



Earth Science Lesson

NC State Science Standards:

- EEn.2.5.4 Predict the weather using available weather maps and data (including surface, upper atmospheric winds, and satellite imagery).
 - Observe, analyze and predict weather using technological resources.
 - Interpret and analyze weather maps and relative humidity charts.
 - Explain the importance of water vapor and its influence on the weather (clouds, relative humidity, dew point, precipitation).

Essential Questions:

- How do we measure air pressure, gases, and temperature changes in the atmosphere?
- Explain relative humidity and dew point and how they help predict the weather?
- What factors influence relative humidity and dewpoint?
- How does water vapor influence weather (clouds, relative humidity, dew point, precipitation)?
- What are weather maps and how are they used?
- What is a weather station and how do we read one?
- How do these measurements help meteorologists make predictions about the weather?
- How does weather data contribute to overall climate normals for a region?

Brief Lesson Description:

Utilizing an exchange student scenario, students will explore the science of predicting and forecasting weather using a variety of weather data collection tools. Students will be able to compile their data to compare and contrast weather and climate differences across the state of North Carolina.

Performance Expectation(s) and Specific Learning Outcomes:

- Students will be able to utilize a variety of weather measurement tools to collect data on local characteristics of weather.
- Students will be able to utilize their data, along with current state weather and climate data to identify trends across the different microclimates of North Carolina.
- Students will be able to apply what they learned from analyzing state data to weather and climates across the globe.

Prior Student Knowledge:

- Composition and structure of the atmosphere.
- Familiarity with characteristics of weather such as temperature, precipitation, air pressure, and wind.
- Basics of weather formation such as air mass development and movement, frontal systems, and types of weather formed by the interaction of air masses.

Possible Preconceptions/Misconceptions:

- The weather is easy to predict.
- Weather and weather forecasting is consistent and an exact science.
- Weather across North Carolina does not vary much.

Materials:

- Thermometers
- Anemometers
- Fans (small desk will work)
- Jars
- Straws
- Balloons
- Tape
- Index cards
- Heat lamps
- Rulers
- Rubberbands
- Sling Psychrometers
- 200 mL Beakers
- Ice
- Plastic pipettes
- Computers

LESSON PLAN - 5-E Model	
ENGAGE: Opening Activity - Access Prior Learning / Stimulate Interest / Generate Questions:	Time: 15 Minutes
<p><i>How do meteorologists measure, predict, and forecast the weather for a given area? How are these measurements used to establish climate normals for a given area?</i></p> <ol style="list-style-type: none"> 1. Explain to students that you are thinking about hosting a foreign exchange student from another country (choose a country that has a very different climate from NC). You are worried they will not know how to pack for an entire year in North Carolina because their climate is very different from here. Tell students you want to give the exchange student a detailed description of our climate, including evidence of daily weather data, and you need their help to make it happen! 2. Ask students what they might need to know in order to create a very detailed weather/climate overview for the visiting student. Record these ideas on an anchor chart. 3. Explain to students that they are going to explore some of the tools we use to measure the weather in order to get a better idea of how meteorologists measure the weather and determine climate norms for a given area. 	
EXPLORE: Lesson Description - Materials Needed / Probing or Clarifying Questions:	Time: 270 Minutes
<ol style="list-style-type: none"> 1. Explain the <i>Weather Tools Station Lab</i> to students. Facilitate the lab as students work through each station in groups of 2-3. <ol style="list-style-type: none"> a. Station 1: Measuring Temperature with a Thermometer b. Station 2: Measuring Precipitation with a Rain Gauge c. Station 3: Measuring Wind Speed with an Anemometer d. Station 4: Measuring Air pressure with a Barometer e. Station 5: Measuring Dew Point with a Thermometer 	

- f. Station 6: Measuring Relative Humidity with a Sling Psychrometer
 - g. Station 7: Understanding Weather Tech Tools: Radar and Satellite Systems:
<http://cimss.ssec.wisc.edu/satmet/>
 - h. Station 8: Using Weather Maps and Weather Station Models
2. When students have completed the lab, have students summarize their findings and share what they learned with other groups.
 3. Ask students how all of these might be used together to make weather forecasts. Collect student ideas on how weather forecasts are made utilizing the weather tools on an anchor chart.

