ENGINEERING DESIGN JOURNAL

STUDENT NAME: ______________________________ ID #______________

CLASS: ____

PERIOD: ____

SCHOOL: ____

DATE: ____

GROUP MEMBERS: ____

Hofstra University Center for Technological Literacy
Simulations and Modeling for Technology Education

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SURVIVAL MASTER ACTIVITY

THIS ACTIVITY WILL INVITE YOU TO UNDERTAKE THE DESIGN OF AN EMERGENCY SURVIVAL SHELTER.

KEY:
BLUE PAGE TABS: *Individual Activity*
GREEN PAGE TABS: *Group Activity*

PROBLEM SITUATION: *Here's the problem situation:*

You and three others are competing to become part of an elite team known as the Survival Masters. Survival Maters are highly skilled survivalists who help when natural disasters strike. The competition is taking place in a remote area of Alaska.Shortly after arriving, an earthquake strikes and destroys buildings, wrecks power lines, cracks the airport runway, damages roads, and triggers a landslide. Even the tent you were using has been ripped to shreds by falling debris. You are cut off from civilization except for the battery operated radio equipment that you have brought with you.

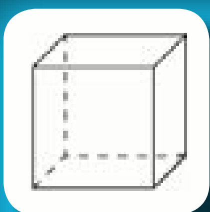
DESIGN CHALLENGE: *Here is the design challenge you are asked to undertake. It should be pretty interesting for you and you'll need to use your science, technology, engineering, and math skills.*

You and your fellow contestants are 200 miles from the nearest city and the earthquake has made travel impossible. You must work together as a team to build a shelter to keep you warm during the time it will take for a rescue team to reach you.

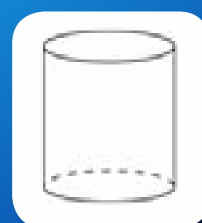
With temperatures below freezing, your challenge, as one of a team of earthquake victims, is to design and build a rapidly erectable structure that will provide insulation from the cold, withstand the weight of snow (snow load) and the force of wind (wind load); and be built from materials that are readily available locally.

SURVIVAL MASTER ACTIVITY

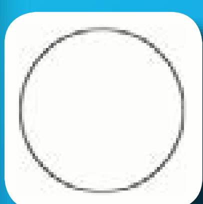
SHELTER SHAPES: *Here are the shapes you will consider for your shelter design challenge.*



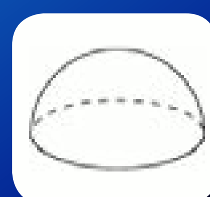
CUBE: Volume (V) of a cube is $V = s^3$
The surface area (SA) of a cube is $SA = 6*s^2$



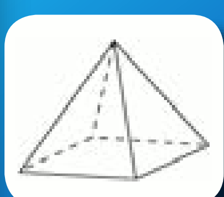
CYLINDER: Volume of a cylinder is $V = \pi r^2 h$
The surface area of a cylinder is $SA = 2\pi r^2 + 2\pi rh$



SPHERE: Volume of a sphere is $V= 4/3 \pi r^3$
The surface area of a sphere is $SA = 4 \pi r^2$



HEMISPHERE: Volume of a hemisphere (half a sphere) is $V = 2/3 \pi r^3$
The surface area of the hemisphere is: $SA_{hemisphere} = 2 \pi r^2 + \pi r^2 = 3 \pi r^2$



SQUARE-BASED PYRAMID: Volume of a square-based pyramid is $V = (1/3)\ l*w*h$
The surface area of the square-based pyramid is $SA = 2bh+ b^2$

DESIGN SPECIFICATIONS: *Specifications are the performance requirements that a design solution must fulfill. These are the design specifications you will have to meet.*

DESIGN SPECIFICATIONS:

- We can assume a daytime temperature high of 65° F and that temperature will fall drastically once the sun goes down.
- The shelter must be kept at an inside temperature of at least 45° F when the outside temperature drops to 25° F. Lower than that, hypothermia will set in even if the team members are wearing jackets.
- The only heat source available is the body heat of the four team members.
- The shelter must be large enough for all four survivors to sleep side by side and sit up comfortably within it.
- The shelter must sustain a 40 mile per hour wind and a snow load of 20 pounds per square foot.

DESIGN CONSTRAINTS: *Constraints are often related to the kinds of materials you can use, how much time is available, and in many cases, how much money the finished design can cost. Because you're in a survival mode, cost is not as important as it might otherwise be. Here are the constraints (the limitations) that you have to work within.*

DESIGN CONSTRAINTS:

- The shelter must be built in one 13-hour day (equivalent to about twenty 40-minute class periods), or survivors will be at risk of hypothermia.
- Your team may use only the materials found at the earthquake site to build the shelter including:
  - Natural materials (such as spruce trees and boughs)
  - Items that were stored in the team's tent including:
    - Plywood, 1 x 2s, and 2 x 4s
    - Fiberglass fishing poles
    - Fiber glass and Styrofoam insulation
    - Newspaper
    - Corrugated cardboard
    - Plastic (polyethylene) tarps
    - Canvas
    - Rope and twine
    - Duct tape
    - Assorted hardware, and hand tools
    - Any other materials provided by the instructor

INDIVIDUAL STUDENT ACTIVITY

This Guide is provided to help you design your emergency survival shelter in a structured and logical way. In order to better complete the design challenge, you need to first gather information to help you build a knowledge base. You will do so by completing a series of **Knowledge and Skill Builders** (KSBs).

Doing so will help you design a functional survival shelter.

