AVID Summer Bridge

Curriculum Sampler

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AVID Math and Science Summer Bridge Program

ProPhone

AND THE ENVIRONMENT

An Integrated Math and Science Environmental Project

AVID Center

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UNIT 7:
TOPOGRAPHY AND WATER TESTING

OVERVIEW

Unit 7 of the program focuses on topography and water. Students learn about topographic maps and create two-dimensional and three-dimensional models. Students investigate some of the various characteristics of water chemistry including temperature, pH, conductivity, and turbidity through data collection and lab work. Analysis of data from this unit will be key in the decision of where to build the ProPhone factory.

Objectives: The Students Will...

- Interpret and construct topographic maps and use the maps for informed decision-making.
- Investigate various dynamics of water chemistry and how they affect components of an ecosystem.
- Develop the understanding that an ecosystem is a series of interactions between biotic and abiotic features.
- Analyze the effects of changing variables within an ecosystem.
- Evaluate characteristics of the desert site as a location for a factory.

Activities

- *Team Builder: Pyramid Challenge* (25 min) **$$**
- *Topographic Maps and Models* (75 min)
- *Characteristics of Water: Cornell Notes* (40 min)
- *Brain Break: Stand Up and Spell* (5 min)
- *Water Testing* (60 min)
- *Interactive Notebook Reflection, Unit 7* (20 min)

Handouts

- *Pyramid Challenge: Rules of the Game* (1 per class)*
- *Topographic Maps and Models*
- *Topographic Maps #1–#4* (1 map per group)*
- *Characteristics of Water: Cornell Notes*
- *Water Testing Lab Sheet: Temperature Conversions* (1 per station, in page protector)*
- *Water Testing Lab Sheet: pH Tests* (1 per station, in page protector)*
- *Water Testing Lab Sheet: Conductivity Tests* (1 per station, in page protector)*
- *Water Testing Lab Sheet: Turbidity Tests* (1 per station, in page protector)*
- *Desert Site: Soil and Water Data*
- *Desert Site: Topographic Map*

Resources and Supplies

Markers, highlighters, pencils, scissors, sticky notes, glue sticks, adhesive tape, colored pencils, computer, speakers, and document camera

- String or yarn (~0.5 m per student)
- Cups, 3 or 4 oz (10 per group)
- Rubber bands, medium size (1 per group)
- Cardboard pieces for "spacers" (many small pieces)★
- Construction paper (1 multicolored package, including black)
- Page protectors (4)
- Lab safety goggles (1 per student)
- Lab aprons, optional (1 per student)

pH Tests

- Water samples: tap water, distilled water, and well water (or prepared hard water sample) (~250 mL of each type)
- Droppers or plastic pipettes, labeled (~10)
- Litmus paper strips, red and blue (~25–30 of each)
- pH paper strips (~25–30)
- Distilled water, "wash" water (~500 mL)
- Beakers or paper/plastic cups, ~100 mL or 4 oz (2)
- Ammonia solution, household, ~5% (~25 mL)
- Lemon juice (~25 mL)
- Milk, vinegar, orange juice, baking soda (suggested liquids for pH test demonstration) (few mL each)★

Conductivity Tests

- Conductivity meters or multimeters (2, including an extra meter) (directions in Appendix VI for constructing a homemade conductivity tester)
- Sample of electrolytic solution (Gatorade or salt water) (~250 mL)
- Water samples: tap water, distilled water, and well water (or prepared hard water sample) (~250 mL each)
- Distilled water, "wash" water (~500 mL)

Turbidity Test

- Secchi disk (1) (construction directions in Appendix VI)
- Four tall cylinders (250 mL graduated cylinders or tall, clear plastic bottles)
- Powdered milk (~4 grams)

Teacher Preparation

- Cut strings for *Pyramid Challenge.*
- Prepare a model of a topographic map.
- Collect small pieces of cardboard for "spacers" for topographic maps.
- Collect water samples (tap water, distilled water, and a third sample that differs from the tap water. See *Water Testing* notes for adjusting this water sample.).
- Label beakers/cups and droppers/pipettes for water testing stations.
- Prepare powdered milk solutions for turbidity testing.
- Set up water testing stations with supplies and *Water Testing Lab Sheets* (in page protectors).
- Construct or borrow from a science lab a simple conductivity tester, and construct at least one Secchi disk (see Appendix VI for construction directions).

