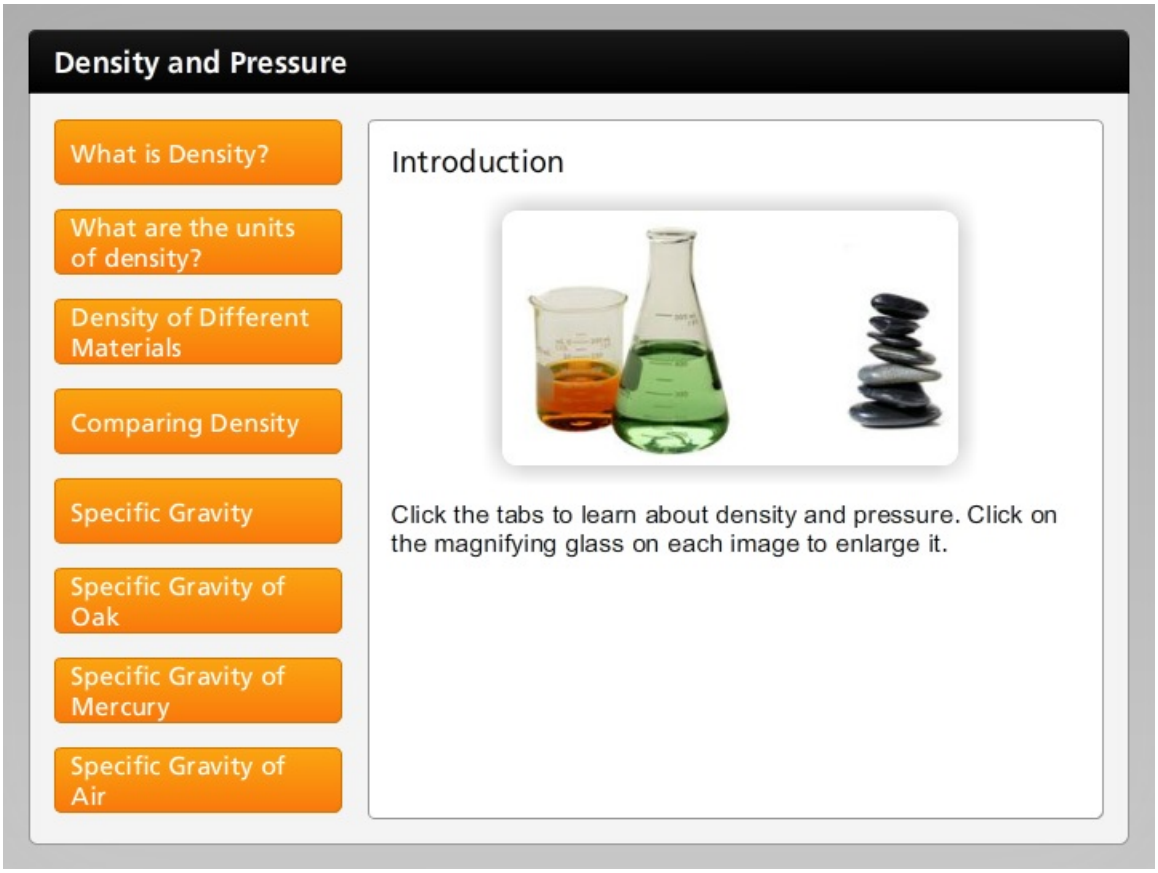
Module 9: Fluids
Topic 1 Content: Density and Pressure

