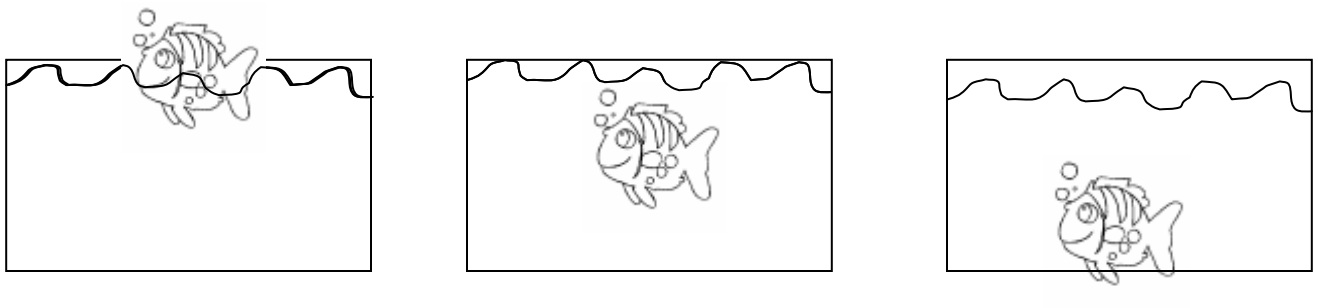
Fishy Physics

A **B** **C**



Fish are very mobile in water. They are able to swim to the surface, lounge in the middle of the water or sink to the bottom.

How are fish able to move so easily from one location to the next?

I. Building Fish

To understand how fish change height in water you will be creating your own water balloon fish. Your job is to use a balloon, and salt & water to create three fish. Fish A will float on top of the water. Fish B will float in the center of the water. And fish C will sink to the bottom. (See picture above.)

Each group will be given the materials to create their fish and a beaker of water to test their fish creations.

Making Sense Fish Heights

1. Take the mass of each fish and record in table below.
2. Measure the volume of the fish.
3. Measure the volume of the water displaced by the fish.
4. Calculate the density of the fish.

Fish Data

Fish	Mass of Fish (grams)	Volume of Fish (mL)*	Volume of Water Displaced by Fish	Density of Fish (g/mL)
A				
B				
C				

Which fish is the least dense?

Which fish the most dense?

How does density relate to the depth of the fish?

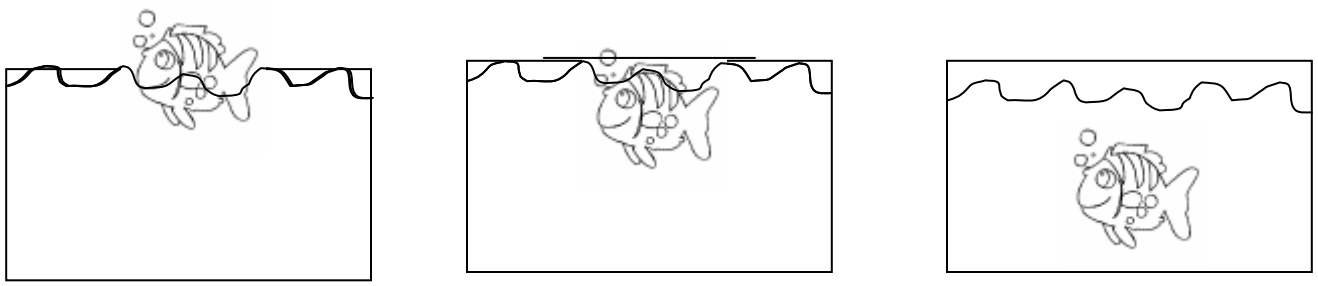
If each depth correlates to a specific density how is a single fish able to move from the top of the water to the bottom of the water? Find an article or book that explains how fish do this.

Buoyancy Force

We have observed the phenomena that a fish floats to the top if it is less dense than water, sinks if it is more dense than water and floats in the middle if it has equal density of water. Let's now analyze the forces involved.

1. Draw the forces acting on each of the fish below and clearly label each force.

A **B** **C**



Check your force diagrams with the instructor.

