Changing Buoyancy ***Nar m tyaww ko (name in Burmese)*** _____

Phenomenon: The following pictures are of different species of rockfish that have been caught by anglers. What has happened?



Activity 1 - Mini-Submarines

Focal Question to be answered by the end of this activity: How do fish and submersibles (submarines and research vessels such as Alvin) change their position in the water column?

1. Predict: Based on our prior investigations how do you think fish change their position in the water column? Manmade submersibles?

Investigation: Making a Mini-Submarine

Task: **Design and construct three different submarines using different materials. You may need to research methodologies on your Chromebooks as simply combining powders is not permitted. Record the exact procedure used to construct each submarine. Be conservative with your materials. You must show me at least one of your working submarines to receive credit**.

Materials:

- Canister with hole in lid
- Pennies
- Baking soda (approximately 10 mL)
- Effervescent antacid tablets (one package only)
- Container
- Baking powder (approximately 10 mL)
- Citric acid (approximately 10 mL)

**Be conservative with your materials.

2. Write out your procedure and have your teacher approve it before conducting your experiment 3. Revise your procedure as needed to complete the task

Table 1: _____

Submarine	Contents *(including amounts)*	Observations

Conclusion/Reflection

4. What needed to occur in order for your mini-submarine to touch the bottom then rise to the top? Explain.

5. How do you think bony fish achieve the same thing? Submersibles?

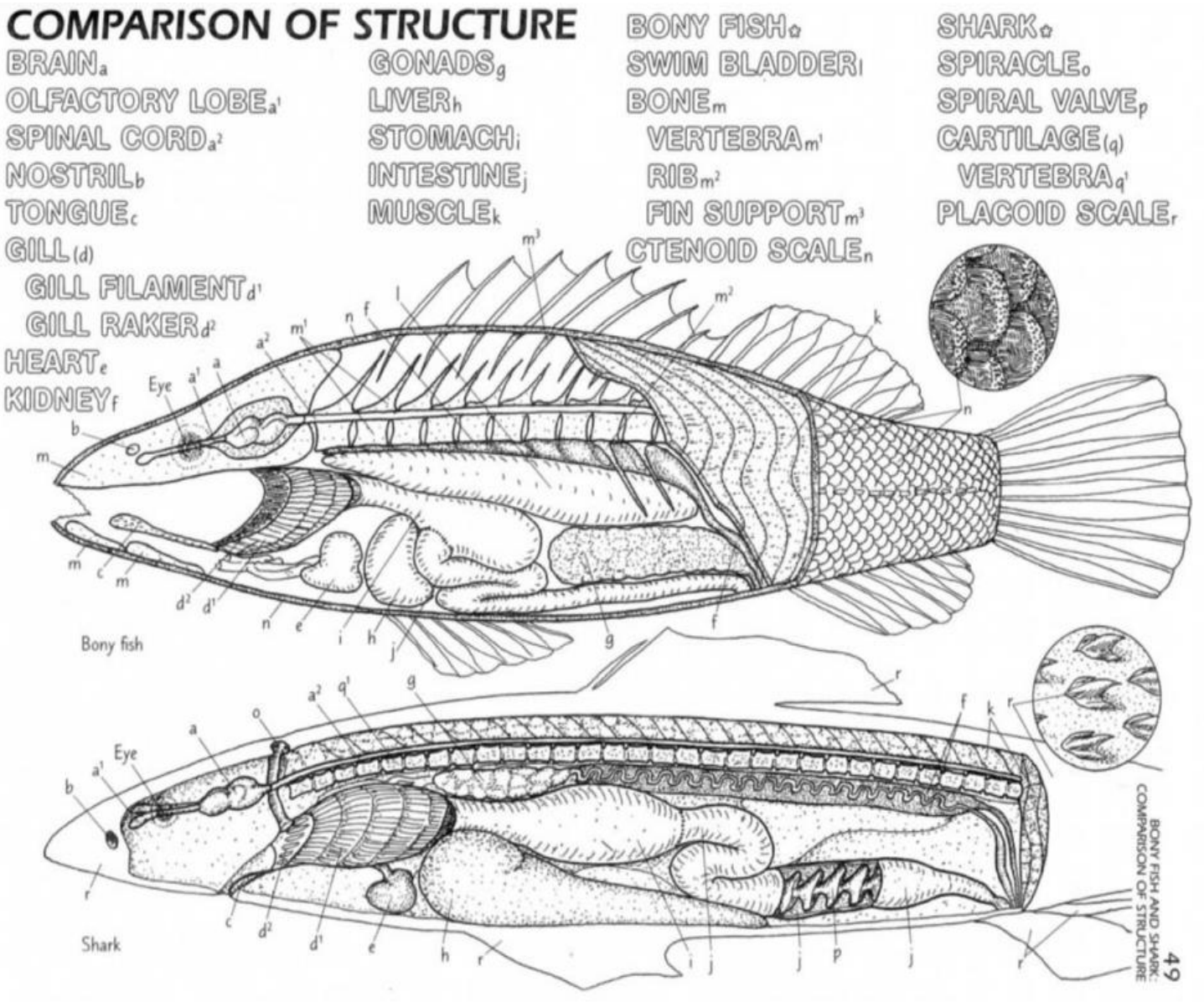
Activity - Diagramming Mini Submarines – A Reflection

