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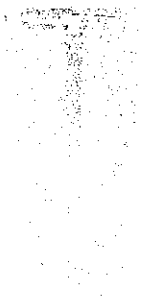
Engineer your own YETI!!!



http://yeti.com/tumbler-30

Review Key Terms:

Fill in the rest of these statements:

Heat is _____

Heat always flows from _____ to _____

If we heat up a material (such as water), the molecules begin to _____

Complete these statements:

Conduction is heat transfer that occurs _____.

Convection is heat transfer _____.

Radiation is heat transfer that is carried by _____.

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I. Challenge problem: Design an insulating device that will keep 250 ml of water the warmest for 30 minutes compared to your peers' devices.

Design constraints:

1) Fit in your teacher 's hand
2) Must hold 250 mL of hot water
3) Be structurally sound (doesn't easily fall apart)
4) No part of your container may be permanen tly altered as a result of the final test (your results must be repea table without changing your container .)
5) The container that shows the lowest change wins!

You May:

1) Use a plas tic/glass/ ceramic cup as the core
2) Use any raw materials at home or from the store as long as they obey the "May NOT" section.

You May NOT:

1) Use a thermos/tr avel mug as the core
2) Use materials only accessible to resear ch labor atory personnel
3) Use a top/ cap/lid that comple tely seals the thermos.

II. Research the problem: In the space below, summarize what you learned from your research.

Questions

Ever wonder why a thermos keeps drinks cool or warm? Or why coffee shops put cardboard sleeves around paper coffee cups? You will find out in this project! But first, ***answer these questions and cite where you found the information.*** 2 sources = 2 points

1. What does insulation do?

Citation:

2. The goal is to prevent heat from leaving your bottle. What types of materials do you think would be good at this? Tell why they might be good. List them below.

Citation:

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3. Does the thickness of your insulation matter?

Citation:

III. **Brainstorm Solutions:** In the space below describe (draw/write/label) your initial design ideas. Include annotations, questions, measurements, sources (where you found the information) ***NOTE:*** *There are just your ideas. You will describe your prototype in the next sectic*

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IV. Build a Prototype: Now that you have selected an idea to begin with, use the space below to draw your initial design before you begin building. Take you time and put effort into this drawing. It should include clean lines, measurements, labels, at least two perspectives (cut away and top down), materials, and notes. 9pts.

Prototype needs to be built by it should match your initial design and meet the constraints. (7 points)

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V. Test the prototype: Congratulations. You have built your first prototype and are ready to begin initial testing. Your initial tests should include the following:

- Size: Will it fit in your teacher's hand?
- Water holding ability: Will your prototype hold 250 ml of water?
- Structure: Is your prototype build to last? Is it structurally sound?
- Insulation: Will it keep 250 ml of water warm for 10 min or longer?

Use the space below to display your testing data. Please include a brief description of each test and column/row headings for tables and units for all data. *Attach additional pages if needed* Le points

Size Test	
Water Holding Test	
Structure Test	
Insulation Test	

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VI: Communicate Results: Now that you have tested your device, what have you learned? Is there more research you need to conduct? Are there changes you wish to make to your design? In the space below, summarize your test results and the next steps you plan to take. If you are considering a new design, please attach the new blue print to this packet. 4points

VII. Redesign/Test/Communicate: Continue with your design, building and testing. Summarize all changes you make to your design, include your revised design drawings, test data summaries and conclusion. Please take notes and include a new drawing in the space below. Remember to have two perspectives. 8 points

Final prototype consistent with your redesign, needs to be built by end of class 4).
and meet the constraints. (7 points)

Name: Date: Hr:

Class Test Results:

Time (min.)	Control Temperature	Time (min)	Our Temperature
0		0	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
Total Change		Total Change	

What was the total change in temperature of your device?

What was the total change in temperature of the winning device in your class?

Complete Summary on the next page.

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Summarize your final test data. Includehow you think you arrived at these results. What about your design worked? What did not work? How was heat energy transferred in your device? What helped the winning design retain the most heat? If you had to do these all over, what would you include in your design or what furtherresearch would you conduct to design a winning thermos or improve the one you built. (one-two paragraphs) Make sure you answer each question. (7points)

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NAME: *Class:*

Research-	
Student used at least two sources	2pts
Initial Ideas-	
Student recorded initial ideas using both words and pictures	2pts
Included annotations, questions, measurements, labels.	2pts
Incorporated research content in designs	2pts
Included at least two perspectives (cut away and top-down)	3pts
First Prototype-	
Student built a prototype consistent with their initial design	3pts
Prototype was built by deadline (Due Date:)	2pts
Prototype met the design constraints	2pts
Testing-	
Student completed first round of testing	2pts
All tests were recorded in journal/lab packet	2pts
Data tables with labels/units were used when appropriate	2pts
Communicate-	
Student summarized test results	2pts
Questions, additional research, design modifications included	2 pts
Redesign-	
Student created new drawing (final)	2pts
Included annotations, measurements, labels.	2pts
Incorporated research content in designs	2pts
Included at least two perspectives (cut away and top-down)	2pts
Final Prototype-	
Student built a prototype consistent with their initial design	3pts
Prototype was built by deadline (Due Date:)	2pts
Prototype met the design constraints	2pts
Summary- (Due Date:)	
Student summarized final results including	
-The problem they worked on	1pts
-How their initial ideas changed from first to final prototypes	2pts
-How heat energy transferred worked in all their designs	2pts
-Which was most efficient at retaining heat and why	2pts

TOTAL /50