2. For each of the fish write an equation using Newton's Second Law write an equation for the net force for each of the fish.

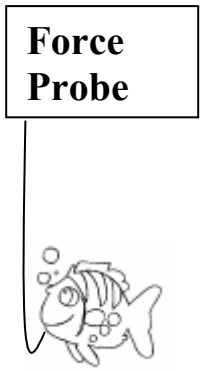
Net Force on Fish A =

Net Force on Fish B =

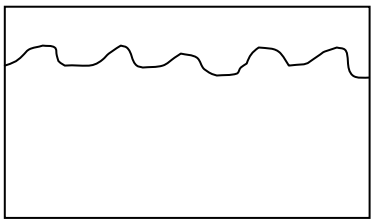
Net Force on Fish C =

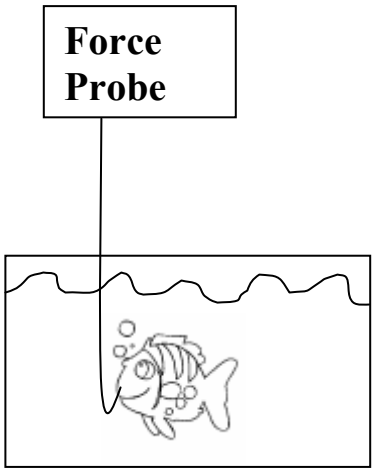
The force the water applies to the fish is called the ***buoyant force*****.**

3. In the diagram below a fish is attached to a force probe in which the fish is being lowered into a cylinder of water. On each diagram draw the forces acting on the fish.



Fish A





Fish B

4. Using Newton's Second Law write the net force acting on both fish.

Net Force on Fish A =

Net Force On Fish B =

5. Now solve for the buoyant force for each fish.

Buoyant Force on Fish A =

Buoyant Force on Fish B =

Check buoyant force equation with instructor.

6. Zero Force Probe

Make sure the mass is attached to the spring and mass is at rest.
Press 1 for SETUP
Press 3 to ZERO
Press the number corresponding to CH1- Force (n)
Press ENTER

7. Attach a water balloon fish to the force probe as shown in the above diagram.
8. Record the force probe reading when the fish is above the cylinder of water in the table below.
9. Now lower the fish into the water so that 2 mL of water is displaced. Record the force probe reading.
10. Repeat step 3 until the entire fish is submerged in the water.
11. Calculate the buoyant force on the fish at each depth in the cylinder.

Buoyant Force Table

Volume of Water Displaced	Force Probe Reading	Buoyancy Force
0		
2 ml		
4 ml		

12. Graph the buoyancy force vs. volume of water displaced with the graph paper supplied. Attach graph to lab pages.

13. What is the relationship between the water displaced and buoyancy force?

14. Calculate the slope of the graph.

Slope =

This slope is the density of water. At room temperature is should be 998 g/mL.

15. Write an equation that expresses the buoyant force on a fish in terms of the volume and density of the water displaced.

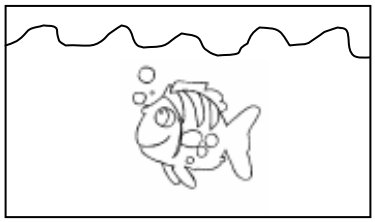
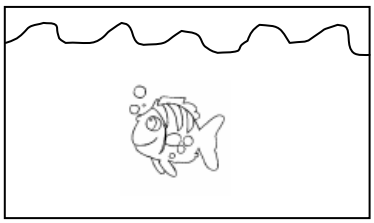
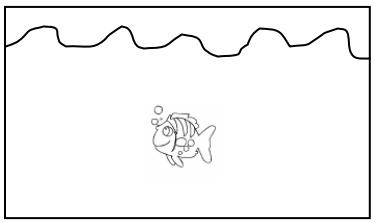
Buoyant Force =

Check equation with instructor.

