Name _____
Date_____ Per. _____

Snack Attack!!

A team of engineers was hired to design packaging for individual S'mores made of graham crackers, a marshmallow and chocolate. The goal was to design a good package at the lowest possible cost.

The engineers considered the following:

- protection from heat or cold
- protection from being crushed
- protection from water
- cost of the packaging
- time to build
- a budget that does not exceed 50 cents per package

Total Budget: $1.87

The engineers designed and tested several packages. They performed the following tests:

- Heat Test (90 seconds under a hair dryer on high).
- Water Test (1 pitcher of water poured over the package)

Cost Sheet and Materials Purchased

Item	Cost per Item
Cardstock Pieces	10 cents
Aluminum Foil	8 cents
Wax Paper	5 cents
Plastic Wrap	10 cents
1/2 Foam Plate	15 cents
Toothpicks	2 cents

Package Design	Materials Used	Time to Build (min)	Total Cost
Design A	4 pieces of cardstock 1 wax paper	20	45 cents
Design B	2 foam plates 5 toothpicks 1 plastic wrap	25	50 cents
Design C	4 aluminum foil 2 wax papers	10	42 cents

Test Performance: The results of the tests are in the data table below:

Package Design	Heat Test	Water Test	S'more Broken or Not Broken When Package Was Opened
Design A	Marshmallow Browned Chocolate Melted	Graham Cracker Soggy	Not Broken
Design B	Marshmallow Browned Chocolate Partially Melted	Graham Cracker Dry	Not Broken
Design C	No Browning of Marshmallow Chocolate Melted	Graham Cracker Dry	Broken

Circle the steps of an engineering design cycle the engineers have completed so far?

Brainstorm
Create
Design
Identify the problem
Redesign
Share solution
Test and evaluate

What is the problem to be solved?

What are the criteria for designing the packaging?

specific conditions that must be met to solve probem -cost of one package - 50 cents, no breaking, not wet

What are the constraints for solving the problem?

factors that limit a solution or problem - total mount of money available, materials avaialble, time

The engineers tested three packages. Which package should the engineers choose for the Smore's? Support your answer with evidence. Be sure to include data.

What are the trade-offs if the engineers choose Design B?

+/- or Pro and con - give up something in order to get something else

You can get a Smore that isn't broken or wet, but it costs a lot of money and takes a lot of time to build.

If you were to redesign one of the engineer's designed packages, how would you do it? Fill in the data table below with your redesign plan.

Package Design	Materials Used	Total Cost
Redesign		cents

In this exercise you will read the following scenario and identify the different parts of a controlled experiment.

Cattails

A scientist noticed that cattails grew only in swampy parts of his backyard. He decided to try to find out why. He went to the library and found out the following facts: Cattails are not found in deserts, Cattails are usually found in many swamps, Cattails sometimes grow in rivers and streams. The scientist thought for a while, and then said, "I think I have figured out the answer. Cattails need a lot of water to grow." He then went into his yard and dug up 125 cattails. He divided them into five groups. Each group contained 25 cattails. All of the groups were grown in the same type of soil, they all received the same amount of light, and they were all kept at the same temperature. There was only one difference between the groups. Group 1 received 4 mL of water a day. Group 2 received 3 mL of water a day. Group 3 received 2 mL of water a day. Group 4 received 1 mL of water each day. Group 5 received no water. Every day he went out and measured the plants. After 30 days he observed that the plants in Group 1 had grown an average of 8 cm. The plants in Group 2 had grown an average of 4 cm. The plants in Group 3 had grown an average of 2 cm. The plants in Group 4 had grown an average of only 1 cm. The plants in Group 5 had not grown at all. He then decided that the amount of water that a cattail receives affects its growth. Plants that receive more water grow more. The scientist then repeated his experiment using another 125 cattails.

1. Hypothesis: (If/then statement) If you give cattails more water, then they will grow more.

2. Dependent Variable: (What is being measured?) Height of cattails

3. Independent Variable: (What is being changed?) water amount

4. Constants: (What 3 things are kept the same for all of the Groups?)same soil, amount of light, and temperature

5. Control Group: (The group receiving no change) Group 5 – no water

6. Experimental Group: (The group(s) receiving a change) Groups 1 - 4

7. Conclusion: (What can the scientist conclude about plants and water?) If you give cattails more water, then they will grow more.

In this exercise you will read the following scenario and identify the different parts of a controlled experiment.

Christian's Cart Experiment

Christian wonders if a heavier cart will roll faster down-hill than a lighter one. He formulates a hypothesis and then decides to conduct an experiment. First, he finds a smooth ramp and a cart. He makes sure that the wheels of his cart roll freely. He set the ramp against a chair so one side of the ramp was 0.5 m off the ground. Next, he measures the distance the cart will travel down the ramp. He leaves about 10 cm at the top of the ramp and draws a line to mark the release position of the car. He then measures the distance the cart will travel down the ramp and has a stopwatch to time how long it will take to reach the bottom of the ramp. He starts the experiment by measuring the time it takes the cart to roll down the hill without any weight on it. For the next five trials he adds a 1 kg mass to the cart each trial. The times of the trials were 1- 27s, 2- 32s, 3- 30s, 4- 29s, 5- 30s. When comparing the data points, he decides to allow for a 5 second "fudge factor" since he may not have released the cart at precisely the exact same spot each time. He finds that adding mass to the cart does not affect the time it takes to roll down the ramp since all of his times were within 5 seconds of each other.

1. Hypothesis: (If/then statement) If mass is added to a cart, then it will roll faster down a hill.
2. Dependent Variable: (what is being measured?) time to roll down a hill/speed
3. Independent Variable: (what is being changed?) added mass
4. Constants: (List those things kept the same for all tests.) ramp 0.5 off the ground, same distance, same release position
5. Control Group (the group getting no change) carts with no added mass
6. Experimental Group: (the groups getting a change) carts with added mass
7. Conclusion: Adding mass to a cart does not affect the time it takes to roll down a ramp.