Mystery Cube

Task: Work with your table group to make and share observations about the cube. Develop an answer to the questions:

What is on the bottom of the cube?

What is on the inside of the cube?

Come up with an explanation of what is on the bottom of the cube **based on evidence.**

One group member should record the teams questions, observations, and conclusions.

Rule: You may not lift the cube OR look at the bottom.

Field Investigations:
Using the Outdoors to Foster Student Learning of Scientific Processes

What Are Field Investigations?

- Involve systematic **collection of data** for the purposes of scientific understanding.
- Designed to **answer an investigative question** through the collection of evidence and the **communication of results**.
- Contribute to scientific knowledge by **describing** natural systems, **noting** differences in habitats, and **identifying** environmental trends and issues.

Why Conduct Field Investigations with Students?

- Understand that science doesn't only happen in a laboratory or classroom.
- Help students become systems thinkers.
- Learn the skills of scientific inquiry.
- Engages students in their communities.

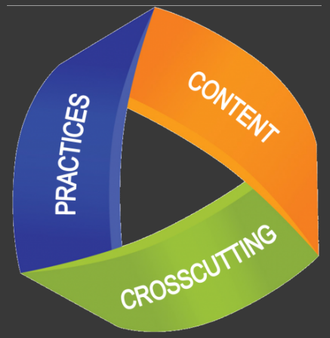
Inquiry

"Inquiry is a set of interrelated processes by which scientists and students pose questions about the natural world and investigate phenomena; in doing so, students acquire knowledge and develop a rich understanding of concepts, principals, models, and theories."

- National Research Council, 1996

Science Inquiry Steps (described by NOAA B-WET):

- Formulating scientific questions students can answer using data
- Making predictions or hypotheses
- Collecting data or using existing data
- Analyzing and interpreting data
- Making conclusions and adjusting predictions/ hypotheses
- Developing presentations of their findings



"Because the term 'inquiry' has been interpreted over many different ways…. part of our intent in articulating the practices is to better specify what is meant by inquiry in science"

- National Research Council 2012

Next Generation Science Standards Scientific and Engineering Practices

1. Asking questions (science) and defining problems (engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Developing explanations (science) and designing solutions (engineering)
7. Engaging in argument
8. Obtaining, evaluating, and communicating information

Science Inquiry Steps

1. Formulating scientific questions students can answer using data
2. Making predictions or hypotheses
3. Collecting data or using existing data
4. Analyzing and interpreting data
5. Making conclusions and adjusting predictions/hypotheses
6. Developing presentations of their findings

Field Journals

Field journals are used by all field scientists, researchers, naturalists, and ecologists to record what they find, observe, and collect while in the field.

- Journals are a reference of the work done, and may be used many years in the future by others continuing similar work, in the same area.
- We often forget what we have observed-so write it down!
- Observations may have a direct impact on our findings and data. For example, if it is raining you may record higher levels of dissolved oxygen, or have a harder time finding macroinvertebrates.
- Journals help us keep permanent records as we study an area over time.
- We may need to know why a certain day has such different data, and our observations may help with this
- By keeping observations we are helping to document history about ecological relationships that include biotic factors observed such as: plants and animals, and abiotic factors such as: water levels or amounts of woody debris.

Developing Questions through Observations

- I wonder…
- How does…
- Why are…
- Something I would like to know…

What makes a good investigative question?

- Cannot be answered with a simple yes or no
- Leads to gathering evidence and using data to explain how the natural world works
- Centers on objects, organisms, and events in the natural world
- Should lead to answers that fill in the gaps of what we know and what we want to know
- Needs to be interesting to you
- Connects to scientific concepts rather than to opinions, feelings, or beliefs
- Must be able to measure/study within our timeframe and with our tools
- Can be investigated through experiments or observations
- Promotes different answers to be compared and used to develop solutions to problems
- Starts with words like:
  - How does…
  - What is….
  - Would x affect y…

Types of Questions

"Given particular subject matter or a particular concept, it is easy to ask trivial questions….It is also easy to ask impossibly difficult questions. The trick is to find the medium questions that can be answered and that take you somewhere."

