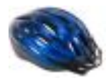
Name: ______________________

Partner: ______________________

 ____ / 40 

Monday, September 17th, 2017
ST 306-08
Centennial Regional High School

LAB I: HELMET ENGINEERING CHALLENGE (PART B)

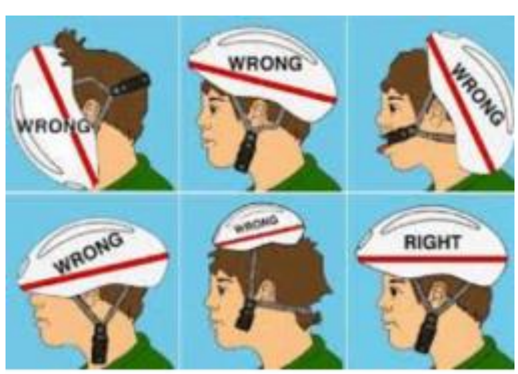
EXPLANATION AND PRELIMINARY RESEARCH

The bones of the musculoskeletal system protect vital organs such as the brain, heart, lungs, and spinal cord. However, sometimes this protection is not adequate enough to handle traumatic constraints.

Using information from the previous part of the lab, your class notes, and from external sources, your job is to engineer a miniature helmet that will minimize the damage caused by a traumatic constraint as much as possible. In other words, you and your partner are competing against the rest of the class to design the best miniature helmet. You will be using the materials that you analyzed in the previous activity.

Before you begin the exercise, briefly research what makes a helmet effective (you may use your phone to look up information). Your research should aim to answer these questions:

- What type of materials are typically used?
- How are these materials arranged?
- How strong must a helmet be to be considered safe?
- Any other considerations that you believe are relevant.



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Material Properties

Describe the properties of the materials that are needed for the inner lining and outer shell of your helmet. What materials do you think are most suitable?

Inner lining: ____

____

____

Outer shell: ____

____

____

___ / 6

Materials and Procedure

For this lab you are provided with:

- A mass
- A drop tube apparatus
- Playdough to simulate the brain
- Caliper
- Various materials (foam core, foam, cardboard, bubble wrap, grip mat, grid mat, felt). You are only provided with **one** piece of each material.

Before building or testing the strength of your helmet, you need to have a control value to measure your results against. This means you need to simulate a trauma event with <u>no protection</u> so you can see the difference a helmet makes. Follow these steps:

1. Mold your playdough into a hockey puck shape. Make sure the thickness of the playdough puck is as consistent as possible.

2. Measure the thickness of your puck using the caliper. Record this thickness in Table 1.

3. Place the puck directly under the drop tube.

4. Drop the mass down the drop tube such that it lands directly on top of the puck.

5. Using the caliper, measure the new thickness of the puck after the impact. Record this thickness in Table 1. Use this number to calculate the change in thickness.

6. Repeat these steps twice more so that you have 3 trials.

7. Record the average width and change in width from before and after the drop for your 3 trials.

In the box below, draw a diagram of the drop tube apparatus (using **colour**). Label the drop tube, mass, playdough, landing platform and support arm.

Diagram: ___ / 4

Labels: ___ / 1

Purpose of mass: ______________________________

____

Purpose of playdough: ______________________________

____

Purpose of drop tube: ______________________________

____

___ / 3

Table 1: Control Drop (No Helmet Protection)

	Width Before Drop	Width After Drop	Change in Width
Trial 1			
Trial 2			
Trial 3			
Average			

___
3

Build your helmet and draw a cross-section of it below, using **colour**. Make sure that each material is labelled.

Diagram: ___
4

Labels: ___
1

Repeat the procedure, but this time with your playdough puck **protected** by your helmet. Put all your results in Table 2.

Table 2: Test Drop (With Helmet Protection)

	Width Before Drop	Width After Drop	Change in Width
Trial 1			
Trial 2			
Trial 3			
Average			

___ / 3

<u>DATA ANALYSIS</u>

1. What **mechanical constraint** did you put on your device? Give the name and draw the symbol that represents it.

   ____

   ____

2. What **mechanical property** of the playdough was used to show how much force was transferred through the protective layers?

   ____

   ____

3. What type of material **deformation** did you measure with the playdough puck?

   ____

   ____

___ / 6

CONCLUSION

Use the data you collected to compare the results of your protective device to another group's results. Describe how you could have made your helmet or the other team's even more effective. Be **very specific** in your recommendations, using the vocabulary that you have learned in class.

____ / 5

This lab is due Thursday, September 21st (Period 4).
You lose 10% for every day that it is late.