This unit, we've talked a lot about mass because we've needed it to find the density.

Let's refresh our memories.

What is mass?

What can we use to measure mass? What units might we use to measure mass?

What changes on the moon, mass or weight? Why is this?

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Let's refresh our memories.

What is mass?

-the amount of matter in an object

What can we use to measure mass? What units might we use to measure mass?

kg, g, lbs,

What changes on the moon, mass or weight? Why is this?

Your weight changes on the moon because it takes gravity into consideration. Weight is actually a force, it describes the force gravity needs to pull you down.

Because weight is a force, it's measured in Newtons. However our bathroom scales change that into kg or lbs so it's in commonly used units.

Exploring Mass and Weight

Let's experiment their relationship in numbers:

This is a 500g mass.

To measure it's **weight** I can use a spring scale that will measure the force in Newtons.

Let's predict:

Will it's weight also be 500g?

Let's measure it!

Exploring Mass and Weight

This is a 500g mass.

It weights 5N

If I told you the relationship between weight and mass is

F=ma meaning Force = mass (kg) * acceleration (gravity)

Can we figure out the number for gravity?

What is our mass in kg?

So if F=(mass)(gravity)

and 5=(.5)(gravity)

what is the number for gravity?

From our experiment:

What quantity is measured with a balance scale? How do you know?

What quantity is measured with a spring scale? How do you know?

What is the relationship between mass and weight on Earth?

Why do I specify that I'm asking about the relationship only on earth?

Using the equation F=ma, we can say the weight is _____ times the mass, when on Earth.

Mystery Solving

-discuss in groups

Buoyancy is another property of fluids.

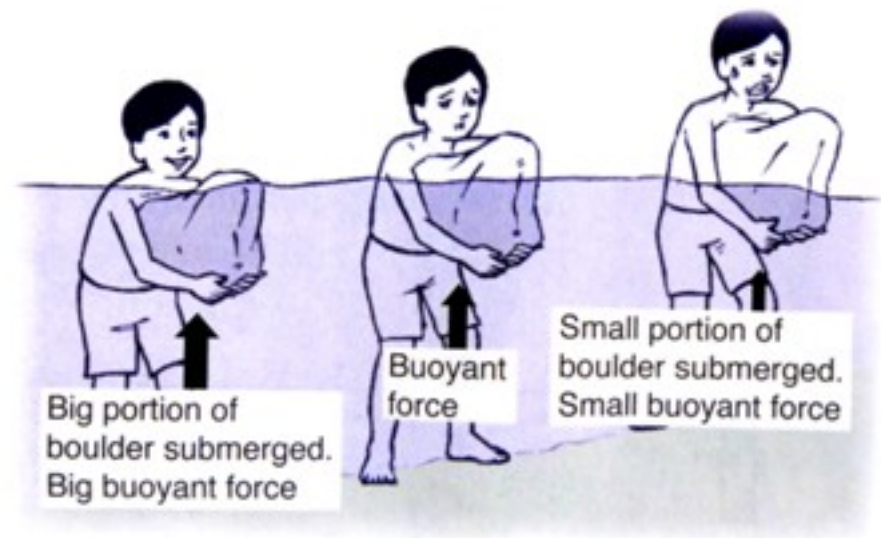
What do you think buoyancy means?

The **buoyant force** is the force exerted by the liquid, pushing the object upward.

Floating occurs when the upward force (buoyant force) is greater than the downward force (gravity).

When an object is in a liquid, the force of gravity (gravitational force) on the object pulls the object down toward the Earth.

The liquid, exerts an opposite force called the buoyant force which tries to push the object up.



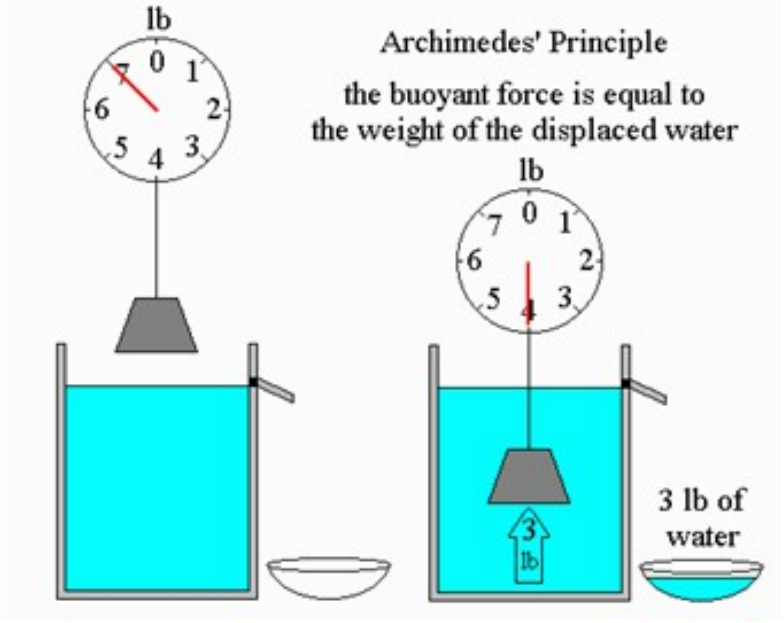
The students in the Mystery did not make a mistake, they discovered what Archimedes realized in the bath.

