

## 4E – PROJECT: DESIGN AN INSULATOR

### Research

Using available resources (i.e. text, notes and/or internet), research the performance of insulators and their everyday uses. You will use this research to help create and complete the design of your cup.

Cost Considerations: You will need to select and measure out the specific materials you would like to use for your design. Keep track of what you are using, the quantity used and the cost of the materials. If you have brought in any alternative materials, you will need to research their price and suggest a price to your teacher based on comparable materials in the table below.

Materials	Cost
Polystyrene foam	\$0.12 per in <sup>2</sup>
Aluminum foil	\$0.10 per in <sup>2</sup>
Cardboard	\$0.08 per in <sup>2</sup>
Bubble wrap	\$0.08 per in <sup>2</sup>
Cotton ball	\$0.40 each
Rubber band	\$0.50 each
Tape	\$0.10 per in

Keep a record of your results below. Attach a separate paper if necessary.



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## Re-Design

Record your response to the following in the space below; attach another paper if necessary:

1. Alter the design and recalculate cost in order to minimize cost and heat loss. Sketch a new design, calculate cost, get approval for your new design, build it and test it as before. Record the temperature change in the Analysis section.

## Summary

Your team will present the initial and final insulator designs and overall findings to your supervisor (the class). You may use a traditional presentation board, PowerPoint presentation and/or another multimedia presentation device such as Animoto, PowToons and/or iMovie. This is your sales pitch; your team is competing with other teams to earn a contract to build the insulators for your company. Review the grading rubric on the next page to increase your chances of a successful sales pitch.

Present the insulator and graphs of all the data you collected during your sales pitch. Use these materials to justify the most cost-efficient and thermally efficient design for your insulator. Speak in an objective and scientific tone. Discuss points your audience will be interested in. For example, what are the specific reasons why the materials you chose make good insulators?

Include the cost of materials and estimate the actual cost of production to create your insulated cup. The cost of production includes pay for individuals that build the insulator, transportation costs to distribute the insulator to stores, etc. Recommend a profitable sales price for your insulator with at least 50% profit. Remember, your company is interested in a design that works and can be made at a low cost while being sold at a reasonable price.

Your supervisor is a very busy person, so keep your presentation short and to the point. It must be less than 3 minutes long. Everyone on the team must speak an equal amount of time during the presentation.

## Extension

For an additional challenge, you may be asked to explore the following options:

1. Test very cold water to determine the rate of temperature change using the beaker. The designed insulator should be able to reduce the overall temperature change for both the hot and cold water.
2. Test the hot water over a 10-15 minute time frame in order to minimize the heat lost in the design relative to the amount of heat lost in the glass beaker.
3. Limit the design to no more than 100 g above the mass of the glass beaker used. You will need to mass the beaker alone and again with the insulated material used.
4. Limit the design to an overall materials cost of no more than \$2.
5. Use recyclable, green material proposing an eco-friendly design that can be recycled upon disposal.

## Grading Rubric

<i>Criterion</i>	<i>Criterion Not Met (0 pts.)</i>	<i>Needs Improvement (1 pt.)</i>	<i>Satisfactory (2 pts.)</i>	<i>Excellent (3 pts.)</i>
<b>Temperature Change</b>	Temperature changes not measured	Temperature lost is <b>greater than</b> 2 °C in 2 minutes.	Temperature lost is <b>equal to</b> 2 °C in 2 minutes	Temperature lost is <b>less than</b> 2 °C in 2 minutes.
<b>Data Collection &amp; Analysis</b>	Data from the design and re-designed experiments are not included.	Insufficient data collected to prove the effectiveness of the design. Data may be incomplete or erroneous. Data may be disorganized and difficult to interpret.	Control data with the beaker alone indicates the overall amount of heat lost in 2 minutes. Data for the design indicates the overall heat lost has been reduced relative to the controlled experiment. Data is interpreted correctly but may not include a graph to compare runs.	Control data with the beaker alone indicates the overall amount of heat lost in 2 minutes. Data for the design indicates the overall heat lost has been limited to under 2 °C in 2 min. Students have included a graph comparing <b>multiple</b> data runs.
<b>Design</b>	The design is incomplete or missing.	Design is not reasonable to build.	Design is reasonably easy to build.	Design is attractive to consumers and reasonable to build using available supplies.
<b>Build Cost</b>	The build cost is missing.	The cost to build exceeds the sales price proposed.	The cost is less than the sales price but the profit margin is less than 50%.	The cost is less than the sales price proposed with a 50% profit margin.
<b>Visual Presentation</b>	The visual presentation was not included.	The visual presentation is missing key information required.	Visual presentation addresses all required components and is simple.	Visual presentation summarizes all required components and is interesting.
<b>Oral Presentation</b>	The oral presentation was not completed.	The salesperson was unable to explain the design, data and/or cost.	The sales group could address the design, data and/or cost but did not add in any additional, possibly pertinent information for consideration.	The sales group could address the design, data and/or cost adding some limited information that was pertinent to the sales pitch.