Type of Questions	Examples
Book/Internet Research	What is the name of this tree or shrub? How tall does this tree grow? Where does this tree grow?
Essential- Life Pondering, Always wonder	How do trees alter climate?
Descriptive	What do twigs look like in the winter? What plants live on this tree? What animals use this tree for their habitat? How does this tree produce seeds?
Comparative	Which type of tree grows fastest? Are deciduous or broadleaf evergreen leaves stronger?
Correlative	How is tree leaf color related to the number of sunny days in fall? How is hot weather related to disease in pine trees?
Why Questions	Why are there deciduous and evergreen trees?

Formulating Investigative Questions

Descriptive **Describing &/or quantifying parts of the natural system.**	**Comparative** **Collecting data on different populations/ organisms, or under different conditions (e.g., times of year, locations) to make a comparison.**	**Correlative** **Measuring or observing two variables and searching for a relationship.**
How many? How frequently? What happened?	Is there a difference between groups, conditions, times, or locations? Make a prediction or hypothesis about differences.	Is there a relationship between two variables? Make a hypothesis about the relationship.

Planning a Field Investigation

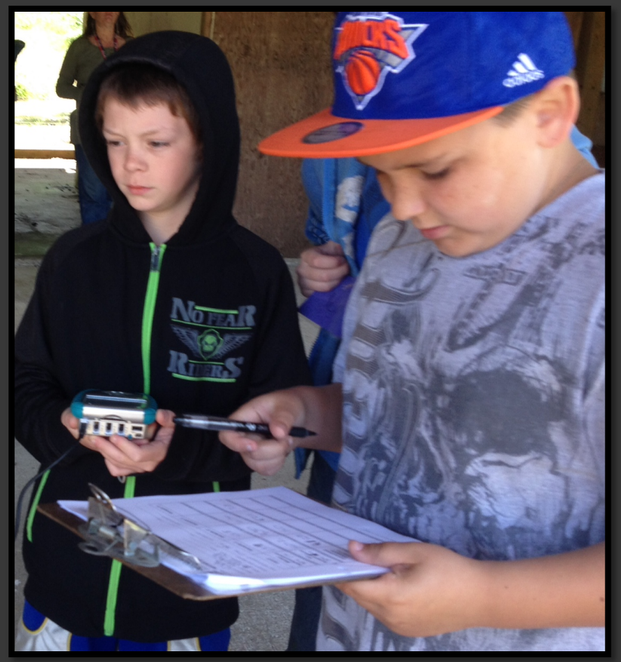
Question: Which location- on the open grass, under the bushes, or on the black top- has the highest surface temperature?

Prediction/Hypothesis: State which location will have the highest/ lowest temperature and a reason for this prediction.

Materials: Thermometer, stop watch, materials to shade thermometer

Independent Variable: Location

Dependent Variable: Temperature



Procedure

1. Leave thermometer outside for 5 minutes to make sure the first readings are accurate.
2. Place thermometer flat on the ground in the first location (black top), shade from direct sunlight and wait two minutes.
3. Record the temperature in C without picking up thermometer.
4. Repeat the temperature measurement in this location two more times.
5. Move to second location (on open grass) and take three temperature measurements and record.
6. Move to the third location (under the bush) and take three temperature measurements and record.

Underlined: Independent Variable
Double underlined: Dependent Variable

Sample Data Sheet

Date: May 5th, 2015 **Time:** 10am

Study site (location): We will be working in three locations on Marshfield High School grounds……GPS coordinates?

Study site Description: The open grass site is the school soccer field…….

Weather: Partially sunny with 30% cloud cover.

Location	**Surface Temperature**			
	Trail 1	Trail 2	Trail 3	Average Temperature
Open Grass				
Under Bushes				
Black Top				

Divide into Topic Area Groups

Soil (6-8)

Water (6-8)

Forest (10-12)

Into the Field!

Your group leaders will lead you to your investigation sites where you will see what tools you have to work with, develop a question, and create an investigation plan.