When he stepped into his bath, he sank because the water that his body displaced weighed less than he weighed.

When Archimedes steps into a boat and it still floats, the total water displaced had a larger weight than the boat and him together.

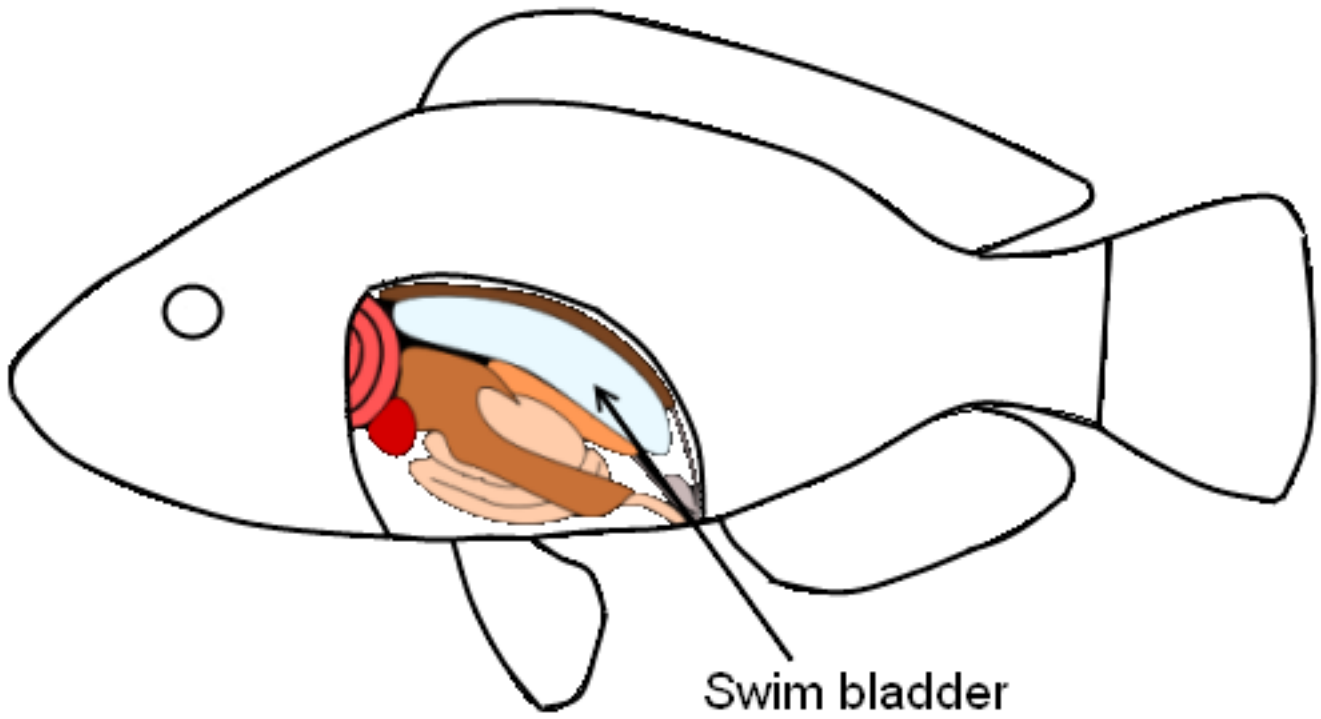
Archimedes' Principle: the buoyant force acting on an object

is equal to the weight of the fluid displaced.

