NORTH CAROLINA CLIMATE OFFICE

5th Grade Lesson 3

NC State Science Standards:

- 5.E.1.1 Compare daily and seasonal changes in weather conditions (including wind speed and direction, precipitation, and temperature) and patterns.
- 5.E.1.3 Explain how global patterns such as the jet stream and water currents influence local weather in measurable terms such as temperature, wind direction and speed, and precipitation

Essential Questions:

- What influence does the jet stream have on seasonal patterns of weather?

Brief Lesson Description:
Students will use what they have learned from the prior lesions to investigate the jet stream. Students will be given the problem of time differences in air travel across the US to learn about high altitude air currents. They will then apply this knowledge to the effects of the jet stream on North Carolina weather.

Performance Expectation(s) and Specific Learning Outcomes:

- Students will be able apply prior knowledge from previous lessons to explain air currents in higher altitudes.
- Students will be able to describe the jet stream, what causes it, and how it affects weather.
- Students will be able to infer how the jet stream affects weather in North Carolina.

Prior Student Knowledge:

- Air is made up of molecules. It contains matter therefore it has mass and takes up space.
- Earth is unevenly heated by the absorption of energy from the sun.
- Understand the water cycle and its function in the atmosphere.

Possible Preconceptions/Misconceptions:

- Heated air weighs more than cold air.
- Hot air weighs less than cold air.
- The atmosphere is made up solely of air.
- Clouds block wind and slow it down.
- Cold temperatures produce fast winds.

Materials:
Print outs from the Supplemental Materials
Large Aquarium for whole class or glass cake pans for individual groups
Aluminum Foil
Food Coloring
Candle
Ice

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LESSON PLAN – 5-E Model

ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:	**Time: 20 Minutes**

How does heat transfer affect the development of weather on a global scale? How do these global phenomena affect weather on a local scale?

1. Explain to students that you heard an interesting theory. Supposedly, if you are traveling in an airplane from the east coast to the west coast it will take longer than if you were traveling from the west coast to the east coast. *It might be helpful to refer to a map here so students have an idea of the distance. Flight time from San Francisco, CA to Washington, DC is 4 hours 59 minutes. Flight time from Washington, DC to San Francisco, CA is 5 hours 37 minutes*
2. Ask students if they have heard of this phenomenon. Have students brainstorm why this might happen if the destinations are the same.
    a. Have them list out all the potential variables that could occur: the plane is going faster one way than the other, the flight route is slightly different, there is a layover on the longer trip, the fuel used is different, the planes are different and so have different aerodynamics, etc. *It might be helpful here to discuss the scientific process with students. What are variables, when testing why do we only change one, etc*
    b. Explain to students that all of their ideas sound great, but believe it not, they are all consistent. In other words, none of them have much of an effect on the travel time.
    c. Tell students to think about what they have learned already about convection currents and air masses. Explain that they will now investigate if air masses and convection may have something to do with the flight time differences.

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:	**Time: 90 Minutes**

1. Have students use Turn and Talk to discuss what they learned about air masses and air movement from the previous lessons. Encourage students to use the vocabulary from the last lesson.
2. Facilitate the *Airplane Travel Investigation*. *We recommend doing this in an aquarium to allow for more dramatic results. However, this can be done in glass or plastic containers on a smaller scale in individual groups.*
    a. Discuss results with students. Ask students to use what they learned in the prior lessons to develop a claim about what is happening with the air planes as they travel east and west across the US.
    b. Have students create a CER to support their theory of why travel time is different depending on direction of travel.
3. Ask students if there might be some limitations to their model.
    a. Have students point out things that might be different in real life such as air instead of water, limited to the aquarium, airplanes don't have propellant, etc.
    b. Explain to students that the current formed by convection in the atmosphere has a name and it's called the jet stream! Show the jet stream image. Explain that the jet stream is not formed by a simple convection current formed from west to east like the aquarium model displayed, but instead is a much more complicated system that involves cold air from the poles and warm air from the equator.

c. Transition students to explaining the jets stream system now that they have solved the airplane travel problem.

EXPLAIN: Concepts Explained and Vocabulary Defined:	**Time: 90 Minutes**

1. Have students read and watch the video at NOAA's SciJinks: https://scijinks.gov/jet-stream/ to expand on their knowledge about the jet stream. *We would suggest using a reading strategy such as a symbol read to help students engage with the article.*
2. Have students complete the jet stream graphic organizer using what they learned from the SciJinks site.
3. Use the 3-2-1 Protocol from the previous lesson to have students make 3 connections to what they learned previously, 2 new things they learned, and 1 question they still have.

Vocabulary: jet stream, convection currents, equator, poles

ELABORATE: Applications and Extensions:	**Time: 90 Minutes + Time for comparing 5 day predictions**

How does the jet stream affect weather (moves with it or can be stationary if nowhere near it)?

1. Ask students if they think the jet stream could affect local weather.
   a. Have students use Turn and Talk to discuss.
   b. Show students the following video: https://unctv.pbslearningmedia.org/resource/ess05.sci.ess.earthsys.flood/the-great-flood-of-1993/
   c. iscuss the video with students. Ask if it is possible this could happen over North Carolina. What would the circumstances have to be?
   d. Have students draw a predictive jet stream current if a similar weather event happened over North Carolina.
2. Divide students into pairs. Have students use the two jet stream models to predict how the jet stream will affect weather in their area over the next 5 days: http://www.stormsurfing.com/cgi/display_alt.cgi?a=nam_250, https://www.netweather.tv/charts-and-data/global-jetstream#2021/02/22/0000Z/jetstream/surface/level/overlay=jetstream/orthographic=-101.96,42.60,767 *It might be appropriate to display these two tools on the overhead to show students how to use each of them before they begin utilizing the tools on their own.*
3. When finished, discuss student results. It is important to emphasize that their predictions may not be completely accurate, and there are many factors that play into weather development.
4. Each day over the next 5 days, take a few minutes to see if students' predictions were correct. Discuss why or why not and what other factors could be playing a role in the weather. *There arenumerous factors that could be affecting the current weather, but also the jet stream, including the time of year. It is important to discuss some of these factors here.*

If the jet stream does not seem to be affecting the weather during the time the lesson is conducted, archives of the GOES satellite and Storm Surfing are included and can be utilized instead of current data.

EVALUATE:	**Time: Throughout Lesson**

Formative Monitoring (Questioning / Discussion):

Formative assessment can be conducted throughout the lesson.

Summative Assessment (Quiz / Project / Report):

Summative assessment can be conducted during the investigation, elaborate, and the extension activity.

Elaborate Further / Reflect: Enrichment:	**Time: 90 Minutes**

Studying the high altitude winds with rockets:

1. Show students the article/video: https://svs.gsfc.nasa.gov/10922
2. Discuss the video with students. Ask what kinds of information can we get from the rockets? How might we utilize the high altitude winds?
3. Give students an opportunity to build their own Anomalous Transport Rocket Experiment (ATREX) using the following straw rocket template: https://www.jpl.nasa.gov/edu/learn/project/make-a-straw-rocket/
4. Facilitate building the rocket first so students understand the protocol. Then allow students to experiment with different variables such as different types of adhesives, different types of paper, fin shape and number, etc.
5. Challenge the students to design their rocket to be able to carry a payload (using a penny or other very light weight object).
6. Allow students to “launch” their rockets together and then reflect on what worked and what didn’t work. Ask students how they might make their rockets even better.
7. Allow students to follow the Anomalous Transport Rocket Experiment (ATREX) launch updates at: https://www.nasa.gov/mission_pages/sunearth/missions/atrex.html