<u>Follow- up Questions</u>

1. **Would the buoyant force increase, decrease, or remain the same if you continued to move the balloon fish deeper in the water after submerging it completely?**

2. Which of the following fish has displaced the greatest amount of water?

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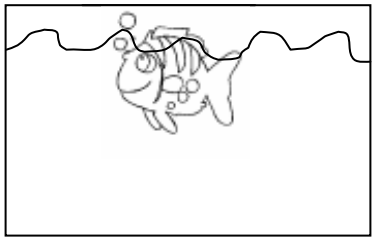
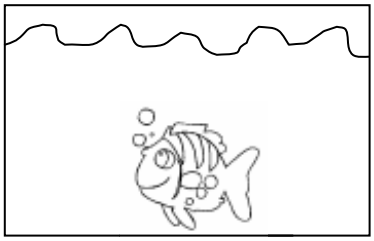
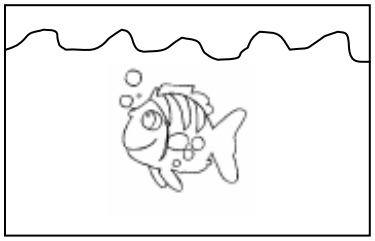

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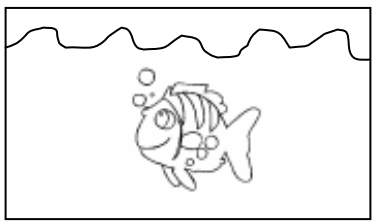
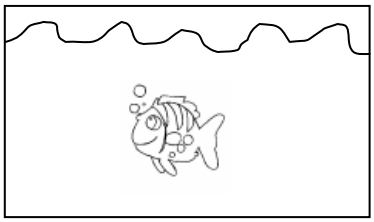
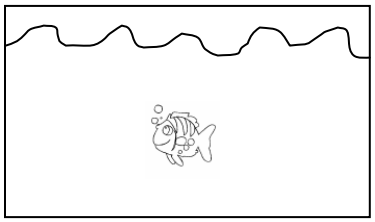

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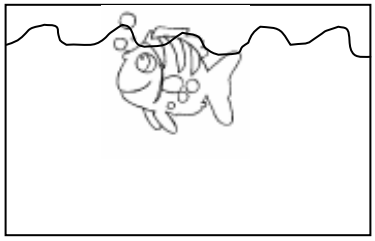
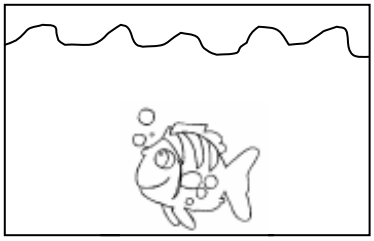
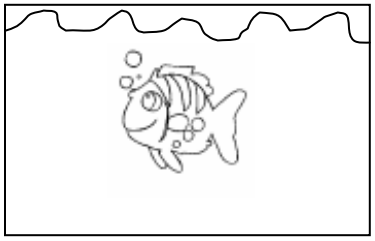

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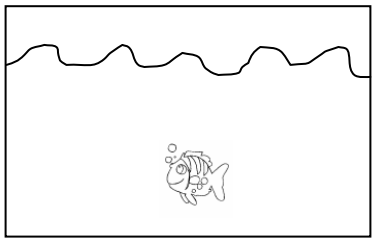
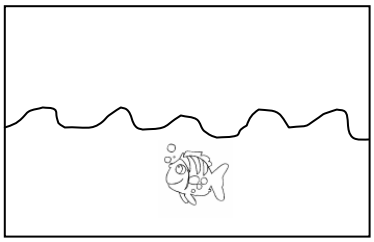
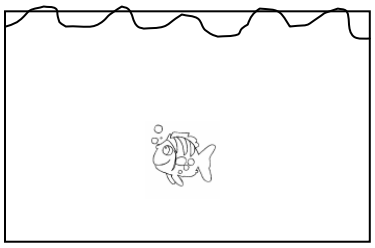

Equipment

 # per group

- **Balloons (3)**
- **Salt, water → to create three fish at different levels**
- **Labpro (1)**
- **Force probe (1)**
- **Graph paper**