Weather and Climate Project Based Instruction Lesson
Teacher Directions

Driving Question:
Is possible to predict the weather? Is it possible to predict climate?

Standards: (National Science Education Standard – See Atlas of Science Literacy Volume 2)

- Because the earth turns daily on an axis that is tilted relative to the plane of the earths' yearly orbit around the sun, sunlight falls more intensely on different parts of the earth during the year. The difference in intensity of sunlight and the resulting warming of the earth's surface produces the seasonal variations in temperature. (4B/H3 BSL)
- Transfer of thermal energy between atmosphere and land or oceans produces temperature gradients in the atmosphere and the oceans. Regions at different temps rise or sink or mix resulting in winds and ocean currents. These winds and ocean currents which are also affected by the earths' rotation and the shape of the land carry thermal energy from warm to cool areas. (4B/H2)
- Climatic conditions result from latitude, altitude and from the position of mountain ranges, oceans and lakes. Dynamic processes such as cloud formation, ocean currents, and atmospheric circulations patterns influence climate as well. (4B/H5)

Skills:

- Make a claim
- Use data to justify claims.
- Write explanations citing evidence.
- Graphically display data to support a claim
- Use GIS to understand content and communicate claims/evidence

Habits of mind:

- Collaboration
- Teamwork
- Interdependence

Products/Criteria:

- Maps and claims/evidence for Running Hot and Cold/ end of activity assessment in Mapping Our World book
- Data tables, claims and evidence for Angle of Insolation activity/end of activity assessment in Earth Science with Vernier
- Maps and claims/evidence for Sibling Rivalry/end of activity assessment in Analyzing Our World book
- Maps and claims and evidence for Windblown/end of activity assessment in Analyzing Our World book
- Final project/criteria –see rubric.

Lesson Sequence

Pose the Driving Question: Is possible to predict the weather? Is it possible to predict climate?

Present the Challenge –

The CHALLENGE:

You are a member of a research expedition for a week during the month of _____ in _____. Your goal is to collect weather and climate data at this location. You will have to choose a site for a device that will collect weather and climate data outdoors in this region for the next 10 years. What weather do you expect during the week you are visiting? How do you know this? What will affect daily weather patterns in this region? What will this data collection device have to withstand due to typical variations in climate, month by month? Is there a primary climate for which it must be designed? What kind of fluctuation will this device experience? What design features must be present? You must present your findings to the rest of the research team, including the engineers.

Equatorial high (Quito), Equatorial low, extreme location, temperate, polar, monsoon/India, desert, see MOW lessons. Cities: Melbourne Lhasa Vancouver Nairobi Kisangani Bangalore Khartoum Laos Jakarta Beijing Taipei Singapore Buenos Aires Irkutsk Montreal Quebec City

Provide students a copy of student handout (below) and the rubric

Elicit Student Prior Knowledge

GENERATE IDEAS. – Students have an opportunity to explore what they currently know about the challenge. This includes their naïve concepts or models of the domain and will provide a baseline or pre-assessment of what they know about the challenge. (Elicit Prior Knowledge)
What kinds of things affect climate and weather patterns?
Use probes and formative assessment techniques – *Uncovering Student Ideas in Science* and *75 Formative Assessment Classroom Techniques*, Keeley, P.
From Running Hot and Cold: using the supplement map, select cities that are the hottest in July and the coldest in January.

Understanding the Task/Building Background Knowledge

RESEARCH AND REVISE - Students engage in a series of learning activities (such as simulations, lectures, homework, labs, and readings) designed to help them focus on the important dimensions of the challenge. These activities are designed to help the students make a link to the original "Challenge."
(Explain or Guided Practice)

Students complete a suite of activities to build their knowledge of what affects weather and climate. Direct students to keep meticulous scientific journals in order to incorporate what they learn into their final presentations. Students will gather data to support evidence for the factors that might affect weather and climate patterns. Several activities can support the investigation. Some will utilize GIS, others will not.

TEST YOUR METTLE– As students complete each activity; there will be assessments and products that follow. These assessments (homework questions, online quizzes, essays, etc.) provide students the opportunity to apply what they know and evaluate what they need to study more. It also allows the students to reflect on how well they've learned the content and to evaluate if they are ready to Go Public with what they know. (Elaborate or Check for Understanding)

GIS Activities from *Mapping Our World, Book 2* and *Analyzing Our World, Book 3*

I. Running Hot and Cold (MOW2, Mod 3, Lesson 1 Running Hot and Cold)
   a. Observe annual temperature patterns
   b. Identify latitude zones
   c. Observe Climate Distribution
   d. Observe monthly temperature patterns in N. Hemisphere/S. Hemisphere
   e. Activate the World Cities data frame. Using the monthly temperature graphs, select individual cities to view their monthly temperature.
   f. Hint: examine all cities in Canada, examine cities running north to south, examine cities running east to west, examine all cities on the Equator
   g. How do changes in latitude, elevation, and water affect weather patterns? Climate?

