Science: Physics

Archimedes' Principle

Objectives

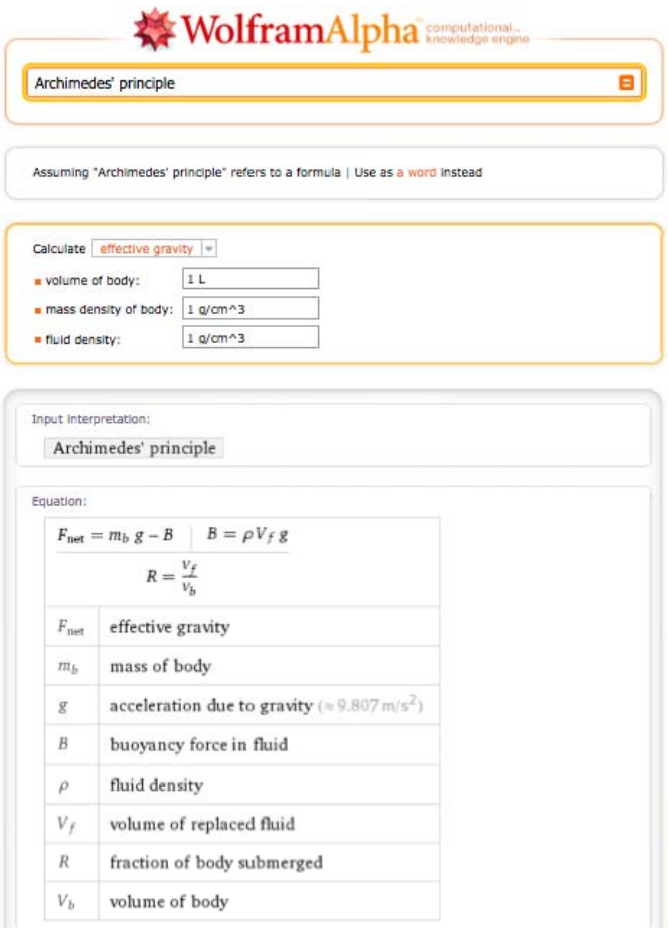
Students will be able to:
• Identify the relationship between buoyancy and density.
• Use Archimedes' principle to calculate buoyant force.
• Determine what fraction of a floating object will submerge in a fluid.

Warm-Up

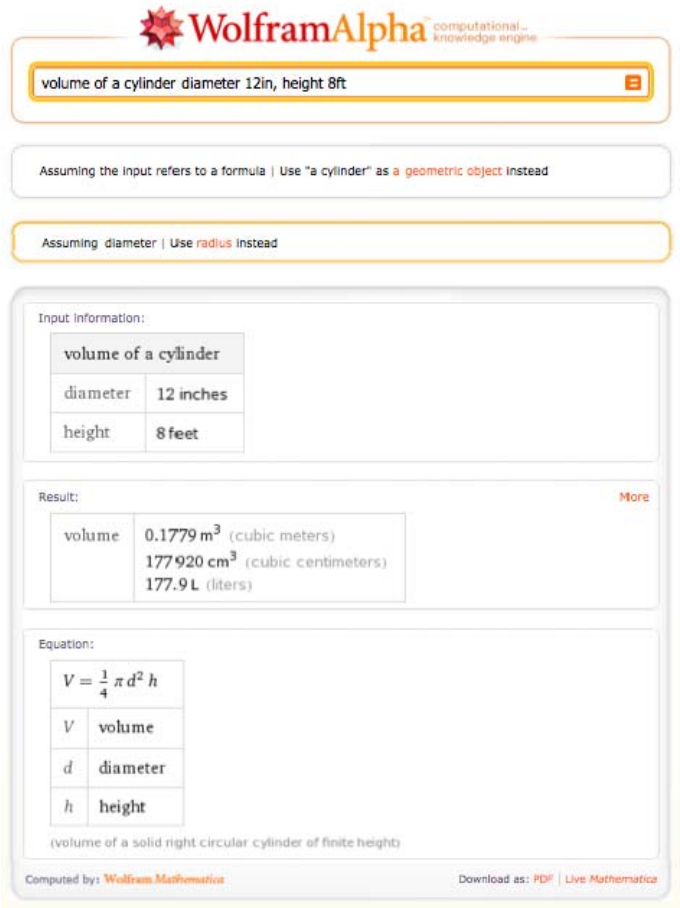
Ask students whether wood floats or sinks in water. The question may elicit a variety of responses. Some students may have seen sticks or fallen branches sink to the bottom of a pond, while the very existence of wooden rafts implies that wood floats. Can students explain this difference?

