1. What direction do the RED currents flow in the northern hemisphere (Where the USA is located)? **West to east.**
      2. What direction do the RED currents flow in the southern hemisphere? **East to west.**
      3. What effect do the RED currents have on the adjacent lands? **Warming.**
      4. What effect do the BLUE currents have on adjacent lands? **Cooling.**
      5. What effects would the ocean currents (both RED and BLUE) have on the ocean water and the air above the water? **Red will warm the surrounding water and the air. Blue will cool the surrounding water and air.**

f. Station 6: Ocean Streams Around the Globe
   i. Students are to locate the Atlantic Ocean on the globe.
   ii. Using the ocean current map from the previous station (#5), they are to tape the arrows in the correct order onto the globe starting at the equator.
   iii. Then the students will answer the following questions on their recording sheet:
      1. What do the red arrows represent? **Warm ocean currents.**
      2. What do the blue arrows represent? **Cool ocean currents.**
      3. How would the land next to the red arrows be affected by this current? **It would bring warmer temperatures.**
      4. How would the land next to the blue arrows be affected by this current? **It would bring cooler temperatures.**
      5. What heat movement drives these currents around the Atlantic Ocean? **Convection currents.**

Expand

- Students will broaden their knowledge through a whole group discussion applying their learning from the stations. Students will answer the following questions:
  - What did you notice was different above and below the jet stream? **Air pressure and temperature.**
  - What effect would that have on the air? **Move the air, wind.**
  - What would cause the winds to move faster? **Greater pressure difference above and below the jet stream.**
  - What temperature does a jet stream bring? **The temperature from the area it is coming from.**
  - A polar jet stream would bring what kind of temperature? **Colder.**
  - Infer what would happen in the area where the pressure differences meet. **Change in temperature, precipitation.**
  - If ocean currents are behaving like a giant conveyer belt transporting water, what would the water from the equator bring up North? **Warm, moist air.**
  - What effect would that have on the temperature and precipitation? **Higher temperature, more precipitation.**
  - A cold water current was off the coast, how would that effect the summer weather? **Keep it moderate and not too hot.**
  - Identify a current that would affect Florida temperature. **Gulf stream** What is the effect? **Bringing warm weather and moisture.**

Evaluate

FORMAL EVALUTION

1. Assessment

INFORMAL or OPTIONAL EVALUTIONS

1. Student questioning (see Explore Section)
2. Student/group handout

Supplementary Resources

Teachers

Interactive Science Florida Textbook

Students

Interactive Science Florida Textbook

CITATION OF SOURCES.

__✓__ Yes, I cited all materials and resources used in this lesson. *Melissa Arroyo, Kyle Clark, P.J. Maccio, Carey Potter-Whiting, Stephanie Robinson, Diana Sayers,*

Lesson author's signatures

Blackline Master 1

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Blackline Master 2

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