FINDING FOOD: WHY WEDDELL SEALS DIVE DEEP INTO THE OCEAN AND HUMANS REACH DEEP INTO THE REFRIGERATOR

Although swimming is a fun activity for people, we're not very good at it compared to marine mammals. Fortunately for us, we don't rely on having to swim, dive, or hold our breath in order to find food, the way a Weddell seal does. Our bodies and Weddell seal bodies are different physiologically. For example, even though we both breathe oxygen in order to stay alive, Weddell seal bodies differ from human bodies in that they are able to hold much more oxygen in their blood and their muscles than human bodies rather like an internal SCUBA tank. This allows the seals to hold their breath for much longer than we can. Since oxygen is necessary for muscles to be able to work, Weddell seals also have developed special ways of swimming that minimize the amount of oxygen their muscles use while they are diving, allowing them to conserve their internal SCUBA tank and stay underwater even longer. By compressing and moving the air in their lungs they can change buoyancy during the dive. These changes help them sink to the bottom of the ocean during the descent part of their dive and then surface like a balloon on the ascent portion. In this way they can take fewer flipper strokes – which enables the diving seal to save oxygen. Weddell seals can cruise around underwater with very little flipper movement at all, which lets them dive down hundreds of feet into the water and stay down for as long as over an hour!

If this doesn't seem remarkable to you, let's do an activity to demonstrate how well-adapted Weddell seals are for diving, and why it's a good thing that humans have grocery stores and refrigerators. Would we be able to survive if we had to find food the way a Weddell seal does?

Materials:
1 meter stick
1-2 pieces of chalk (for schools with outside hallways)
Masking tape (for schools with inside hallways)
Watch with second hand, or a stopwatch

Part One:

First, let's get some perspective on just how deep a Weddell seal can dive. A Weddell seal can dive as deep as the Empire State Building is tall. The Empire State Building is 1,453 feet, or about 443 meters, tall (one meter is equal to 3.28 feet). For the first part of this activity, let's find out how long your school hallway is, and how many times you'd have to walk up and down the hallway to equal the height of the Empire State Building or the depth of a Weddell seal dive. Using a meter stick, measure the length of your school hallway. Mark off each meter with a piece of chalk (for outside hallways) or a piece of masking tape (for inside hallways).

Length of hallway (in meters): _____

Height of Empire State Building (m)	Divide by length of hallway (m)	Answer

Remember, the answer is how many times you'd have to walk up and down your hallway to equal the height of the Empire State Building.

Part Two:

Second, let's compare how fast we usually move about on land to how fast a Weddell seal typically cruises around underwater. To give you an idea of how fast some things with which you may be familiar move, take a look at this table.

	Average Speed in meters per second (m/s)
Weddell Seal	2
A really fast snail	0.008
Cheetah (71 mph)	31.75
Car in a school zone (25 mph)	11.18

How fast do you move on land when you're just walking? Follow these steps to find out. For this part of the activity, you'll work in groups of four. You'll need someone to move, someone to count lines, someone to time the person moving, and someone to record the data.

1. Moving person: line yourself up on one of the meter lines you drew or taped off in the hallway.
2. Moving person: Stare straight ahead without looking at the meter lines. Looking at the meter lines may affect the way you walk, and the idea here is to find out how fast your **normal** walk is.
3. Timing person: get ready to time the person walking, either with a watch with second hands, or with a stopwatch. If you're using a watch with a second hand, wait until the second hand lines up with the 12 before you tell the moving person to start walking.
4. Moving person and timing person: when the timing person says "Go!" the moving person should start walking along the meter lines.
5. The counting person should count how many lines the moving person crosses.
6. After 15 seconds, the timing person should yell "Stop!" and the moving person should stop right where he or she is.
7. If the moving person stopped somewhere between two meter lines, then the counting person should estimate the point between the two meter lines (halfway between, a quarter of the way to the next line, etc.).
8. The data recorder should record on the moving person's data sheet how long it took the moving person to walk 15 seconds.
9. All four people should rotate through all four jobs, so that everyone gets a chance to record how many meters he or she walked in 15 seconds.