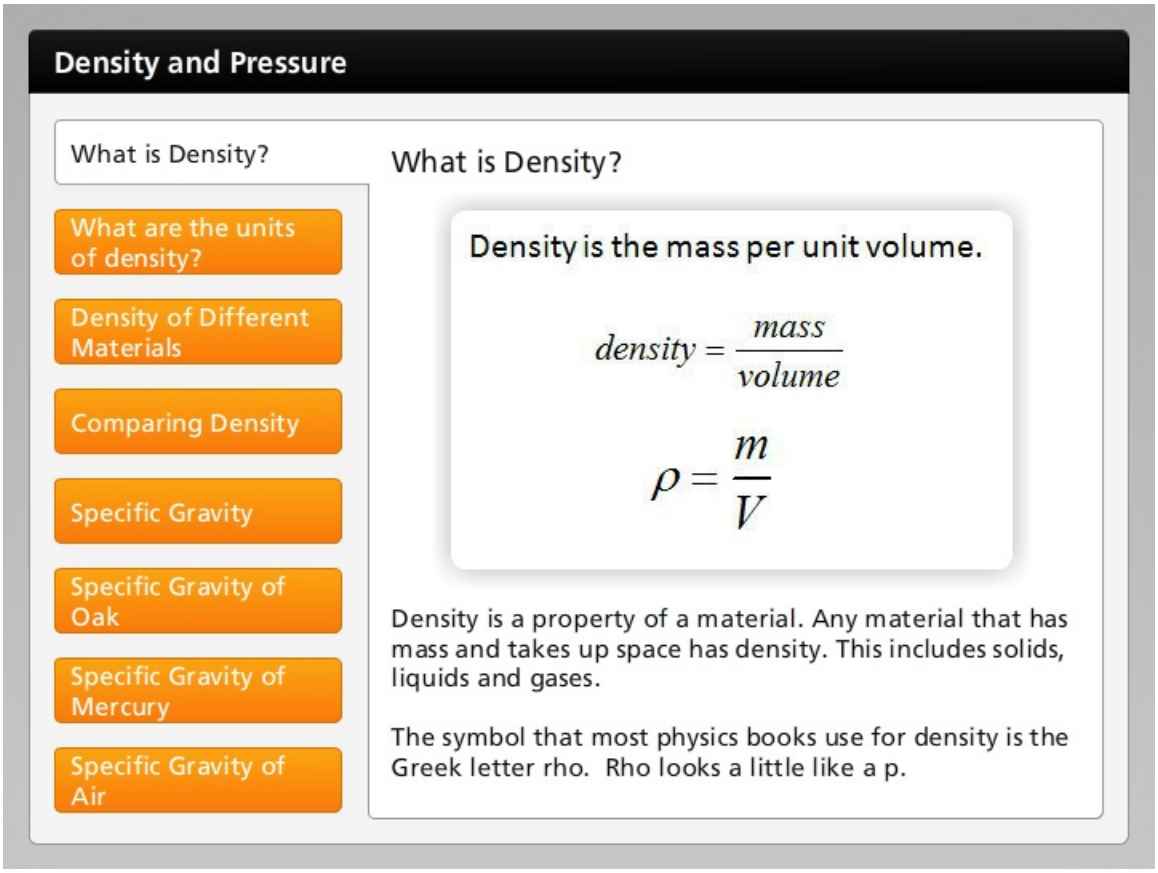
Introduction



Click the tabs to learn about density and pressure. Click on the magnifying glass on each image to enlarge it.

Module 9: Fluids
Topic 1 Content: Density and Pressure

What is Density?