What was happening to the mini-submarine in order to change its position in the tank. Your model must include the following:

- The role of density
- The forces acting on the submarine (weight and buoyant force should figure in)
- What occurred that resulted in the change of position

Activity 2 - Bony Fish and Shark: Comparison of Structure

Directions: Complete the bony fish and shark comparison of structure coloring activity. For each of the structures choose the color you would like to use and color on both fish.



7. Compare and contrast the adaptations that the bony fish and shark have for buoyancy. How is this related to the phenomenon?

Activity 3 – Fish Morphology

Directions: Use the handout to color the different structures on the fish and answer the following questions. Feel free to use the links on the pdf version of this document on the website to help you answer these questions. Detail is key, as is the major physical ocean characteristics we've covered to date.

8. What is the function of a streamlined body shape in fish?

9. Compare the different body forms. Which body form is best suited for swimming? Which is not? Why?

10. Complete the following table in your lab notebook to identify the function of each fin on the fish.

Table 2: _____

Structure	Paired? Yes or No	Function
Caudal Fin		
Dorsal Fin		
Anal Fin		
Pectoral Fin		
Pelvic Fins		

11. What might happen to a fish if it were lacking an operculum? Lateral line?

12. How do the nostrils of the fish differ from yours? How are they alike?

13. How is the placement of the mouth on a fish related to its function?

Activity 4 - Fish Anatomy Review – These links can be used to answer any of the questions regarding fish anatomy.