Meters walked in 15 seconds	Divide by 15 to calculate meters walked in one second	Walking speed in meters per second (m/s)

Compare your speed to the animals in the table shown above.

Part Three:

Let's assume that when we're walking at our normal speed, we're not exerting ourselves very much compared to when we are jogging or sprinting. That means that we're using a minimal amount of energy (and that we're using a minimal amount of oxygen) to move around, so we should be able to walk pretty far at this speed. So, now that you know what your regular walking speed is, let's find out how long it would take you to walk the height of the Empire State Building, which is also how deep a Weddell seal dives, while walking at your normal speed. You already know from Part One how many times you would have to walk up and down your school hallway to walk the length of the Empire State Building. Ready to see how long it would take you? Remember, this is not a race. Keep walking at your normal speed. For this part of the activity, you'll work in groups of four again. You'll need a moving person, a timing person, a counting person, and a data recorder. Follow these steps:

1. Moving person: line yourself up on one of the meter lines you drew or taped off in the hallway.
2. Moving person: stare straight ahead without looking at the meter lines in order to do this part of the activity. You'll need to see the last meter line at each end so that you know when to turn around, but while you're walking, don't look at the lines, because it will affect how fast you walk.
3. Timing person: get ready to time the person walking, either with a watch with second hands, or with a stopwatch. If you're using a watch with a second hand, wait until the second hand lines up with the 12 before you tell the moving person to start walking.
4. Moving person and timing person: when the timing person says "Go!" the moving person should start walking along the meter lines up and down the hallway the appropriate number of times to equal the height of the Empire State Building.
5. The counting person should be keeping track of how far the moving person has walked, and should yell "Stop!" when the walking person is finished.
6. Right when the counting person yells "Stop!" the data recorder should immediately write down the time it took the moving person's data sheet.
7. The other three people in the group should determine how long it would take them to walk 443 meters by doing math. You can divide 443 by your walking speed in meters per second to figure out how long it would take you to walk the height of the Empire State Building. If there's time at the end of the activity, you can actually walk the 443 meters to see how close your actual

and calculated times were. Record your calculated time on your own data sheet.

When you record how long it took you to walk to walk 443 meters, remember that that's a one-way trip for a Weddell seal diving to the bottom of the ocean. To figure out how long it would take you to walk 886 meters (a round trip – surface to bottom to surface again), multiply your walking time by two.

Time taken to walk 443 meters	Multiply time by two	Time to walk 886 meters (a seal round trip)

Did you get tired? Well, walking 886 meters is the easy part! Weddell seals have to exercise while holding their breath! Lets find out how long you can hold your breath while remaining still. Keep your groups of four for this part, but pair up within your group, because you'll need a breath-holding person and a timing person. (NOTE: Teachers should monitor these activities.)

1. Breath-holding person: take 2 **slow** deep breaths (without hyperventilating!) This will help you store as much oxygen as you can in your blood.
2. Timing person: wait until your second hand lines up with 12, or get ready to use your stopwatch.
3. Timing person: say "Go!"
4. Breath-holding person: Take a deep breath and try to hold it.
5. When the breath-holding person starts breathing again, timing person should record the time that he or she held his or her breath on the breath-holder's data sheet.
6. Switch jobs, if time permits.

Length of time you held your breath:_____

You've collected a lot of data during this activity. Now we need to answer some questions to figure out what we've learned.

Questions:

1. A Weddell seal can hold its breath for over 70 minutes on extreme dives. How did your breath-holding ability compare to the seal?

2. Do you think you could hold your breath as long when you're more physically active? What is your body using up when you're moving your muscles?

3. Do you think you could even come close to walking the length of the Empire State Building on one breath? Can you think of how Weddell seals can dive that deep?

4. If seals cruise at a speed of 2 m/s, and they can dive as deep as 443 meters, how long does it take them to dive that deep?

5. Based on the cruising speed of a seal and the fact that seals can stay underwater for over an hour, do you think that they're spending the whole time either on the way down or on the way up?

6. If you think that seals are doing other things underwater, what do you think those things are? Why do they need to stay at the bottom for so long?

7. Why don’t humans need to hold their breath for as long?

8. Who do you think would win a race on land: a human or a seal? Why?