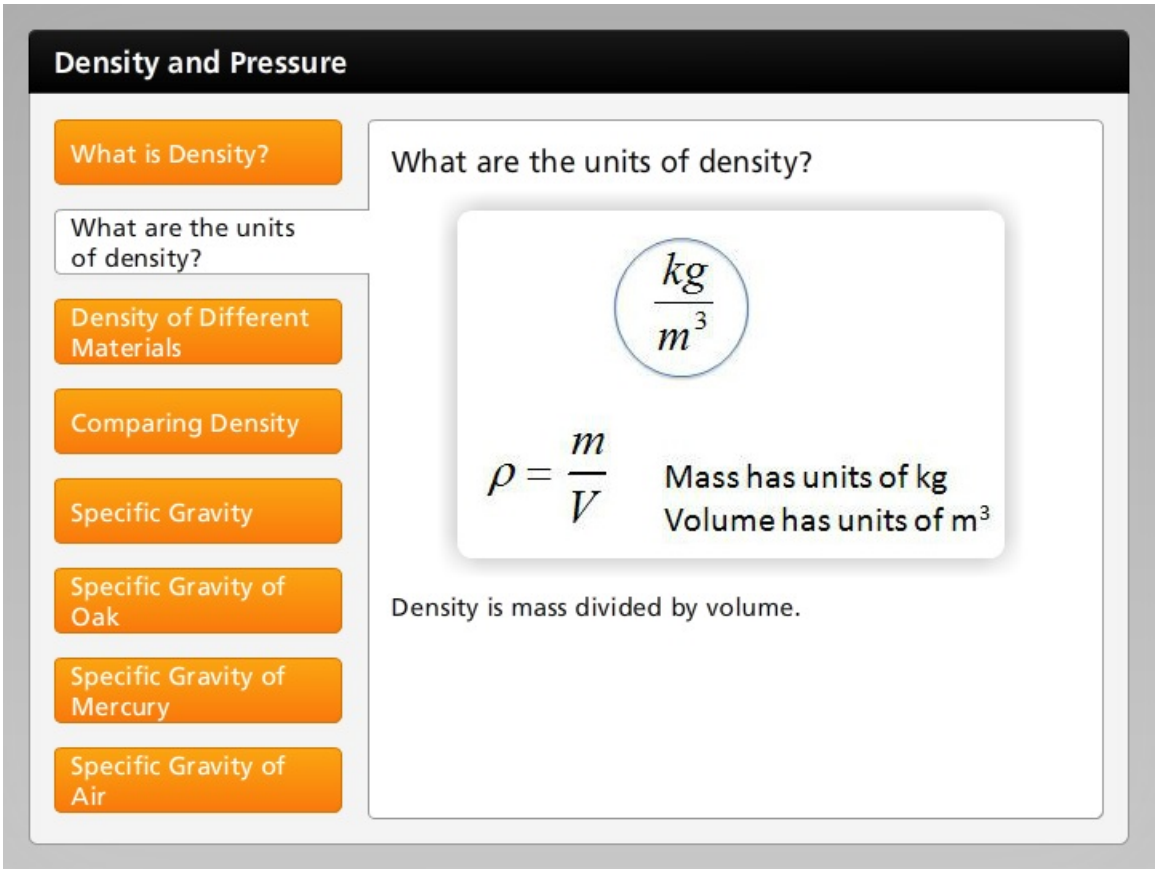


Density is a property of a material. Any material that has mass and takes up space has density. This includes solids, liquids and gases.

The symbol that most physics books use for density is the Greek letter rho. Rho looks a little like a p.

You probably already know a little bit about density from science classes you have taken before. Density is a property of a material. Any material that has mass and takes up space has density. This includes solids, liquids and gases. Let's review the definition of density. Density is the mass per unit volume. The symbol that most physics books use for density is the Greek letter rho. Rho looks a little like a p. In equation form, you would write rho equals m divided by V.

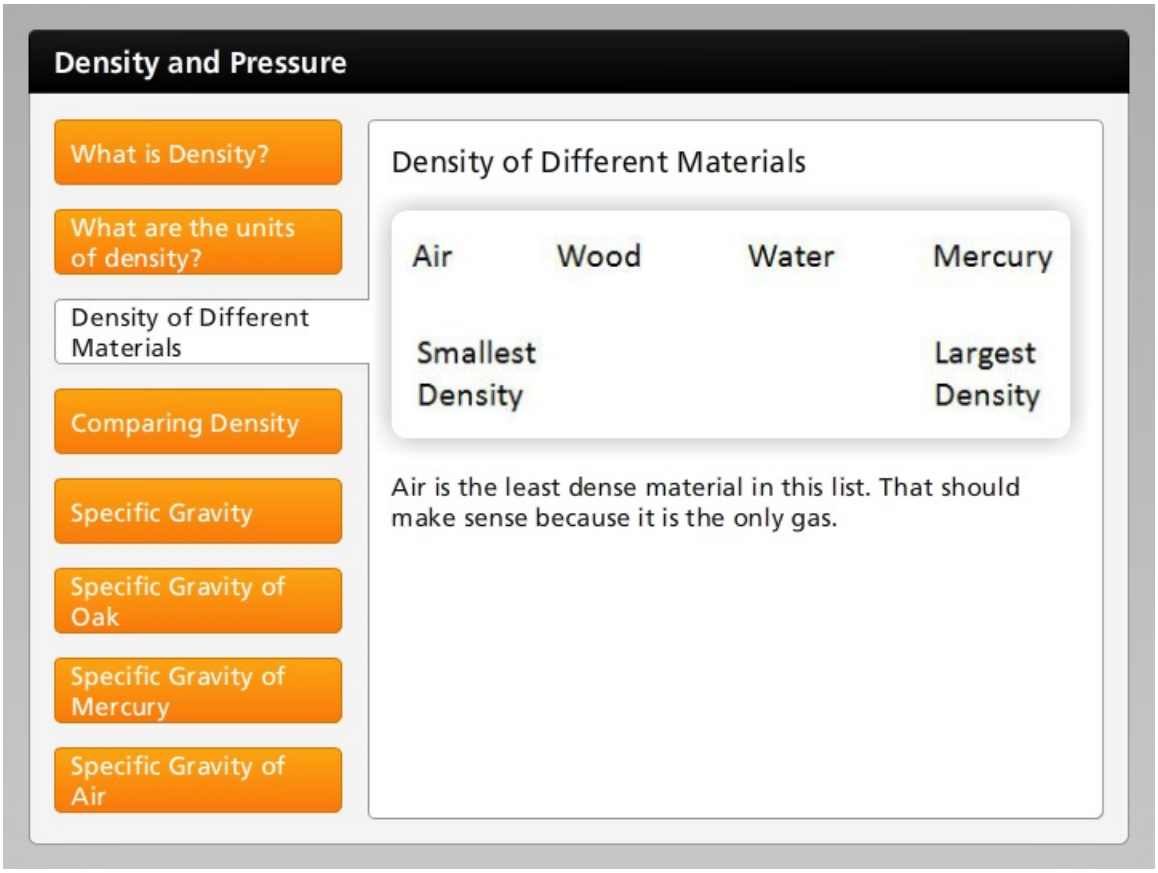
What are the units of density?



