Build the Best Thermos

Name _____

STUDENT ACTIVITY

Class _____

This is a project based STEM activity that will require you to understand and perform the processes of engineering design:

- Identify
- Research
- Design
- Create
- Evaluate
- Communicate

Vocabulary

- Thermal insulator
- Temperature
- Heat
- Cooling rate

Activity Materials Per Student Group

- Compatible TI Technologies: TI-Nspire™ Apps for iPad®
- Vernier™ Go Wireless® Temp sensor
- Bottles of various sizes
- Cardboard boxes
- Newspaper
- Plastic bags
- Packing peanuts
- Vermiculite
- Perlite
- Various recycled or trash materials from around your school
- Shredded paper
- Ice cooler
- Refrigerator

Procedure

- Open the document called, “Build_the_Best_Thermos.tns” on your iPad.
- Work your way through all of the pages in the document. Make sure you pay close attention to the Background Information and the instructions that are included. Use this information as you experiment with different thermos designs.

The Engineering Problem

Your company designs and manufactures extreme outdoor clothing and equipment. Your project manager wants you to investigate insulation materials that can be used to design new products for the company. The insulation material that you recommend will be used in containers to keep food hot or cold and for cold weather sleeping bags and clothing. Your task is to determine the best insulation material

for the products and to support your conclusion with test data.

1. **Identify:** State your engineering goal here. What are you trying to build? What does it need to accomplish? How will you evaluate how well it works?

2. **Research:** Use appropriate internet resources to learn about your engineering goal. Your research may include building processes, constraints, potential problems, sources of error, materials, time limits, and scientific principles that apply to your design.

3. **Design/Prototype:** Once you have researched the engineering goal, create a plan for the building of your design. Your design may include drawings, labels, materials lists, cost lists, etc. The prototype may be a first-time attempt at building the final product to learn how to put it together. Share your design and prototype with others, listen to their suggestions and decide for yourself the very best design.

4. **Create/Build:** Use your design and prototype experience to build your product to your specifications.

5. **Evaluate/Test:** Design an experiment that will help you to decide the best design to accomplish the engineering goal. You can use the Vernier Go Wireless™ Temp probe. These wireless probes can be used inside of a refrigerator or cooler. On page 2.2 you will find data collection page for the Temp probe.

6. **Analyze:** Determine a method to analyze the collected temperature data that will help you to decide the best design. You might consider: change in temperature, best-fit linear regression, and exponential decay models

   a. Why is the slope of this graph negative?

   b. What are the units of the slope of the graph?

   c. What does the slope of your graph tell you about the thermos?

   d. What are does the Y-intercept of your graph represent?

   e. What affect would an excellent thermos have on the rate of cooling of the sensor?

f. How could the data you collected be used to evaluate your thermos?

7. **Refine:** After you have built your design and tested it, think about what you like and do not like the design. Show your product to your friends and family and listen carefully to their comments. Include the best suggestions from your customer feedback into your design and rebuild your deign to make it better!

8. **Present:** Prepare a brief presentation of your creation in a cloud based collaborative environment such as Google Drive. Share your presentation with your teacher, family and friends.