WICOR Strategies

W - Make notes; construct relationships for concepts; build vocabulary; write reflection for lab investigations

I - Consider what information is important in analysis, create questions in note-taking; form predictions; investigate water characteristics; evaluate data

C - Work as a group in creating topographic maps; collect and analyze data together

O - Plan and organize using note-taking and Interactive Notebooks

R - Read a topographic map; mark text material

Correlation to Next Generation Science Standards

Disciplinary Core Ideas and Performance Expectations

- MS-LS2.C: Ecosystem Dynamics, Functioning, and Resilience (PE: MS-LS2-4)
- MS-ESS3.C: Human Impacts on Earth Systems (PE: MS-ESS3-4)
- HS-LS4.C: Adaptation (PE: HS-LS4-6)
- HS-LS4.D: Biodiversity and Humans (PE: HS-ESS3-4)
- HS-ETS1.A: Defining and Delimiting Engineering (PE: HS-ETS1-2)

Science and Engineering Practices

- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Using Mathematics and Computational Thinking
- Constructing Explanations (for science) and Designing Solutions (for engineering)

New Vocabulary

- acid
- alkaline
- conductivity
- contour
- electrolyte
- hydrogen ion (H^+)
- hydroxide ion (OH^-)
- neutral
- relief
- scale
- topographic map
- topography
- transparent
- turbidity

Topographic Maps and Models

INTRODUCTION

In this activity, students will investigate topographic maps and how they can be used by scientists. The teacher will lead a discussion about topographic maps and share examples. Students will analyze topographic maps to create three-dimensional models of the maps, then exchange the models with other groups and create two-dimensional topographic maps of the model they received.

time

75 minutes

handouts

- *Topographic Maps and Models*
- *Topographic Maps #1–#4* (1 map per group)*

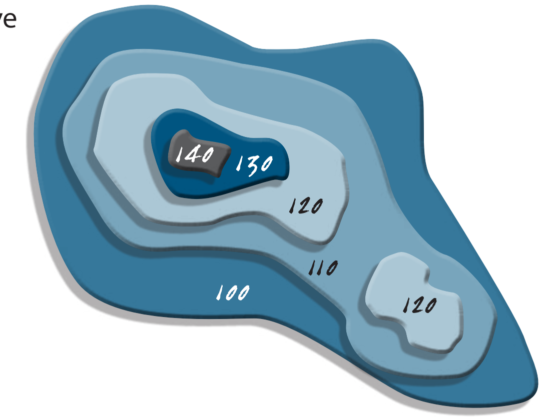
supplies

- Cardboard pieces for "spacers" (many small pieces)★
- Construction paper (1 multicolored package, including black)

Teacher Directions

- Prior to class, prepare a three-dimensional model of a topographic map using the directions on the student instruction sheet, so that students can see an example of the type of model they will make.
- Collect small pieces of cardboard for "spacers," which represent the increase in elevation between each contour line in the topographic models.
- Discuss background information on topographic maps, including the following points, with students as they take notes in their INBs (page 56):
    - *Topo* means "place" and *graph* means "writing or picture."
    - Topographic maps show surface shapes and features of the earth, both natural and manmade. They are constructed to show elevations and landforms.
    - The maps are used extensively by geologists, field biologists, hikers, and campers.
    - Direct the students' thoughts to water flow and runoff, based on their common knowledge.
- Show examples of topographic maps from internet sites such as the following.
    - http://www.lib.utexas.edu/maps/topo/texas (offers close-up looks at specific cities)
    - http://www.trails.com/topo-learn-more.aspx (examples of various types of topographic maps)
    - http://www.compassdude.com/topographic-maps.shtml (reading topographic maps)
- As you show maps from the websites, introduce basic terms used in describing topographic maps:
    - *Relief:* the difference in elevation between two points. Where relief is low, the area appears to be relatively flat. Where relief is high, the area is steep, as in mountainous regions.
    - *Contour lines:* the imaginary line on the Earth's surface connecting points of the same elevation. Contour lines are widely spaced on gentle slopes and closely spaced on steep slopes.
    - *Contour intervals:* the difference in elevation between adjacent contour lines. Usually every fifth contour line is printed heavier than the others and is marked with the elevation above sea level.

- *Scale:* the relationship between distance on the map and the true distance on the Earth's surface, generally expressed as a ratio or fraction, such as 1: 24,000 or $\frac{1}{24,000}$.



- Form student groups of three members to build the models and give each group one of the four topographic maps (numbered 1–4) to build their models.
- Have students turn to *Topographic Maps and Models* (INB page 57) and review the directions with them. Show students your model so they will have a visual reference of the type of product they are preparing.

Processing the Activity

- After the groups have exchanged their three-dimensional models and drawn two-dimensional maps from those models, display and review the different models. Ask students what they would do differently if they were to prepare the models and maps again.
- Begin a discussion on topographic information by asking students to suggest ways in which the topography of a site could be useful to the ProPhone company as it analyzes different sites for construction of its facility. Ensure that the discussion includes the effects of water on the site.
    - Water runoff and water flow, and how water changes the topography of an area
    - Areas that might be affected if pollutants flow from the site
    - Flooding, landscaping, roads, access of trucks, inclement weather
- As a conclusion to the activity, have students brainstorm and list the types of information they will look for as they analyze topographic maps of the potential ProPhone factory sites on INB page 58.

$$

Groups will receive the following for their registers
(to be divided among the group evenly):
$200 for the most accurate map;
$150 for the second-best map;
$100 for the third-best map.