Density is mass divided by volume.

Now that you know the definition of density, what are correct units for density? Since density is mass divided by volume, its units will be mass units of kilograms, divided by volume units of meters cubed.

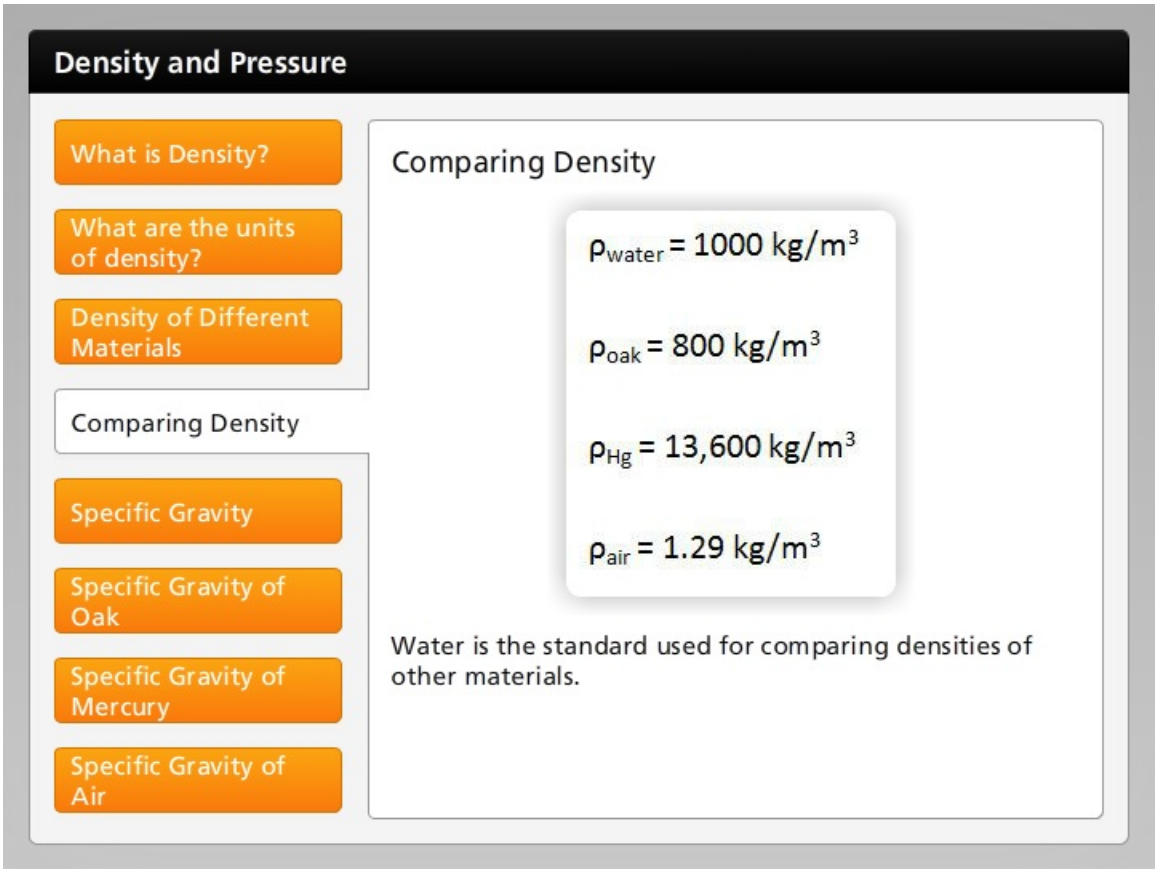
Density of Different Materials



Air is the least dense material in this list. That should make sense because it is the only gas. Now that you know what density is, it would be good to know what reasonable values are for density.

Air is the least dense material in this list. That should make sense because it is the only gas. If we had four soda cans, each one filled with air, wood, water or Mercury, which one would be the lightest? The can filled with air would be the lightest. Mercury is liquid metal, a can of mercury would be the heaviest of the four items. Wood is less dense than water, this is why wood floats in water.

