Broadening Research Interest in Geoscience, Habitat, and Technology (BRIGHT)

Investigation 3: CREATIVE TECHNOLOGY

Grades 9-12

Time requirement: 30 minutes

Next Generation Science Standards (NGSS)

Science and Engineering Practices
Asking Questions and Defining Problems • Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations.
Disciplinary Core Ideas

Engineering, Technology, and the Application of Science
• ETS1 Engineering Design
  ◦ ETS1.C: Optimizing the Design Solution
  ▪ Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed.

Crosscutting Concepts
Science is a Human Endeavor • Scientific knowledge is a result of human endeavor, imagination, and creativity.

OVERVIEW

Using found objects, students develop creative ways to collect data of interest.

LEARNING OBJECTIVES

Students will be able to:

- create scientific instruments to collect data.

INSTRUCTIONAL APPROACH

By brainstorming and designing their own creative technologies, students experience the iterative process of drafting an idea, testing, and making revisions. Ideally, students feel ownership of data they have collected, and creative agency as they make choices about how to develop a technology to collect it. The instructor should accept all student responses as value-neutral, and encourage specific feedback (e.g., what was effective or ineffective, and why).

MATERIALS

- Rite in the Rain 4x6” notebooks, 1 per student
- Other materials depending on lesson focus (e.g., rulers, tapes, string, etc.--see below)

ACTIVITY

Setup

Scout an outdoor field site with abundant natural materials for the purpose of conducting the investigation described below. Consider if you will provide students with supplementary materials like duct tape, cord, etc., or encourage them to use only what they can find in their immediate environment.

Investigation

30 minutes

1. Give students the challenge prompt: in the next thirty minutes, come up with something to measure and how to measure it with materials at hand in our immediate environment.

2. Pairs or groups of students brainstorm, build, and test their creative technologies, and share them with each other if time allows. Instructors may limit students to natural materials only, or allow them to incorporate supplementary materials.

Examples of students' creative technologies:

- Tying a rock to the end of a tape measure or string to measure river depth
- Using a stick to measure river's maximum height (in units of students' height)
- Combining paper and a stick to form a rudimentary wind vane
- Floating objects to measure current

Depth measurement rock on a string, developed and photographed by Kendall, Cassandra, and Bonnie.

3. Discuss the importance of creative problem-solving in general, and in science in particular. Ask students:

    - *What tradeoffs did you make in developing your creative technology?*
    - *If you had more time, what would you change about your design?*
    - *What are other creative solutions you have come up with, and in what context?*

Extensions

Notebooks

10 minutes

Have students write about their experiences in their notebooks. Students should document the procedures they used, their observations, the results of their experiments, and further questions they would like to explore.

Incorporating instruments

15 minutes

If students are working with scientific instruments, they can also incorporate them into their creative technologies, for example, the rock on a string shown above also has a place where students could insert a thermometer to record water temperature at different depths.

Design and refine

30-60 minutes

(http://www.colorsofnature.org/wp-content/uploads/2018/12/K-3-All.pdf)

This extension gives students the opportunity to explore design as an iterative process of evaluating and refining solutions to a problem. Students create variations on their creative technology in order to optimize their design.

1. After evaluating their first pieces of creative technology, have students make a note of what worked and what could be improved.

2. Now, let students know they will be creating a new design based on their analysis of their first one.

3. Have students gather new or additional materials and create another piece of technology.

4. When finished, have students demonstrate and describe their two pieces of technology in small groups. Have the groups respond:

    - *Does one measure more effectively than the other?*
    - *What, specifically, makes it more effective?*
    - *Based on what works, how could this design be improved further?*

5. If time allows, students can create another iteration of their technology, incorporating ideas from their peers and their own reflection to improve their designs.

6. As a whole group, have students share what they discovered in the process of refining their designs.

    - *What changed about your design from the first to the second or third iteration?*
    - *What did you discover in this design process that could be applied to designing a different piece of creative technology (e.g., to measure something else, in a different environment)?*

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