Dynamic Design: A Collection Process

All Cracked Up

TEACHER GUIDE

BACKGROUND INFORMATION

After two years of collecting solar wind particles, the sample return capsule (SRC) will be captured in the air by a helicopter. In the event that this does not happen as planned, the SRC has been designed to survive a land impact of 50 G. In this assessment activity, students will use crackers to model the wafers and design a method for protecting the wafers from breaking up during impact. Students will complete a drop test of their SRC and results will be compared with the drop test results of the Genesis scientists. Students will complete a written report, and a presentation that includes the design process completed during the Development section of this module.

NATIONAL SCIENCE STANDARDS ADDRESSED

Grades 5-8

Science as Inquiry

Abilities Necessary to do Scientific Inquiry

Understandings about Scientific Inquiry

Science and Technology

Understanding about Science and Technology

Science in Personal and Social Perspective

Risks and Benefits

Science and Technology in Society

Grades 9-12

Science as Inquiry

Abilities Necessary to do Scientific Inquiry

Understandings about Scientific Inquiry

Science and Technology

Understanding about Science and Technology

MATERIALS

For each group of 3-4 students:

- 42 crackers for each frame to be constructed, (small hexagon shape if possible)
- Straws, or coffee stirs to construct frame
- Tape
- Gum or other food that could be used to hold the crackers together

OR

- A large cracker (This can be done for their trial run or instead of constructing the wafers and frames with the smaller crackers.)
- Large crackers can be attached so that there are four suspended in the canister and one in the lid.

AND

- Material for canister (possibly an ice cream canister or coffee can)
- Materials for the students to keep crackers from breaking

PROCEDURE

1. Divide the class into teams of 3–4 students each. Assign teams so that they contain members from the various teams used during "Enough is Enough." The process used in that activity is relevant to this one, and intermixing students allows a jigsaw-like sharing of information.

2. If your students have not worked as a Product Design Team (PDT) refer to the "Survival" activity in the *Heat: An Agent of Change* module and "A Design Process for Science Classrooms," in the Food for Thought section of this Web site. Review with your students this process by completing procedure steps 1-7 in the "Survival" activity.

3. Describe the canister restrictions to the students:

    - The canister must conform to specific outside dimensions; it may not exceed specified mass limits.
    - Any materials may be used to "cushion" the fall and keep the wafer/frame intact, as long as basic safety rules are observed.
    - The wafer/frame collection system must be contained in the canister.

4. Students should begin the design phase of this assignment in the PDT. The first step should be the students setting up their designer's notebook as they did in the activity "Enough is Enough."

5. Distribute materials to the PDT when they have completed the design phase. The PDT should first make a prototype canister and do some trial runs. Students may modify their design before constructing the wafer/frame collectors.

6. After the PDT members are satisfied with their design, they may construct the wafer/frame collectors to be placed into the canister. Students should be reminded that the assessment for "All Cracked Up" will not be whether the wafer/frame collectors were broken, rather how the PDT would be able to communicate their design process.

7. Once each PDT has had adequate time to prepare their canisters, the testing phase should begin. Decide the height from which all of the canisters will be dropped from and proceed.

8. After the results have been analyzed the groups should consider what worked, what didn't, why and what they would do differently next time. Crackers should be observed and the amount of breakage should be recorded.

9. PDT's should now develop a presentation to communicate the design processes and test results. It may take many forms including:

    - Video: A pre-recorded presentation showing all the steps of the design process.
    - Computer: Presentation using PowerPoint or other software presentation program to show the process.
    - Audio: Live presentation where students speak from note cards or a script that shows the process with visual aids.

10. The following outline shows requirements and should be given to the PDT prior to the beginning of the design process. Remind groups that their presentation should include the following components:

    Design:
    - Diagrams showing the anticipated product.
    - Diagrams should be labeled and contain measurements.
    - Diagrams may include 2D or 3D drawings or computer modeling.
    - Properties of materials should be included such as mass, durability and cost.

    Production:
    - Show how the wafer/frames were assembled.
    - Show how the wafer/frames were put into the canister.
    - Show how the assemblies were "cushioned" to prevent breakage.
    - Show any changes that were made to the design during production.

    Testing:

- Describe how the prototypes were tested.
- Describe the results of the testing.
- Describe any changes that were made to the design because of testing.
- Describe the procedure for final drop test and include the results from this test.
- Describe any recommendation that might be implemented next time.

Presentation:

- Everyone in the PDT should participate.
- Everyone should speak clearly.
- Each presentation should have visuals to support the discussion.

11. Provide the students the grading rubric prior to presentation preparation (continues to page 4).

Scoring Rubric for PDT Presentations

	3	2	1	0
Design	Diagrams show the anticipated product and completely described.	Diagrams show the anticipated product and partially described.	Diagrams show the anticipated product.	No diagrams are shown of the anticipated product
	Diagrams are completely labeled including all measurements.	Diagrams are labeled but only include some measurements.	Diagrams include labels or measurement.	Diagrams contain no labels or measurements.
Production	Explains how the wafers and frames were constructed and placed into the canister in detail.	Explains how the wafers and frames were constructed.	Explains how wafers and frames were constructed but not completely.	Does not explain how the wafers and frames were constructed.
	Shows how the assembly was cushioned in detail including changes that were made.	Shows how assembly was cushioned in detail, with no mention of design change.	Shows how assembly was cushioned.	Does not show how the assembly was cushioned.
Testing	Describes how the prototypes were tested with complete results and changes made as a result.	Describe how the prototypes were tested with some results.	Describes how the prototype was tested but no results reported.	Did not test the prototype.
	Completely describes each step of the drop test in detail.	Describes each step of the drop test.	Describes some of the steps of the drop test.	No description of the drop test given.
Presentation	Everyone participated, spoke clearly with accurate visuals.	Most everyone participated, spoke clearly with visuals.	Some participated, speech was not clear, visuals were not accurate.	One person participated, with or without visuals.