Comparing Density

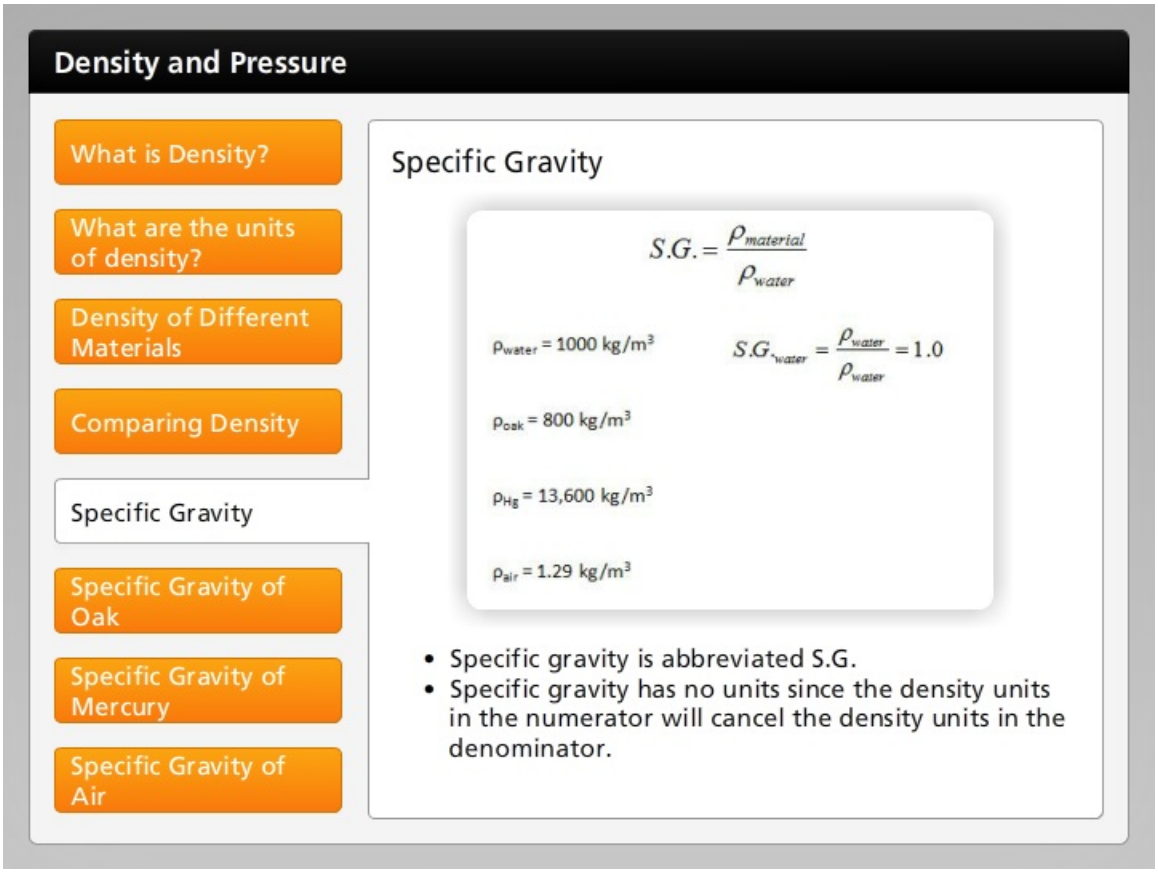


Water is the standard used for comparing densities of other materials.

Let's compare the density values for these materials. Water is the standard used for comparing densities of other materials. The density of water is one thousand kilograms per cubic meter or one gram per cubic centimeter. You may be more familiar with the one gram per cubic centimeter if you took Chemistry last year. But in Physics, we will stick with the standard IS units whenever possible. So we will use 1000 kilograms per cubic meter.

For comparison, the density of wood, such as Oak, is about eight hundred kilograms per cubic meter. Different kinds of wood have different densities. Wood is less dense than water. Mercury has a density of about thirteen thousand six hundred kilograms per cubic meter. Mercury is much more dense than water. Air has a density of one point two nine kilograms per cubic meter. Air is much less dense than water, but its density is not zero!