Topographic Maps and Models

In groups of three, you will build a three-dimensional model of a topographic map marked with elevations of the various land forms present. Groups will then exchange models and create a two-dimensional drawing of the three-dimensional model.

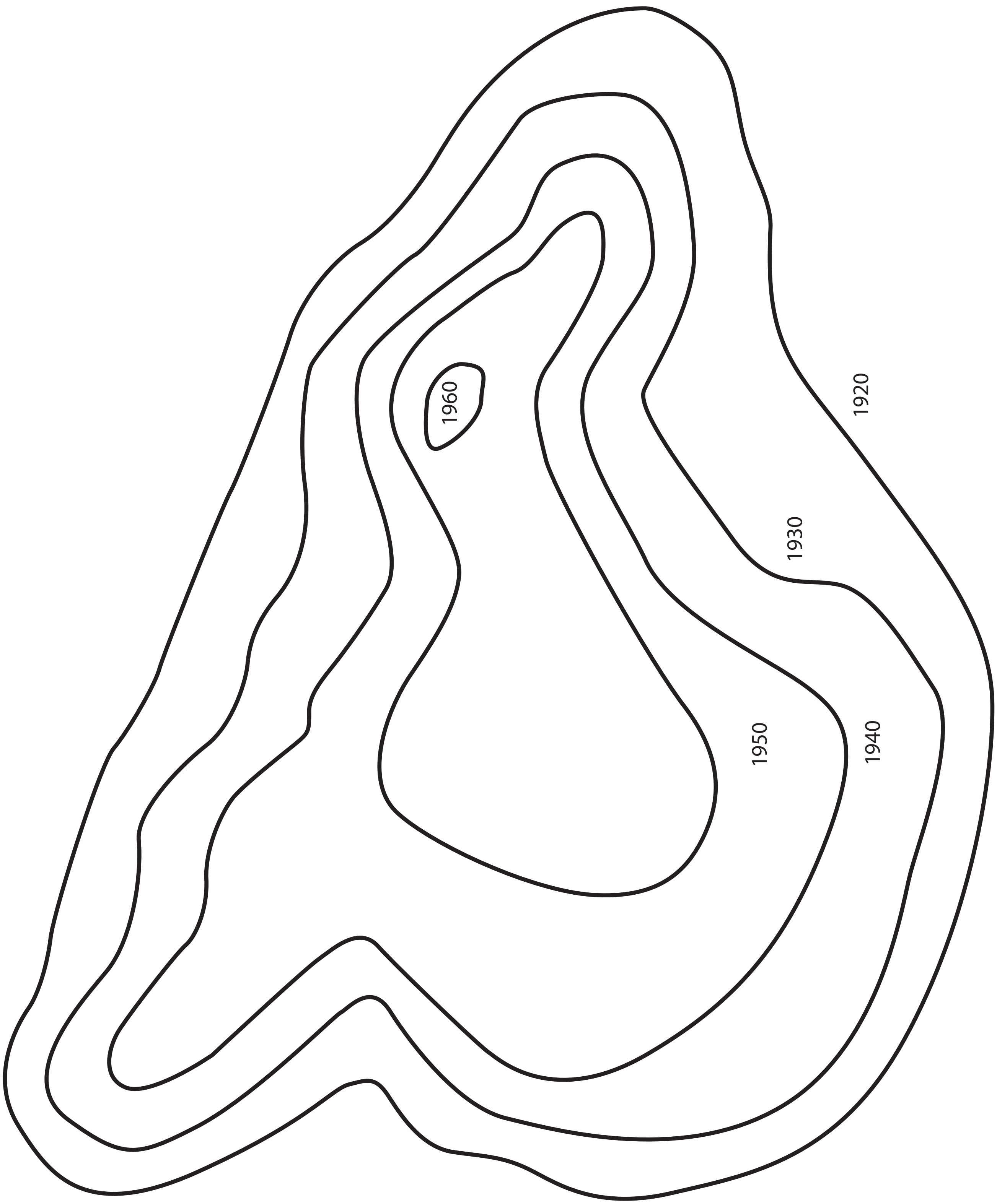
Supplies

- Construction paper, several colors
- Cardboard "spacers" (small pieces)
- Scissors
- Glue
- Sample topographic map

Procedure

1. Place the copy of the sample topographic map on top of black or dark construction paper.
2. Carefully cut along the contour line representing the lowest elevation. Label the back of the construction paper with a "1." This is the first level of the model you will build.
3. Place the copy of the map on top of a different color of construction paper and cut around the next contour line. Label this paper with a "2," indicating the second level of the model.
4. Continue this process for all of the remaining contour lines.
5. Glue several cardboard spacers to the bottom of layer #2 and glue it onto the top of the first layer. The spacers represent the increase in elevation between each contour line.
6. Repeat this process with the rest of the layers until the model is built.
7. Exchange models with another group and *individually* draw a two-dimensional map below of the model you received in exchange.
8. Label your three-dimensional map with the names of the group members and place it in a secure area of the classroom.

