

Student Resource 3.3

Radwaste Device Design Brief

Situation:

Radioactive soil and rocks, tainted with thorium and uranium, have been discovered in a section of Rolling Hills Public Park. The waste, which could be a potential health hazard to people who come in contact with it over long periods of time, may have been deposited in the park for use as fill. It is thought that it was left by the Horace Company, which processed an ore containing thorium for use in manufacturing gas lamp mantles in Rolling Hills City from the late 1890s to the early 1940s.

The EPA (Environmental Protection Agency) will be overseeing the waste removal. They are asking local engineers to develop a device that can safely separate the rocks from the soil, without human contact.

Challenge:

In this small group activity, your team is to design and develop (invent) a prototype (working model) of a small soil/rock separating device.

Criteria and Constraints:

- Your device must be made with at least five different items.
- You must complete a working drawing of your design that includes:
 - Dimensions
 - Two views
 - Explanatory notes
- The rocks and soil must end up in separate containers.
- Human hands may not touch the soil or rocks.
- The device must be able to separate at least 4 ounces of the soil/ rock mixture within 1 minute.

Tools, Materials, and Equipment Needed:

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| sand (20-25 ounces) | Cardstock |
| Small dried beans or pebbles (25-30),(spray painted green- optional) | Scale |
| Paper cups | Hot glue guns, glue |
| Paper clips | Balsa cutters |
| Tape | Scissors |
| 8" x 10" pc of screen or mesh | Rulers |
| Balsa wood | Stopwatch |

* If lab is equipped with power tools, additional materials and tools may be used at the discretion of the teacher.

Procedure:

- Students, working in groups of 4 or 5, will design a device that will separate soil and rocks. Human hands may not touch the soil or rocks.
- Student groups will:
 - a. Assign a group leader
 - b. Obtain and review materials
 - c. Discuss the problem (take notes).
 - d. Discuss ideas for solving the problem (make sketches, or use any design software).
 - e. Choose the best idea and build a prototype (working model).
 - f. Evaluate and test your prototype, refine as needed.
 - g. After the prototype is finished, name it—be creative.
 - h. Make an oral presentation to the class, explaining your process of development and demonstrating your device.

| Assessment Instrument - Engineering Design Process Rubric | |
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| Category | Above Target |
| Defining the Problem | Rephrases the problem clearly and precisely. |
| Brainstorming a Solution | Contributes multiple plausible ideas. |
| Generating Ideas | Contributes multiple plausible ideas. Produces accurate pictorial and orthographic sketches of design concepts. |
| Identifying Criteria | Restates the criteria clearly and precisely and identifies many constraints. |
| Exploring Possibilities | Thoroughly analyzes the pluses and minuses of a variety of possible solutions. |
| Selecting an Approach | Selects a promising solution based on a thorough analysis of criteria and constraints. |
| Making a Model or Prototype | Prototype meets the task criteria in insightful ways. |
| Testing and evaluating the Design | Testing processes are innovative. |
| Refining the Design | Significant improvement in the design is made based on prototype testing and evaluation. |