Specific Gravity

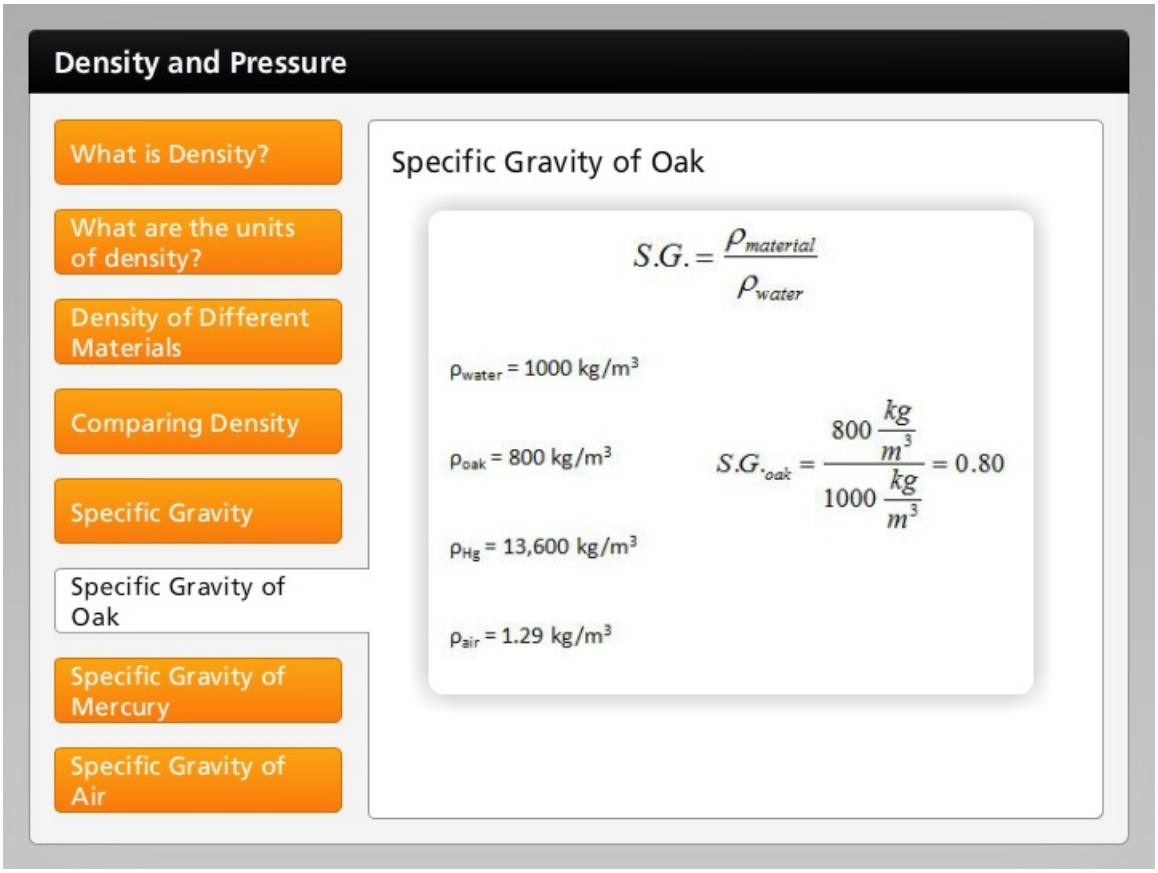


• Specific gravity is abbreviated S.G.
• Specific gravity has no units since the density units in the numerator will cancel the density units in the denominator.

Specific Gravity is way you can precisely compare the density of a substance to the density of water. Specific Gravity is abbreviated S.G. Specific Gravity is equal to the density of the substance divided by the density of water.

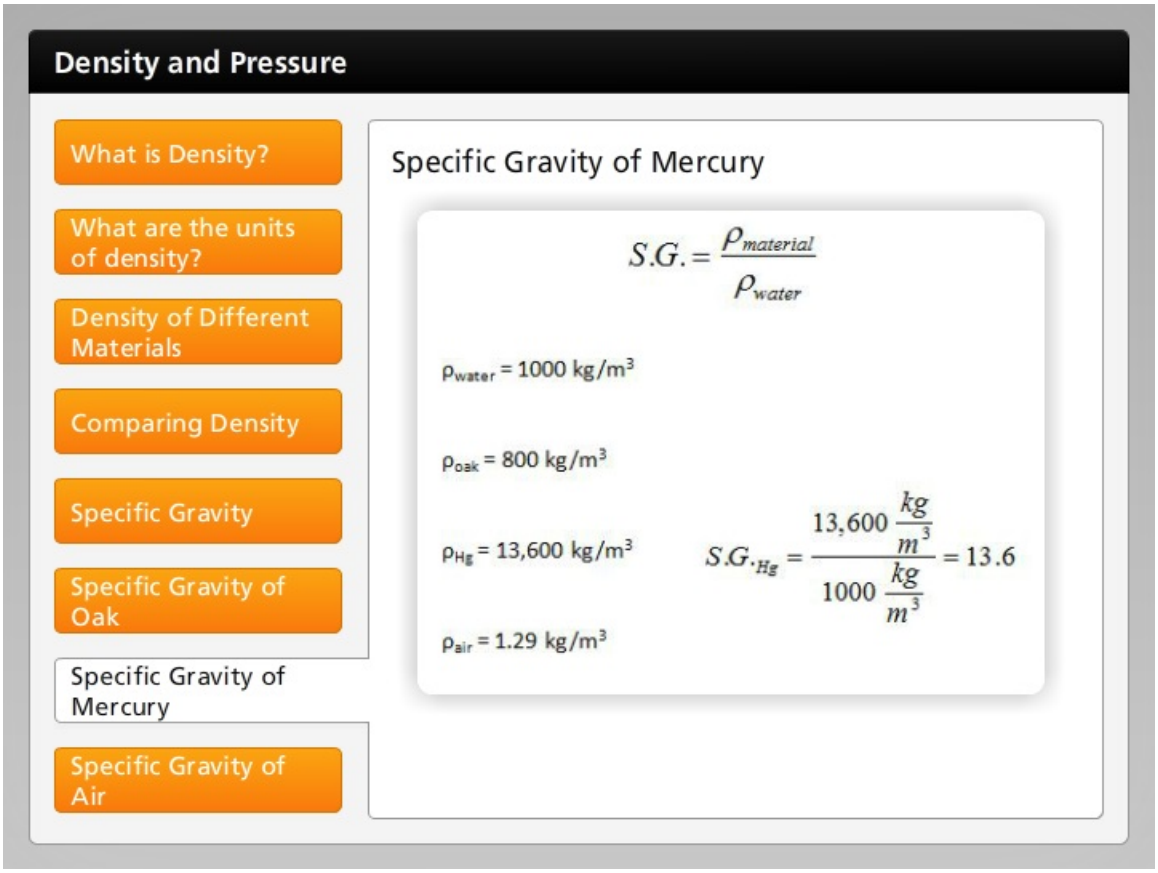
Specific Gravity is used to test different fluid mixtures to see if the mixture proportions are correct. If you test the antifreeze in your car or the water in a saltwater fish tank, you would use a hydrometer. Hydrometers do this by measuring the specific gravity of fluids. Specific Gravity is equal to the density of the substance divided by the density of water. So if we go back to our four examples, we see that the specific gravity of water would be one, since we divide the density of water by itself. Specific gravity has no units since the density units in the numerator will cancel the density units in the denominator.