Salmon Dissection to Review Internal Anatomy

Review External and Internal Anatomy of a Bony Fish

Fish Body Parts Quiz

- Note - Gill Cover is used instead of Operculum

Internal Organs of a Fish Quiz

Shark Anatomy Quiz

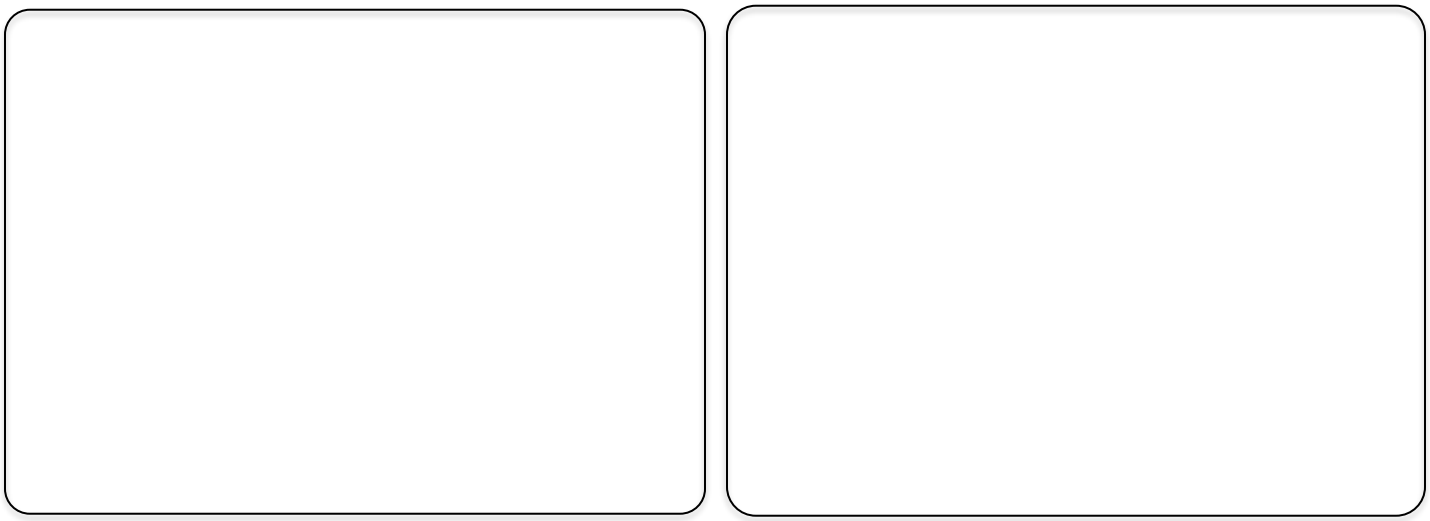
Activity 5 - Under Pressure

Directions: Watch the following short video and answer the questions that follow in your lab notebook.

Fish, Swim Bladder and Boyle's Law

14. In the video what does the balloon represent? Weights?

15. What does Boyle’s law tell us?
16. Draw a diagram showing the role of pressure on a swim bladder at 100 meters vs. 0 meters.



17. Relate your new understanding of Boyle's law and the relationship between pressure and depth to the phenomenon of the rockfish. Start by describing Boyle's law.

Activity 6 - Just how much pressure are we talking about?

Directions: Calculate the amount of pressure at each depth *and answer* the questions that follow.
Remember, pressure is 14.7 psi at sea level and with every foot of depth you dive, pressure (psi) increases by 0.445 psi. Example: So if you're right at sea level, the pressure will be 14.7 psi. And for every foot you go underwater, you add another 0.445 psi. So at one foot deep, the pressure would be 14.7 psi + 0.445 psi = 15.145 psi. And at two feet deep it would be 14.7 psi + 2(0.445 psi) = 15.59 psi, etc.*
Conversion Factors: 1 Mile = 5,280 feet,

Table 3:_____

Location	Elevation (Depth Miles)	Pressure (psi)
Challenger Deep in the Mariana Trench	6.83	
The wreckage of the Titanic	2.4	
First recorded hydrothermal vent	1.6	
Loihi submarine volcano summit	.62	
Museo Subacuatico de Arte	.002	
Sea Level	0	14.7
Mount Everest	5.5	4.5

- *Note that for every foot of depth, pressure (psi) increases by 0.445 psi.*

18. What is the correlation between depth and pressure? **Use data** to support your response.

19. Determine the pressure for the max depth of at which a yellow eye rockfish could be found. You will need to refer to the NOAA fisheries information.

20. How can the difference between the pressure at the max depth for the yellow eye rockfish and the pressure at sea level explain the observed rockfish phenomenon?

