

ENGINEERING/BALANCING FORCES

Building The Best Tray For The Job

Materials Needed:

3x5 index cards-assorted colors or markings, coffee filters, construction paper, craft sticks, hole punches, paper clips, paper plates, pipe cleaners, recycled cardboard, scissors, straws, tape and/or glue, assorted food shaped items like spheres (small oranges), cubes, cylinders (soup cans) prisms (sticks of butter), cones (ice cream cones or their associated plastic, foam, or wooden solids.

Procedure:

Start by giving the students the task of moving a large pile of objects from one side of the classroom to the other. Tell them they can not form a pass line. Ask if anyone has any idea on how to accomplish this easiest. Guide them towards the idea of a tray.

Have a ridiculously large piece of cardboard on which you attempt to carry a single piece of paper. Have a very small plastic bag in which you try to stuff too many items. Point out that there is no such thing as a perfect tray. What might be perfect for one set of circumstances is not perfect for all sets of circumstances.

We might want tall sides on some trays to keep things from falling off, but sides on trays will restrict how many things we can put on the tray. No sides on the tray might allow us to have things hang over the edge but might also allow

round things to fall off. Holes in the tray might allow us to stand cones up so the ice cream does not get all over everything, but also might allow other things to fall into the holes and be unstable. Straps underneath the tray might help the tray stay steady on the hand, but also might get in the way if the hand had to be moved because the weight was not distributed evenly.

Have some pieces of cardboard available for them to try using as a tray. Ask them what is going to keep the round objects from falling off the tray? What is going to keep the ice cream cones upright to keep the ice cream from getting on everything? How can we be sure the shapes will not fall off the tray? How can we be sure we do not make the tray so heavy that a person can not lift it?

Have the students get in groups and make several sketches of different types of trays. Have the teams list the design features on the various trays they have designed. Have them list any problems/limitations they see on their designs.



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Extension

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Give each team an amount of “class money” index cards of various denominations. They will use the class money to purchase the materials necessary to build a tray. Give each of the materials a value. The teams can only spend the money they have. Have the teams build their trays. Have them assess the functionality of their trays. Allow them to make any modifications they might feel necessary. Students are allowed to trade in their original materials for new/different materials without a monetary penalty.

Have students keep a diary of their work and how much class money they spent. Have the students record how many items they were able to hold on the original and revised trays. Be sure they also journal problems with the designs.

Each item the team is able to hold on their tray is worth a certain amount of class money. The students must be able to carry their tray around the room at least once without anything falling off.

This will lead to a discussion of what will cause an item to follow off the tray. What forces are acting on the items on the tray when standing still? What forces is counteracting the force of gravity? What forces are acting on the tray when moving? The team that has the most class money at the end of the project, between the class money they might have left over from making their tray and the class money they get for the items their tray holds wins.



Indiana Standards:

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.

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.

3-PS2-1

Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.



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