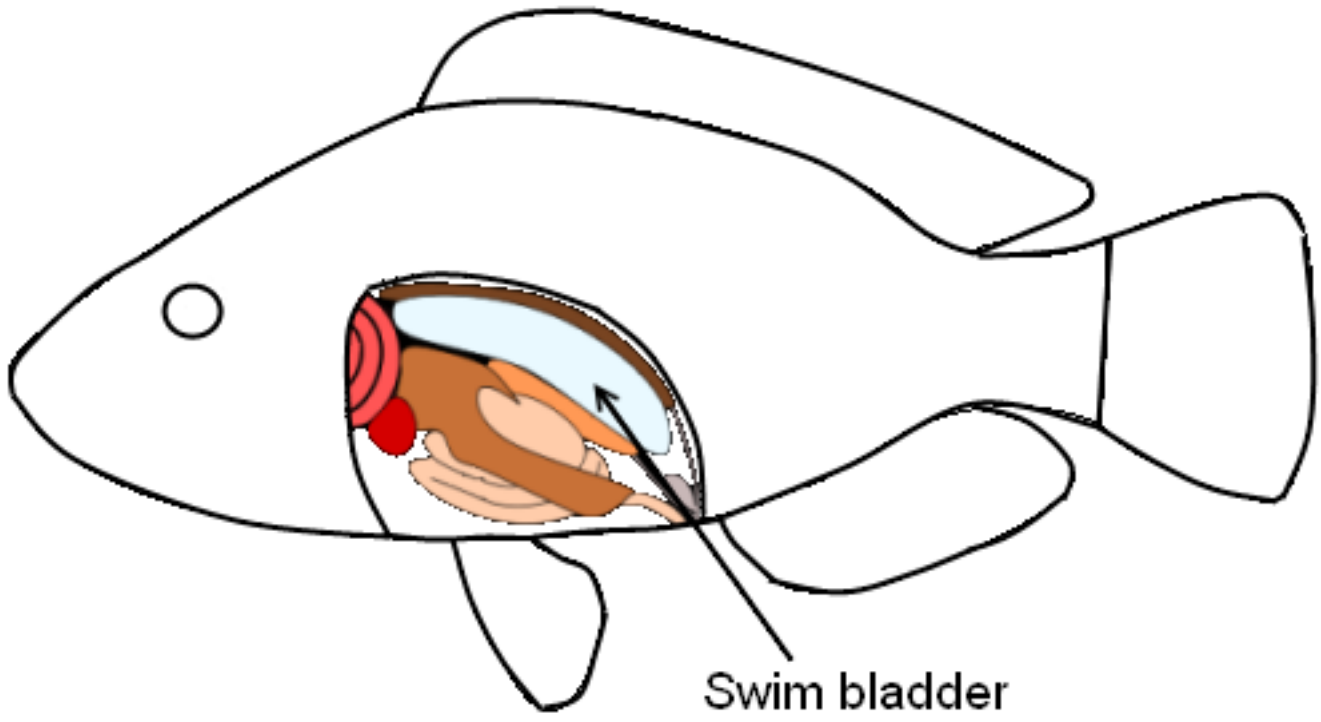


This is why the difference between mass and weight is important. The mass of the trapezoid did not change. It's weight changed because gravity is pulling down 7lb but buoyancy is pushing up 3lb. It's similar to integers! -7 + 3 = -4. So the resulting force (shown on the scale) is -4lb or 4lb downward. This means the object won't float.

If we could get the mass of water displaced to equal the entire mass of the object (7lb), then the object would float.



What does the swim bladder of a fish do?



What does the swim bladder of a fish do?

The swim bladder contains air and water, controllable by the fish. If the fish increases the amount of air in the swim bladder, it's volume increases and more water is displaced. The gravitational force is now less than the buoyant force so the fish will rise closer to the surface.

If it decreases the amount of air in its swim bladder, the fish's volume decreases, the buoyant force is smaller and the fish sinks.

What are the units for density we learned?

Remember that density is the reason we float or sink.

If you're less dense than the fluid, you float because the fluid's buoyant force pushing you up is larger than the force of gravity pulling you down.

If you're more dense than the fluid, you sink because the downward force is greater than the upward force.

With the fish, when it increases the air in it's swim bladder, it's increasing the volume. From our rice krispie experiment, we learned that if the volume increases and the mass stays the same, the density gets smaller. (Think of fractions, the volume is the denominator. If it gets bigger, the overall value of the fraction is smaller. 1/2 is smaller than 1/4)

Are you more dense or less dense than water?

Would you float better in salt water or fresh water?

In summary, the lower the density, the greater the buoyancy. For an object to float, it must be less dense than the water so the buoyant force is greater than the force of gravity. (The positive integers are greater than the negative integers.) In salt water, we increase the mass while keeping the volume the same, meaning our numerator is bigger so the water's density is bigger. The more dense the water, the less dense you are in comparison so you have a better chance of floating!

Now we've related **density** to **buoyancy** and all of that is related to **integers,fractions,** AND **types of water** from last unit!