Teacher Information

Experiment: Cookie Shipping Challenge - Which packing material provides the most protection.

Objective: To determine which packing material best protects an Oreo cookie from breaking when dropped.

Standards Covered:
5-PS2-1 - Support an argument that the gravitational force exerted by Earth on objects is directed down.
3-5-ETS1-1 - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
3-5-ETS1-2 - Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3-5-ETS1-3 - Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Materials Needed:
- Per Student
    - 3 Oreo cookies (or another type of sandwich cookie)
    - Ziploc (to place the cookies in during the experiment)
    - Small boxes or containers (to hold the cookies with different packing materials)
- Different packing materials (e.g., bubble wrap, foam padding, cotton balls, paper towels, tissue paper)
- Testing + Measurement
    - A drop zone (like a small table or a step stool) and a safe place to drop the cookies
    - A ruler/Measuring tape
    - A scale to record the mass of the cookie before and after drop tests
- Tools
    - Scissors (for cutting materials if needed)
    - Tape or glue
    - A pen and paper (for recording observations)

- Optional Materials (for expanded methods)
    - Camera + ImageJ (https://imagej.net/ij/)
        - Measure the area of the cookie based on pictures

Concepts Covered

- Gravity: the force by which a planet or other body draws objects toward its center. The force of gravity keeps all of the planets in orbit around the sun.
    - https://spaceplace.nasa.gov/what-is-gravity/en/

Ways to modify or change-up the experiment

- Different drop heights and locations - stairs, onto or off a table or chair, etc
- Minimal amount of packaging to protect the cookie
- Environmental impact of packaging material
- Making your own packing material
- Different box types
- Different types of cookies - what is more fragile?

Teacher Notes:We recommend doing a few tests on your own to see if your testing ideas are rigorous enough for the control (the non-protected cookie) to break. That way when students compare their data to the control you have a broken control for sure and hopefully some cookies that are not all the way crumbled.

Introduction: Explain to the students that they will test different packing materials to see what method of packaging protects an Oreo cookie from breaking. Discuss what packing materials are and why they are important for protecting fragile items. Allow students to mix and match materials but explain that they will repeat the same method for all three trials.

Procedure/Preparation:

- Gather all the materials and set up a work area where students can prepare their test containers.
- Have each student select a cookie and record the mass of the cookie
- Have students write out a plan on what they will use, why they selected it, and how they will wrap it. They can draw their plan out and label the parts. (Student Sheet 1)
- The teacher should conduct a control test. This would be a box and an Oreo that does not have any other materials protecting it. There should be three trials. This can be your way of demonstrating with an example before the students do the activity.
    - This data can be used as a reference for all students.

Prepare the Test Containers:

- Have the students select packaging material and a method for protecting the cookie package. It is recommended that each student test with two materials or methods.
- Take each packing method and place it into the container (3x3x2 boxes are included)
- Ensure that each cookie is wrapped evenly and securely. Use tape or glue if necessary to keep the packing material in place.

Label the Containers:

- Label each container with the type of packing material it contains (e.g., “Bubble Wrap - Susan” “Cotton Balls - John” etc.).

Set Up the Drop Zone:

- Set up a safe drop zone where the cookies will be dropped. Make sure the area is clear of obstacles.

Conduct the Drops:

- Measure and record the height from which each cookie will be dropped (e.g., 1 meter or 3 feet).
- Teachers may set expectations for how many times they are dropped and how far. The more dropping and height the better.
- Each group/student should conduct three trials of their experiment.

Observe and Record:

- After each drop session, carefully retrieve the cookie, check for any damage, use the scale to measure the cookie (don't count the parts that fell off), and record your findings.
- Record the results in a table. For each type of packing material, note whether the cookie was damaged, slightly damaged, or intact.
- Place the cookie on the scale to see how much broke off

Analyze Results:

- Discuss with the students which packing material provided the best protection and why they think it worked the best.
- Compare the results and determine which packing material was most effective at protecting the cookie.

Conclusion:

- Review the findings with the students. Summarize which packing material worked best and why.
- Create a class data collection after each group has analyzed and graphed their findings
- Discuss how this experiment applies to real-world problems like fragile items during shipping.

Tools for taking it to the next level

- Camera + ImageJ (https://imagej.net/ij/)
    - Measure the area of the cookie based on pictures
- “Slo-Mo” Camera Mode + Background Grid
    - Take a video of the impact with the black/white grid in the background to measure the impact speed and the bounce upon impact.
    - Each row of the grid is 0.2” tall (1 gray + 1 black = 0.4”)