EXPLAIN: Concepts Explained and Vocabulary Defined:

Time: 90 Minutes

1. Facilitate working through the *Weather Tools Foldable* in order to anchor the content students learned in the station lab.
2. Ask students to think about the differences between weather and climate.
 - a. Have students complete the *Weather and Climate Venn Diagram* in pairs.
 - b. Share out their ideas so that they get a complete diagram with similarities and differences.
3. Ask students to discuss ideas on how daily weather data helps contribute to climate normals. Record these ideas on the anchor chart from the beginning of the lesson.
 - a. Break students up into groups of three. Pass out the “climate normals” articles. Each student in the group should have a different article.
 - i. Article 1: *Defining Climate Normals in New Ways*:
<https://www.ncdc.noaa.gov/news/defining-climate-normals-new-ways>
 - ii. Article 2: *There’s a New Definition for Normal Weather*:
<https://www.nytimes.com/interactive/2021/05/12/climate/climate-change-weather-normal.html>
 - iii. Article 3: *NOAA’s ‘New Normals’ Climate Data Raises Questions About What’s Normal*:
<https://insideclimatenews.org/news/15052021/noaa-new-normal-climate-change-data/>
 - b. Have students read their article independently and fill out the *Say, Mean, Matter* chart.
 - c. When students are finished, have them seek out their “like” article. Have students discuss their *Say, Mean, Matter* charts in their “like” groups. Have students write down any additional information they heard on their chart.
 - d. Have students return to their original “different” groups. Give each student time to give a summary of their article. As students are giving summaries, have them listen for similarities and differences in the articles.
 - e. Discuss similarities and differences across articles in a whole group. Ask students why climate normals are important and why they might be changing because of climate change.
4. Explain to students that they will now use what they’ve learned to develop a detailed weather/climate overview for your exchange student.

ELABORATE: Applications and Extensions:

Time: Approximately a month and a half if taking data for the recommended time period.

Part A:

1. Explain to students that they will now collect their own weather data using the instruments they learned about in the station lab.

- a. We suggest using the instruments they explored in the station lab, however; you may have students utilize more accurate instruments such as weather kits provided by The Science House or the State Climate Office. There are also some excellent weather data collection devices that can be purchased such as PocketLab Weather (<https://www.thepocketlab.com/store/pocketlab-weather>), which include relative humidity and dewpoint and can be used in conjunction with other weather data collection tools.
 - b. Have students use their instruments to collect weather data daily for a month in groups. If this is too much time to integrate into your classroom schedule, consider having students take data for two weeks instead.
 - c. Have students compile their data into an Excel spreadsheet.
 - i. Once they have their data in a spreadsheet, help students create graphs that represent their data. Utilizing spreadsheets is an important skill in analyzing and sharing data. This is a good opportunity to allow students to work with spreadsheet tools.
 - d. Have students share and compare their results with other groups. Have students try to identify trends in their data between groups as they analyze and interpret graphs created in Excel.
 - e. Ask students what would be more helpful if we are trying to find trends. Hopefully, students will suggest more data!
2. Show students the EConet website. It is important to take some time to show the students how to use the website and where to find the information they need. Use the *Cardinal and EConet Tutorial* in the *Supplemental Materials* folder to help facilitate.
 3. Have students use EConet to compare their data and look for trends.
 - a. Have students find an EConet station nearby and a little farther away.
 - b. Have students compare their data from their Excel spreadsheet to the data from the EConet stations..
 - c. Have students look for similarities, differences, and trends.
 - d. Discuss their findings in a whole group discussion. Be sure to have students reflect back on the “climate normals” articles they read. *This may also be a good time to discuss microclimates across the state of NC.*

Part B:

1. Explain to students it’s now time to utilize all their new knowledge and weather data tools. Divide students into groups and assign them a region of NC. *Depending on the number of students you may divide NC into as many regions as needed.*
2. Students will use their *NC Regional Weather and Climate Study Sheet* to research and collect monthly weather averages and climate normals using EConet (<https://econet.climate.ncsu.edu/>) and NOAA’s *National Centers for Environmental Information US Climate Normals Data* (<https://www.ncei.noaa.gov/products/us-climate-normals>). Students will look for things like average temperature fluctuations, average severe weather events, avg rainfall, average snowstorms, average droughts, average precipitation, etc.
3. Students will then use their data and research to create a *NC Regional Weather and Climate Study* flipbook using Canva’s Annual Report templates. Students can then share these on a classroom website, canvas, or another classroom/school platform.
4. When all the studies are finished, have students view each other’s studies. Discuss the similarities and differences in the weather and climates of NC. Ask students if they were surprised by any of the results for a given region and why. Ask students what would help make their studies even better and

do they think the exchange student will have enough information to pack for their year of exploring NC!

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 extension activity.

Elaborate Further / Reflect: Enrichment:

Time: 180 Minutes

1. Have students conduct a similar investigation for detailed *Weather and Climate Study* for a place they could go on vacation for a year. Students get to choose their vacation destination!
 - a. Students can use the World Meteorological Organization data found at: <https://dcpc.worldweather.org/dcpc/> and <https://worldweather.wmo.int/en/city.html?cityId=323>
2. Have students compare and contrast the data from NC to the data from their vacation destination and think about the factors involved in the development of weather and climate for a given region of the Earth.