II. Seasonal Differences (MOW2, Mod 3, Lesson 2, Seasonal Differences)

Analyze the variable patterns of precipitation in South Asia that result from the region's seasonal monsoon winds. As you investigate those patterns, you will explore relationships between rainfall and physical features

   a. Observe patterns of rainfall in the region
   b. Compare coastal and inland cities rainfall and the effect of physical features on monthly rainfall patterns as you move west to east
   c. Observe yearly precipitation patterns as they relate to physical features.
   d. How do the physical features and landforms affect weather patterns? Climate?

III. Sibling Rivalry (Analyzing Our World 3, Mod 3, Lesson 1)

Record observations of El Nino and identify characteristics of it and La Nina.

   a. View effects of El Nino on global sea surface temperature
   b. View effects of El Nino on global land temperature
   c. Compare El Nino to La Nina.
   d. Would an El Nino or La Nina year affect the conditions for your site? If so, how?

IV. Windblown (Analyzing Our World 3, Module 3, Lesson 2)

What drives wind direction? What drives air currents? What drives the Earth's oceans? How do flowing wind and ocean currents affect land? NEO site

   a. Examine "true color" image of Earth. Look for evidence of precipitation. Vegetation is present therefore air has cooled and lost moisture.
   b. Deduce ocean current patterns from temperature patterns
   c. How do global winds relate to ocean currents? How do winds and ocean currents flow as related to the Equator? The continents?
   d. Investigate biomes as related to wind, ocean currents, precipitation, and landforms
   e. Investigate precipitation as related to ocean currents
   f. Chart biome conditions in terms of temperature and moisture necessary

V. Eye of the Storm (MOW2, Module 7, Lesson 2)

Examine Hurricane Mitch as it progresses from a tropical storm to a class 5 Hurricane).

Hands on labs and activities

Convection demonstration – GEMS Convection, a Current Event
Pressure and humidity investigations – Living by Chemistry, http://phet.colorado.edu/
Examining the reasons for the seasons – GEMS Space Science Sequence or Reason for the Seasons

Project Description

GO PUBLIC – this is the final assessment of what students know at the end of the module. This assessment could be a presentation of the content, a quiz or test, an essay, homework, etc. (Evaluate)

- Presentations shared in scientific convention
- Students provide feedback to each other

Address the following in your presentation

- Display of data graphically to communicate evidence in support of a claim
- Map created in GIS to communicate evidence in support of a claim
- Factors that contribute to daily weather events (pressure, winds, jet stream)
- Factors that contribute to the general climate of a region (latitude, proximity to landforms and water, elevation)
- Summary list of criteria for device design engineers. What data is it most likely to collect? What must it have to withstand (temperature range, weight of snow, tendency to rust, wind)
- Presentation must include claims with VISUAL evidence

Extension ideas

LOOK AHEAD AND REFLECT BACK (Elaborate, apply to a new situation)
Design the device – engineering design challenges
Climate Change – how will predicted changes in climate affect your device? Would this same device be appropriate in 100 years?

STUDENT HANDOUT

The CHALLENGE:

You are a member of a research expedition for a week during the month of _____ in _____. Your goal is to collect weather and climate data at this location. You will have to choose a site for a device that will collect weather and climate data outdoors in this region for the next 10 years. What weather do you expect during the week you are visiting? How do you know this? What will affect daily weather patterns in this region? What will this data collection device have to withstand due to typical variations in climate, month by month? Is there a primary climate for which it must be designed? What kind of fluctuation will this device experience? What design features must be present? You must present your findings to the rest of the research team, including the engineers.

You must address the following in your presentation:

- The factors that contribute to daily weather events in your region
- The factors that contribute to the general climate of your region

Your presentation must include:

- Claims supported by VISUAL evidence
- At least one display of data graphically to communicate evidence in support of a claim about weather or climate
- At least one map layout created in GIS to communicate evidence in support of a claim about weather or climate
- A summary list of criteria for the data collection device design engineers. What data is it most likely to collect? What conditions must it withstand monthly?

RUBRIC FOR FINAL PROJECT

Standard	Exemplary	Mastery	Does not meet requirements
The student can identify factors that contribute to general climate and daily weather patterns of their assigned region	The student addresses more than 5 factors that affect weather and/or climate for their assigned region. Device specifications for engineers include explanations of the type of conditions the device must withstand and the most likely data it will encounter, including possible hazards in the region	The student addresses some factors that affect weather and/or climate for their assigned region. Device specifications for engineers include some explanations of the type of conditions the device must withstand	Student confuses weather and climate or does not address factors that affect weather and/or climate. Specifications are not tied to conditions expected in the region
The student formulates arguments and scientific explanations using logic and evidence.	Compelling visual (graphic or spatial) evidence is provided for each of the factors the student claims affect weather and/or climate, and for each engineering specification recommended in the data collection device.	Visual (graphic or spatial) evidence is provided for some of the factors the student claims affect weather and/or climate, and for some engineering specifications recommended in the data collection device.	Evidence provided for each of the factors the student claims affect weather and/or climate and for each engineering specification recommended in the data collection device is lacking, incomplete, or incorrect.
The student knows and understands how to use geographic representations and tools to ask questions, analyze data, explain, and solve problems.	The student creates several *original* maps with a GIS that use a variety of data sources to support each claim about weather and climate.	The student uses existing maps created with a GIS to support each claim about weather and climate.	Student does not use maps created in GIS to support claims about weather and climate