Specific Gravity of Oak



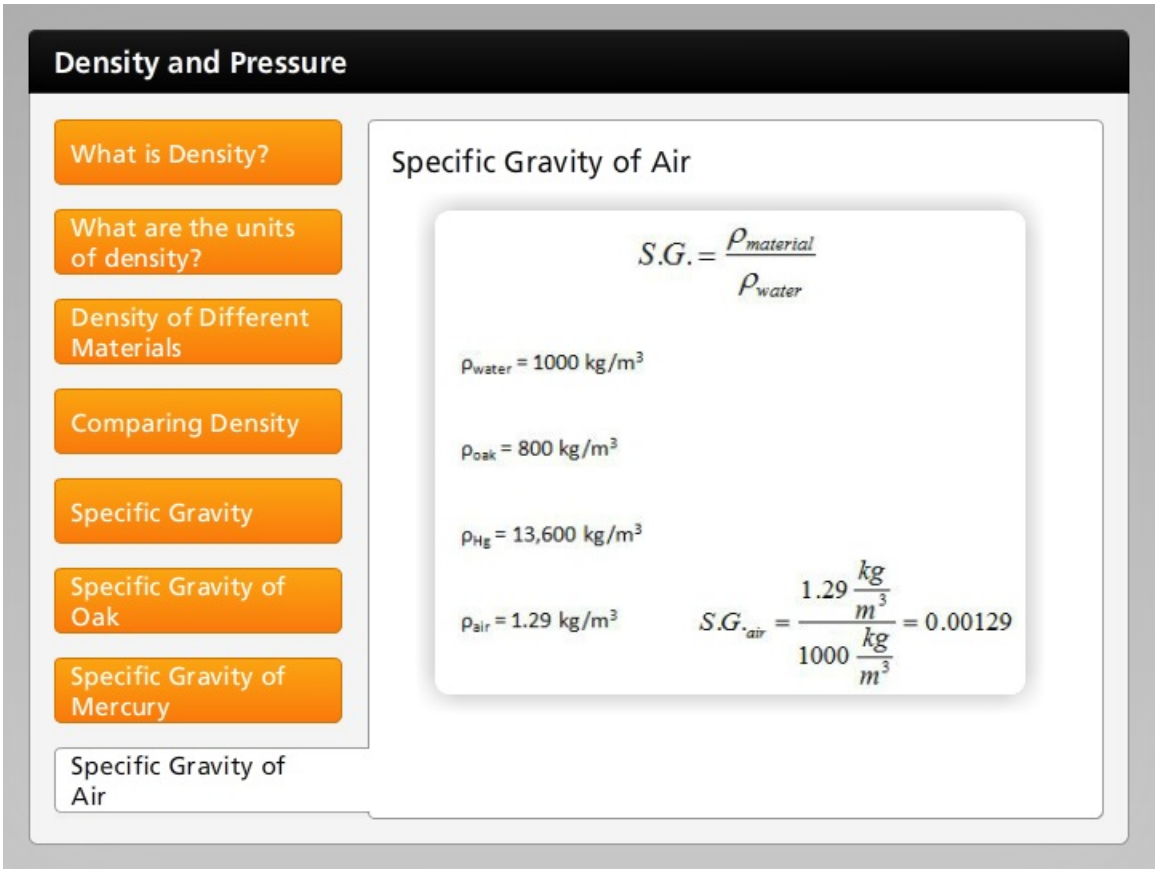
The specific gravity of oak is zero point eight.