Topographic Map 1



Designing an Experiment: Mealworms, Part 1

INTRODUCTION

Students will continue using the tools of a scientist by designing an experiment to test environmental factors affecting the rate of movement of beetles. In this first part of the investigation they will brainstorm, create hypotheses, write procedures, and create data tables. In the following unit, students will perform the experiment and analyze and draw conclusions on the investigation.

time

50 minutes

handout

- *Designing an Experiment: Mealworms, Part 1*

supplies

- Beetles (~75–100): adult mealworm (preferred), mealworm larvae, isopods, or any non-threatening insect that moves at a measurable rate. *The beetles will not be used in this unit, but it is helpful for students to see the motion of the beetles to inform the procedure for the experiment.*

Teacher Directions

Preparing for the Activity

- Present the task of designing an experiment to test environmental factors affecting the rate of movement in beetles.
    - Allow students to suggest some factors they might test (e.g., temperature, humidity, light, type of surface over which the beetles travel).
    - Indicate which standard laboratory tools they could potentially use for the tests (e.g., meter stick, ruler, lamp or flashlight, heat lamp, ice, water), and offer them the option of bringing items from home for the testing (e.g., sandpaper, sand).
    - Outline how the experiment will be processed once the data is taken: graphing data, analysis and conclusion, preparation of poster, and oral presentation.
- Allow students to view the beetles so that they can get an idea of their rate of motion. Emphasize that they must not harm or be cruel to the beetles during their investigations.
- Be careful of not influencing the students' choice of investigative factors, since part of the learning (and the fun) is for each group to truly develop an independent idea of what they want to test. Two groups might choose to test the same factor, but it is likely they will not test it in the same ways.

- Have students open their INBs to page 20, where they will take notes during a brief discussion of the major parts of a good scientific investigation.
    - Identify the *problem*—a question that describes what they are testing
    - Identify *variables*—independent (manipulated) variable and dependent (responding) variable
    - Identify the *control(s)*—the constant factor(s) in the investigation
    - Generate a *hypothesis*—a "cause and effect" statement relating the independent and dependent variables and including a statement of "why"
    - Write a *procedure*—detailed, repeatable steps in the investigation
    - Perform *multiple trials*—a method to obtain better accuracy for the data
    - Communicate *results*—written and graphic data tables and graphs
    - Evaluations and *conclusions*—using the data to explain and accept or reject the hypothesis

Conducting the Activity

- Form groups of three to work together on this investigation.
- Guide groups through each step of the experimental design process, allowing time at each step for group discussions. All ideas, plans, and data tables should be recorded on INB pages 20–22.
    - Step 1: Brainstorm ideas of which environmental factors could be tested. Narrow the ideas down to a single idea.
    - Step 2: Identify the problem and complete the question frame on the notes page.
    - Step 3: Write a hypothesis statement (If ____, then ____, because ____) related to the problem statement.
    - Step 4: Identify the independent and dependent variables.
    - Step 5: Generate ideas on how to measure the movement (e.g., measuring from a single point, tracing the path of the insect and then using string to measure the total distance of the path). As students discuss their plans, monitor and guide them to determine feasible, accurate measurement procedures.
    - Step 6: Once each group's problem and hypothesis is approved, have students write out the detailed procedures they will use to test their hypotheses.
- The actual investigation will be conducted and analyzed in Unit 3. If there is sufficient time remaining in today's class session, students can start gathering supplies and organizing their experiments for the next day.

Designing an Experiment: Mealworms, Part 1

TOPIC: Design an experiment	Name: ______________________ Date: ______________________

ESSENTIAL QUESTION:
How do we design an experiment to test the effect of environmental factors on the rate of movement of beetles?

Questions	**Notes**
	Components of a good scientific investigation
	Problem:
	Variables:
	Control:
	Hypothesis:
	Procedure:
	Multiple trials:
	Results:
	Evaluations and Conclusions:
What environmental factors could be tested?	**Brainstorm the Investigation**
What factor will we test?	
What is the "problem" we will test?	How does ______________ affect the rate of movement of beetles?
What is our hypothesis?	If ______________________, then ______________________, because ______________________.

SUMMARY: