NORTH CAROLINA CLIMATE OFFICE

5th Grade Lesson 2

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:

- How does heat transfer affect the development of weather on a local scale?
- What major variables affect daily weather?
- How is data used to effectively predict weather patterns?
- How can you use data collected from various locations to indicate frontal positions?

Brief Lesson Description:
This lesson will incorporate the heat transfer concepts learned in Lesson 1 to investigate the formation of air masses and formation of weather. Students will utilize the concept of sea breezes to learn about convection currents in the air. They will then apply this concept to air mass and weather formation. Students will collect and analyze their own weather data to predict types of air masses moving through their region of North Carolina.

Performance Expectation(s) and Specific Learning Outcomes:

- Students will be able to describe how convection currents in the atmosphere influence movement of air to create wind.
- Students will be able to describe how convection currents in the atmosphere cause the development of air masses.
- Students will be able to explain how weather forms from the interaction of air masses over a given area.

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.
- Molecules do not have mass because they are too small.
- Air does not have mass or exert pressure.

Materials:

Print outs from the Supplemental Materials
2 Liter Bottles (2 per group)
Clear plastic tubing ~8 inches in length (1 per group)
Smoke sticks (1 per group, can be purchased on Amazon as unscented incense sticks)
Containers to hold water (2 per group)
50 ft. Solar Balloon (can be purchased on Amazon)
Empty soda cans (1 per group)
2 Heavier cups such as coffee mugs (2 per group)

LESSON PLAN – 5-E Model

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

1. Tell students you were at the beach over the summer and you noticed it's always windy at the beach. You've even noticed that people kitesurfing pretty much everyday because there is so much wind! You were wondering why and you hoped they could help you figure it out!.
2. Show 30ish seconds of kitesurfing video: https://www.youtube.com/watch?v=D7tuJ5Ovko0
3. Ask students to brainstorm how reasons for windy beach conditions using the knowledge they gained from the heat transfer lab in the previous lesson. Have students place their ideas on an anchor chart and keep this to reference later. *Encourage students to think about the variables that are affecting the atmosphere as they brainstorm.*
4. Explain to students they are going to explore how weather forms by modeling the formation of an air mass.

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:	**Time: 180 Minutes**

1. Students investigate air mass development and movement with *Air Mass Lab. Each investigation should be done with their lab partner, but facilitated by the teacher. It is recommended that the following investigations be done outside on a sunny day. Investigation 1 uses smoke sticks, which could cause ventilation issues. Investigation 2 will need solar radiation to heat up and float.*

    a. **Investigation 1: Air Mass Movement**
        i. Use turn and talk to have students discuss some of the things they already know about air. Discuss as a whole class.
        ii. Facilitate the Air Mass Movement Investigation with students. *Note: It might be helpful to construct the convection chimneys ahead of time (see teacher tips page in supplemental materials). This can also be done as a demo depending on comfort level.*
        iii. When finished, discuss the findings with students. *Emphasize air masses take on the qualities of the area they form over.*

    b. **Investigation 2: Solar Balloon**

i. Facilitate the Solar Balloon Investigation with students. *You might choose a few student volunteers to help you fill the balloon with air.*
ii. As students work through the investigation, have them think about what might happen to air if it wasn't enclosed within the tube. *It is important here to emphasize the absorption of radiant energy from the sun. Students can reflect back on what they learned in the heat transfer lesson. It would also be important to discuss the water cycle and cloud formation during this demonstration.*
iii. Students infer/draw diagrams of what happens to air when it moves over warm/cold land or warm/cold water
iv. When finished, discuss findings with students.

c. Investigation 3: Air Pressure

i. Remind students that you talked about air pressure briefly in the last lesson in Characteristics of Air Investigation, but now you are going to look at it more closely and how it may affect air mass movement.
ii. Use Turn and Talk to have students discuss what they remember about the characteristics of air and air pressure.
iii. Facilitate the Air Pressure Investigation
iv. When finished, discuss the findings with students. *Be sure to emphasize air movement here is how wind is formed! It is important to discuss that temperature, water vapor, and altitude play a role in air pressure, but with the exception of temperature, it is not important to go into details at this level.*

d. Cause and Effect Wrap Up

i. Facilitate the Cause and Effect Wrap Up with students. Encourage students to think about their investigations and as they predict the effects.
ii. When students are finished, share out and discuss cause and effects. See if students can add to their cause and effect list.