Specific Gravity of Mercury



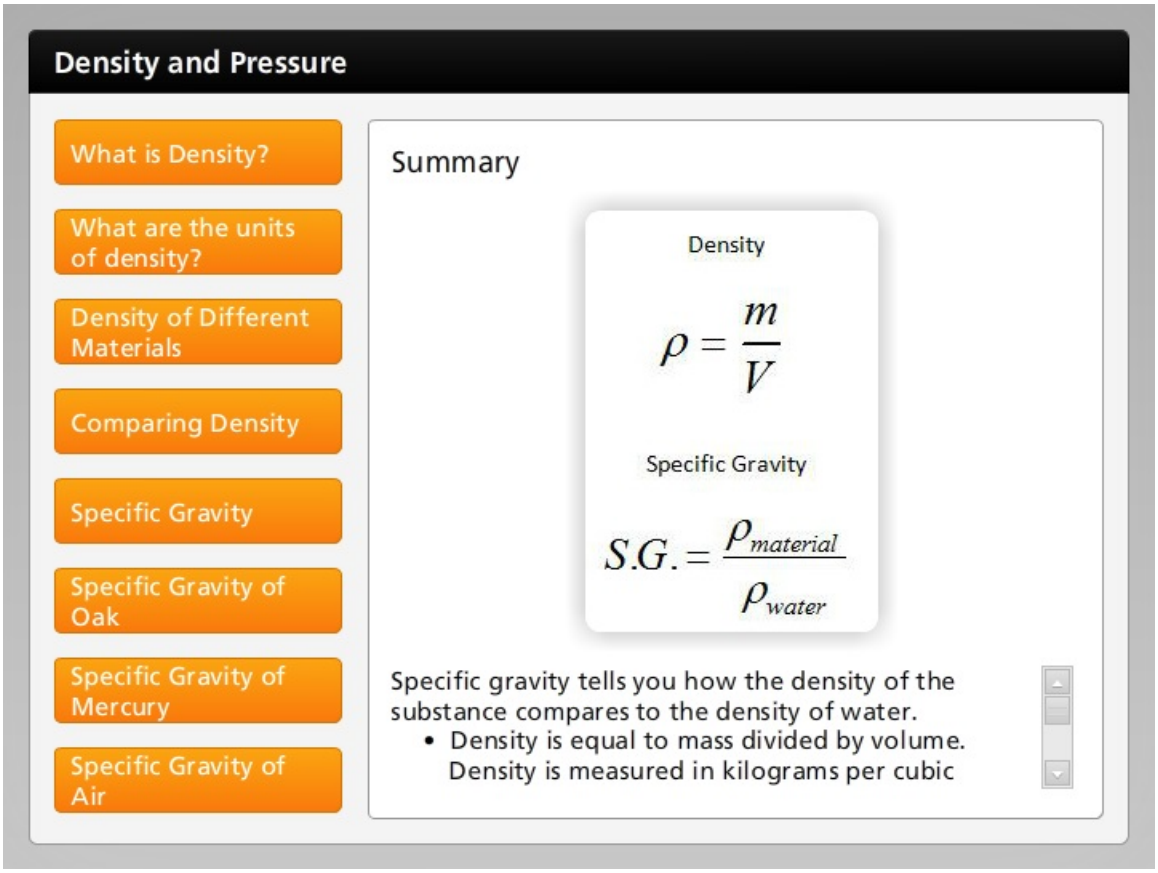
The specific gravity of Mercury is thirteen point six.

Specific Gravity of Air



The specific gravity of air is zero point zero zero one two nine.

Summary



Specific gravity tells you how the density of the substance compares to the density of water.

- Density is equal to mass divided by volume. Density is measured in kilograms per cubic meter.
- Specific gravity is equal to the density of the material divided by the density of water. Specific Gravity has no units.

So you can see that specific gravity tells you how the density of the substance compares to the density of water. When specific gravity is greater than one, the substance is more dense than water, like Mercury. When specific gravity is less than one, the substance is less dense than water, like air or wood.

Later you will learn how to use density and specific gravity to explain why objects float or sink and determine how much of the object will be below the surface of the water. In summary, you have learned two new equations in this lesson. Density is equal to mass divided by volume. Density is measured in kilograms per cubic meter. Specific gravity is equal to the density of the material divided by the density of water. Specific Gravity has no units.

You will use density later when we calculate the pressure exerted by a fluid. This will be important when we come back to our discussion board question of the scuba diver. You will use specific gravity when we study what makes objects float or sink.