FIRST, RESTATE THE DESIGN CHALLENGE IN YOUR OWN WORDS

(Write it below):

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WHAT ARE THE SPECIFICATIONS AND CONSTRAINTS THAT YOU HAVE TO CONSIDER IN DESIGNING THE SHELTER?

(Write them below):

Specifications:

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Constraints:

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INDIVIDUAL STUDENT ACTIVITY

LIST THE MATERIALS YOU WILL NEED

(Write them below):

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______________	______________	______________
______________	______________	______________
______________	______________	______________

INDIVIDUAL ACTIVITY

PLEASE WRITE DOWN ANY SAFETY CONSIDERATIONS YOU CAN THINK OF

(Write them below):

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GROUP ACTIVITY

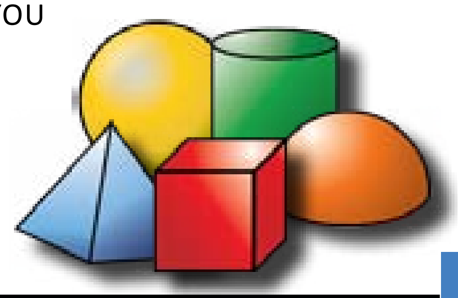
SHARE YOUR IDEAS WITH THE GROUP.

Make any additions shared by group members.

NOW PLEASE GO ON TO KNOWLEDGE AND SKILL BUILDERS 1-4

INDIVIDUAL STUDENT ACTIVITY

AFTER YOU COMPLETE THE KNOWLEDGE AND SKILL BUILDERS, YOU WILL BEGIN TO DESIGN THE SHELTER.



GENERATE ALTERNATIVE DESIGNS

(Describe at least two designs in the boxes below):

DESIGN VERSION 1

DESIGN VERSION 2

GROUP JOURNAL ACTIVITY

CHOOSE AND JUSTIFY THE OPTIMAL SOLUTION

What decisions did you reach that guided your choice of shelter design? Why did your group settle on this approach? What tradeoffs did you make in coming to this decision?
(Write your answers below):

Decisions For Choice:

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Why The Approach:

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Any Tradeoffs:

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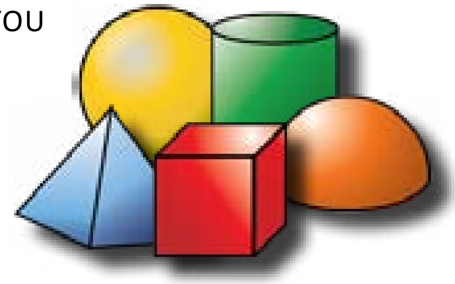
GROUP ACTIVITY

AFTER YOU COMPLETE THE KNOWLEDGE AND SKILL BUILDERS, YOU WILL BEGIN TO DESIGN THE SHELTER.



GENERATE ALTERNATIVE DESIGNS

(Describe at least two designs in the boxes below):

DESIGN VERSION 1

DESIGN VERSION 2

HEAT FLOW CALCULATION:

GROUP JOURNAL

Construct a scale model of your design. Include a photograph of the finished scale model.
(Attach to Journal in the box below):

Photo of Constructed Scale Model

GROUP ACTIVITY

GROUP ACTIVITY

TEST AND EVALUATE YOUR DESIGN

Explain how you designed a test for your solution, and what the results were.
(Write your answers below):

How We Tested (3 Tests):

HEAT FLOW	SNOW LOAD	WIND LOAD
______________________	______________________	______________________
______________________	______________________	______________________
______________________	______________________	______________________
______________________	______________________	______________________
______________________	______________________	______________________
______________________	______________________	______________________
______________________	______________________	______________________
______________________	______________________	______________________
______________________	______________________	______________________

Results:

______________________	______________________	______________________
______________________	______________________	______________________
______________________	______________________	______________________
______________________	______________________	______________________
______________________	______________________	______________________
______________________	______________________	______________________
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GROUP ACTIVITY

REDESIGN THE SOLUTION

What did you learn through the design and/or testing of your model that would inform its redesign? What additional tradeoffs would you have to make?
(Write your answers below):

What You Learned:

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Additional Tradeoffs:

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GROUP ACTIVITY

COMMUNICATE YOUR ACHIEVEMENTS

Describe the plan you will use to present your solution to your class. (Include a media-based presentation). Demonstrate how you tested the design. Explain what the key learnings were in this activity.
(Describe your plan below):

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INDIVIDUAL STUDENT ACTIVITY

REFLECT ON THE KSBS

What did you learn in each KSB?

KSB 1

What did you learn about volume and shapes?

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How does the surface area of a dome compare to a square?

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KSB 2

How does surface area affect heat transferred?

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How does heat flow change with thickness of material?

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KSB 3

R and k value both measure a materials resistance to heat flow. How is R differerant from k?

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KSB 4

What are the different types of loads that can be placed on a structure?

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What does a structure nees to have structural integrity?

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How does a foundation of a structure affect stability?

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Survival Master Presentation Assessment	Participant Name or ID number				
EVALUATIVE CRITERIA					
Overall Presentation Quality (70pts)					
Introduction (interest and appeal) 10 pts.					
Clarity & sequence of presentation 10 pts.					
Students dressed well (business casual) 10 pts.					
Clarity of speech, pacing, pitch 5 pts.					
STEM Learning					
Did students explain what they learned? 10 pts.					
Did students explain the tradeoffs they made in arriving at their group design solution? 10 pts.					
DId students propose revisions based on what they learned? 10 pts.					
Did the students play an active role in developing and making the presentation? 10 pts.					
Use of Media					
Use of multiple types of media 10 pts.					
Quality of materials 10 pts.					
effective use (transitions, creativity) 5 pts.					
Total Points					
Comments:					