Activity 7 - Bring That Rockfish Down

Directions: Watch the following short video and answer the questions that follow in your lab notebook

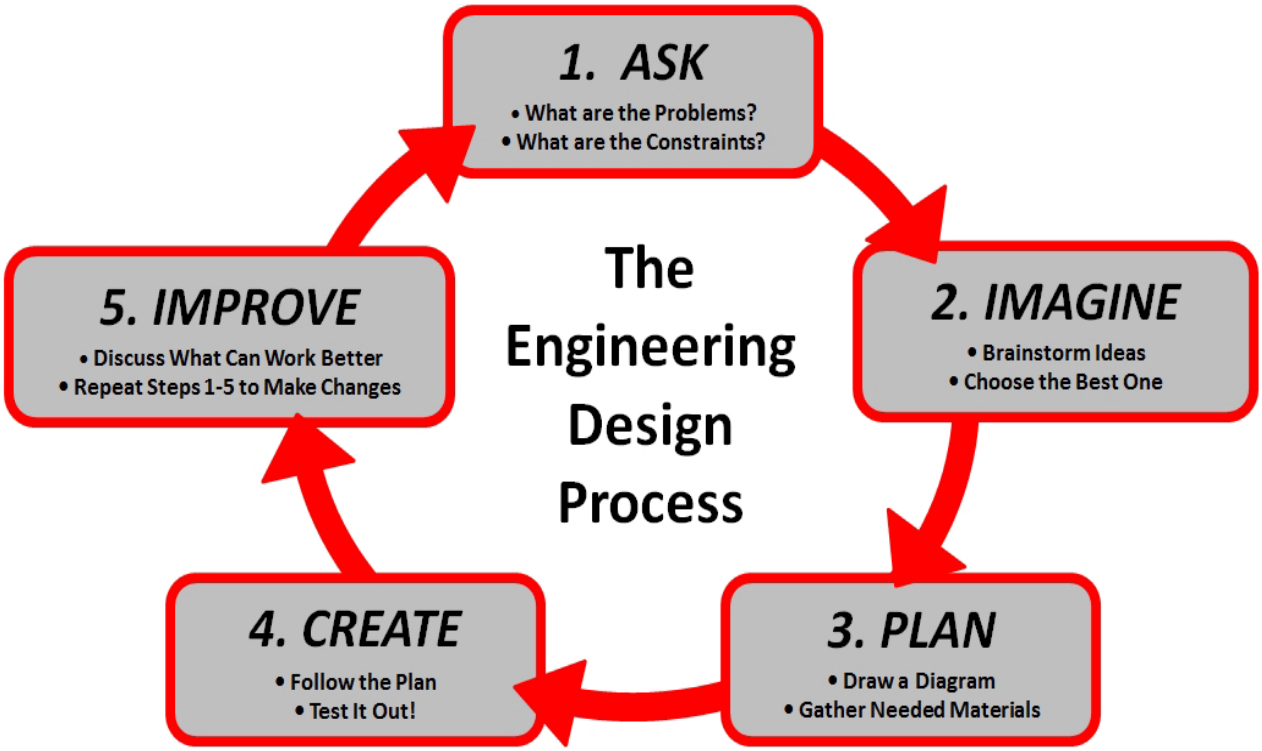
Rockfish Release Devices

21. What do all the release techniques share in common?

22. Using bring that rockfish down, explain the condition that rockfish experience when caught and how these release techniques can save the fish.

Activity 8 - Marine Engineering

Directions: You and your lab group have been hired to collect living fish specimen from the twilight zone of the ocean. You must design a piece of equipment to take along with you on your collection trip that will allow the fish to survive the trip to the surface as well as remain alive to be relocated to a local aquarium. The fish will eventually become part of the new twilight zone exhibit!



24. Complete steps 1-3 of the engineering design below given the design task above.

Activity 8 Continued - Marine Engineering

Directions: Watch the following short video from the California Academy of Sciences and answer the questions that follow in your lab notebook.

Bringing Fish Up from the Deep

25. Compare and contrast your design with the design presented in the video.