Soil: Ryan

Water: Jay

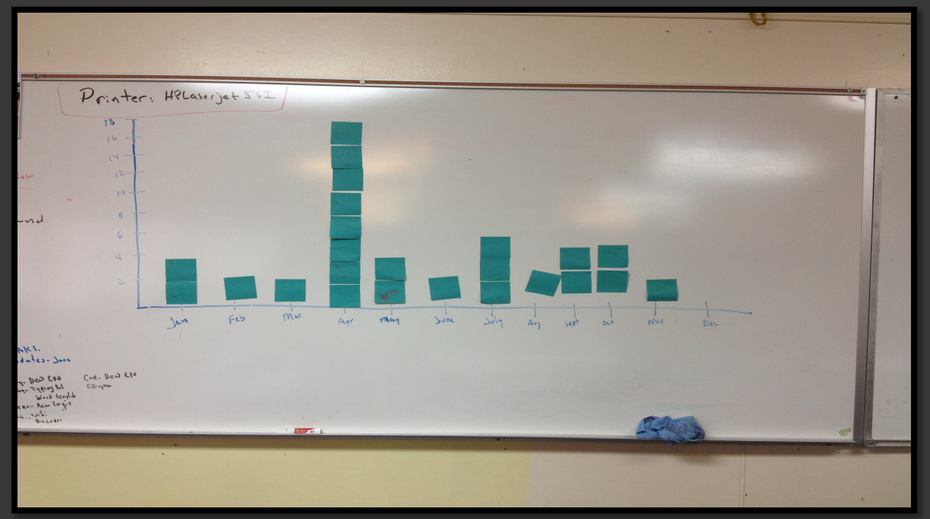
Forest: Renee and Amy

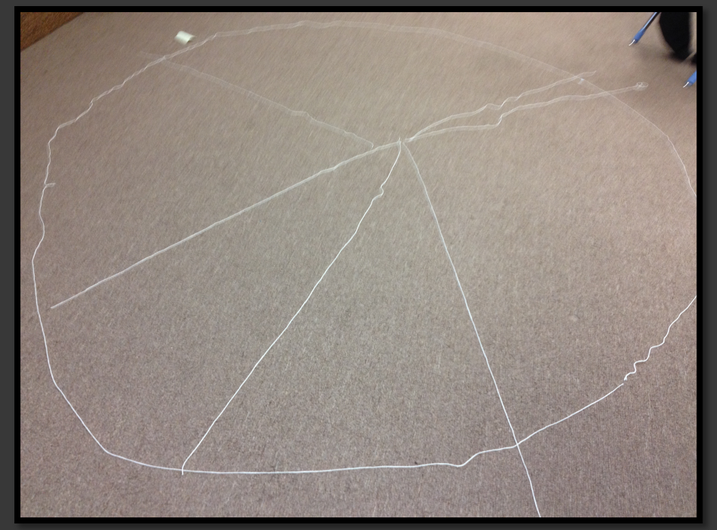
Analyzing and Interpreting Data

Organize results in spreadsheets, graphs, written forms and/or maps using statistics where appropriate.

Typical representations of the data include:

- Charts
- Line Plots
- Bar Graphs
- Maps

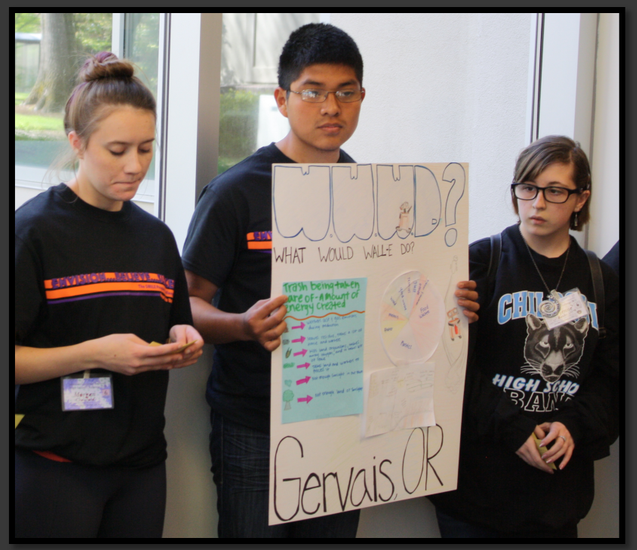




Poster Presentation

Share about your process as well as your investigation findings!

Your team will make TWO posters to share



Poster #1: The Investigation

Poster #2: The Process

Discuss: Given the resources at your school, what kind of investigation could you do with your students?