Design-a-Plankton Challenge

Your task: Your task is to design the 'perfect' planktonic organism. Your model should consider the feeding and survival mechanisms employed by different plankton forms. Most importantly, your model must achieve neutral buoyancy, meaning that your model neither sinks nor floats in water.

Key Background information

If you throw a stone in the water, it will sink. In fact, anything that's denser than water will sink. You've probably noticed that you yourself also sink unless you expend energy and do 'work' swimming to keep yourself afloat. So how come we see whales, sharks and fish 'floating' around, at a range of depths within the water column, not expending energy swimming but still not sinking? After all, they're heavier than us, aren't they? The key is density.

Whether something sinks or floats in water is determined by its density (mass/volume) relative to the density of the surrounding water. The density of water is 1 kg/L (this means that 1 litre of water weighs 1 kg), anything denser than that (that is, anything that has more mass per unit volume, so 1 litre of it weighs more than 1 kg) will sink; anything less dense than that will float, and anything that is exactly 1 kg/L will be submerged motionless, without sinking or floating.

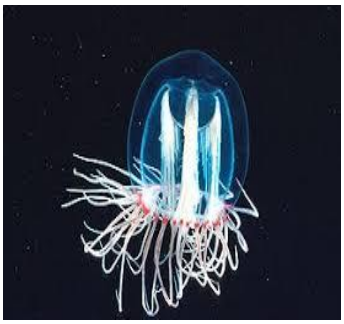
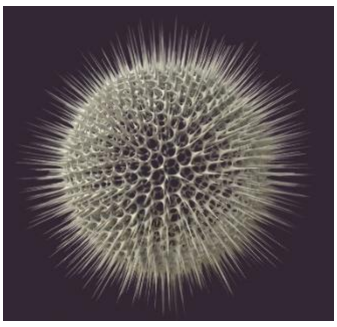
Animals are denser than either fresh or seawater, and therefore tend to sink, unless they have adaptations that give buoyancy. Marine animals have adapted superbly to life in a highly variable and dynamic ocean. Neutral buoyancy is a type of buoyancy common in pelagic marine animals that allows an animal to change its position within the water column (to dive, balance and breach the surface) without it being too energetically costly to the animal. Imagine an animal that is as dense as a rock trying to swim up for air, or one that has low density, like a balloon, trying to dive down to find food; it would take a lot more energy to counteract that net buoyancy-weight force (up or down) than it would if that net buoyancy-weight force was 0. So, by having neutral buoyancy, marine animals save energy. Which is important for ocean-dwelling animals.

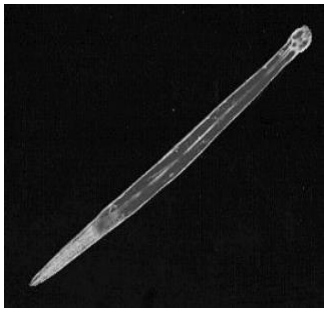
How do marine animals achieve neutral buoyancy? Through adaptations such as:

- Increased fat stores in their bodies (fat is less dense than water)
- Gas filled swim-bladders (air is less dense than water)
- Cartilaginous frames in lieu of bone
- Some sharks have an oily liver (oil is less dense than water)

Things to Consider

Plankton have an assortment of unique adaptations to help them maintain a neutral buoyancy in the world's oceans. Here are some common examples to get you started on your design:

Plankton Type	Adaptations	How to re-create
 Jellies	Their bodies are lightweight and often transparent.	• Plastic • Sandwich bag • Cork • Aluminium
 Calanoid Copepods	Their bodies contain oil sacs to aid buoyancy.	• Air-filled balloon • Sponge • Foam • Styrofoam
 Radiolarians	Many contain bubble-like compartments filled with gases, called alveoli, and long, movable spines and needles that serve to increase the surface area of the organism.	• Air filled balloon • Feathers • Toothpicks • Pipe cleaners • Feathers • Kebab skewers

 Arrow Worm	A large surface area: volume ratio. Their bodies are long, thin and flat	• Thin plastic pieces • Straws • Aluminium

Materials

- A large container to fill with water
- A variety of construction materials, of different weights and densities
- Stopwatch
- Worksheet

Note: *Lots of different household materials can be used to construct your model plankton. Be as creative in your material selection as possible. Each model should be constructed with items that enable your model to sink and items that float to counteract the sinking. You should also consider the 'plankton adaptations' worksheet when designing and constructing your plankter*.

Activity: Can you build the perfect planktonic organism?

Steps:

1. To understand the unique and diverse adaptations and survival mechanisms present within planktonic organisms, read the supporting fact sheet 'About Plankton', plankton adaptations sheet and watch our presentation '
2. In the space below, complete a design scaffold for your plankter. Consider the aspects of neutral buoyancy and key plankton adaptations in your design.
3. Identify and label the key features of your model plankton.
4. List the materials you plan to use for your model.
5. Construct your model.
6. Test your model in a container of water (a large food storage container will work well for this section).
7. Record how long it takes for your model to sink to the bottom. Record your results
8. If necessary, adjust your model and re-test. Record your results.

9. Complete the below questions.

10. Take a photograph of your new plankter & share it with us on at education@sims.org.au

11. Name your plankter.

Your plankters name is _____

Explanation of Name:

Focus Questions

1. Test your plankton model. How long did it take for your model to sink to the bottom of the container?

   Time Trial 1 _____ Time trial 2: _____

   For trial 2, what modifications did you make to your initial design?

   Does size influence the sinking rate of your model? Explain your observation.

   Yes No

2. Describe how you achieved neutral buoyancy in your model? (How did your model not float to the surface or sink to the bottom).

   _____

   _____

   _____

3. What features will give your model plankter an advantage over other plankton?

   _____

   _____

   _____

4. Why is the ability to maintain neutral buoyancy important? Why don't plankton float on the surface or sit on the bottom of the water column?

   _____

   _____

   _____

5. List four adaptations or strategies that plankton (phytoplankton and zooplankton) use to move around the water column?

   1. 3.

   2. 4.

6. Why is important for phytoplankton (plant plankton) to stay in the photic zone of the ocean? The photic zone is the surface layer of the ocean.

7. Why is vertical migration through the water column important for plankton?

Don't forget to share your models with us at education@sims.org.au!

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