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

1. Have students read and watch the video at NOAA's SciJinks: https://scijinks.gov/wind/. *We would suggest using a reading strategy such as a symbol read to help students engage with the article.*
2. Work through the Air Movement Foldable with students.
3. Come back to the windy beach scenario. Revisit the anchor chart with their ideas.
    a. Have students create a CER to explain the formation of wind at the beach using evidence from their investigations. *If you have never used CER with your students, here is a link to a great article on how to incorporate and use it with your students: https://www.edutopia.org/blog/science-inquiry-claim-evidence-reasoning-eric-brunsell*
    b. Students should draw a diagram of the movement of the air based on the day time and night time temperatures. Students will need to pull from their investigations from both lessons. *Use red arrows for warm moving air and blue arrows for cold moving air.*
        i. Have students share their ideas.

c. Show the video: https://www.youtube.com/watch?v=H98GGu5h7II
   i. Have students revisit their diagrams. Do they need to revise them?
   ii. Have students draw a second diagram for night time wind at the beach.
   iii. Ask students could there ever be a time without wind at the beach? What would have to occur for that to happen? Discuss student ideas.

Vocabulary: air mass, water vapor, temperature, pressure, concentration gradient

ELABORATE: Applications and Extensions:	**Time: 180 Minutes + time for data collection**

1. Explain to students that they will now apply what they have learned about air movement and masses to make some predictions about the weather in North Carolina.
2. Show weather video: https://gpm.nasa.gov/education/videos/nasa-our-world-what-weather.
   a. Use a modified 3-2-1 strategy after the video is over. Have students write down 3 connections to what they learned previously, 2 new things they learned, and 1 question they still have.
3. Project the current weather map for that day on an overhead using the following site: https://www.wpc.ncep.noaa.gov/dailywxmap/
   a. Have students go to the NOAA's SciJinks page *How to Read a Weather Map*: https://scijinks.gov/weather-map/ and read the information.
   b. Have students compare the current daily map with what they read about weather maps. Have them discuss with a partner what they see. Can they pick out symbols or lines that they recognize? *Make sure students can pick out North Carolina, H and L symbols, and frontal symbols.*
   c. Ask students what the weather is like today based on their observations out the window. Does this type of weather match up with what they would expect to see based on the symbols on the map? Show the previous day and discuss the same questions.
4. Explain to students that they are now going to monitor the weather for a week. They will make observations and predict the types of air masses and fronts that might be occurring. They will compare their predictions with actual maps. *It may be important to have a basic discussion of weather measurement tools such as thermometers, barometers, etc. before having students collect data. It is also important that students know they should collect their data at the same time everyday.*
   a. Once students have collected their weather data and made their predictions. Have students use the website to compare their results: https://www.wpc.ncep.noaa.gov/dailywxmap/
   b. Discuss with the class about the accuracy of their results. *It's important to explain to students that it is okay if their predictions are not correct. This would be a good time to discuss that predicting the weather is difficult.*
      i. Show a video on being a meteorologist or bring a weather/climate scientist into the classroom from the NC State Climate Office. Contact the State Climate Office to schedule a visit at: outreach@climate.ncsu.edu
      ii. Ask students what other things would have been helpful to know as they were collecting their data. Have students add these to the anchor chart they used at the beginning of the lesson.

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 investigations, the weather observations activity, and the weather channel video.

Elaborate Further / Reflect: Enrichment:	**Time: Variable**

Now that students have learned about air movement, air masses, and the development of weather, challenge them to make a weather channel forecast utilizing their weather maps and observations. Encourage students to utilize the vocabulary they have learned.

Great video making tools for students: https://info.flipgrid.com/ or https://web.seesaw.me/.

Resources for how forecasters utilize data to create forecasts: https://www.youtube.com/watch?v=DviDqe-qjPE and https://www.noaa.gov/stories/6-tools-our-meteorologists-use-to-forecast-weather