Lesson

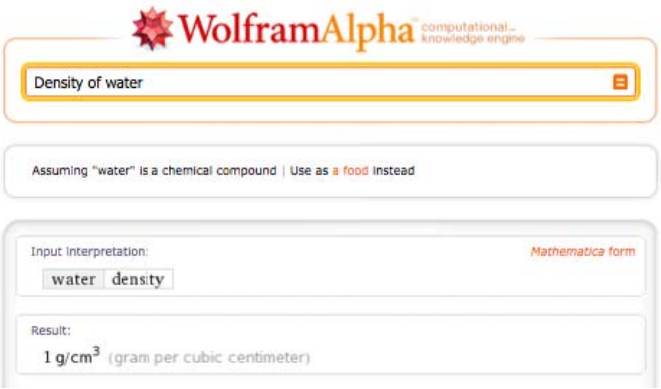
• Explain the story of Archimedes, his melodramatic discovery of the principle of fluid displacement, and this principle's relation to buoyancy. Use W|A to show students the formula for finding the submerged fraction of a solid object in a fluid.



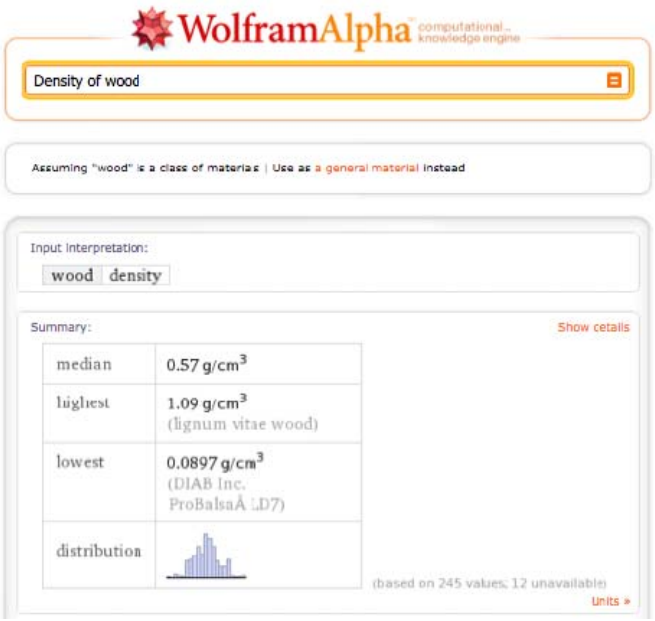
• Now ask students to test their guesses regarding whether or not wood will float in water. Use W|A to find a volume and density for a wooden object (for example, an 8-foot log with a 12-inch diameter) and the fluid in which it is submerged (water in this example).

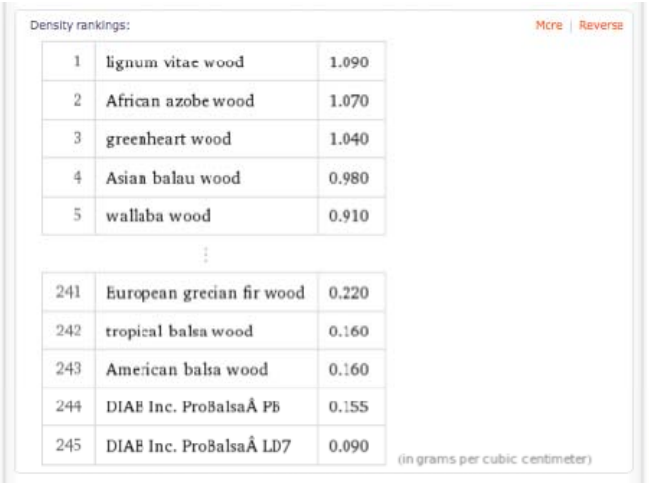


• Next, find the density of water.



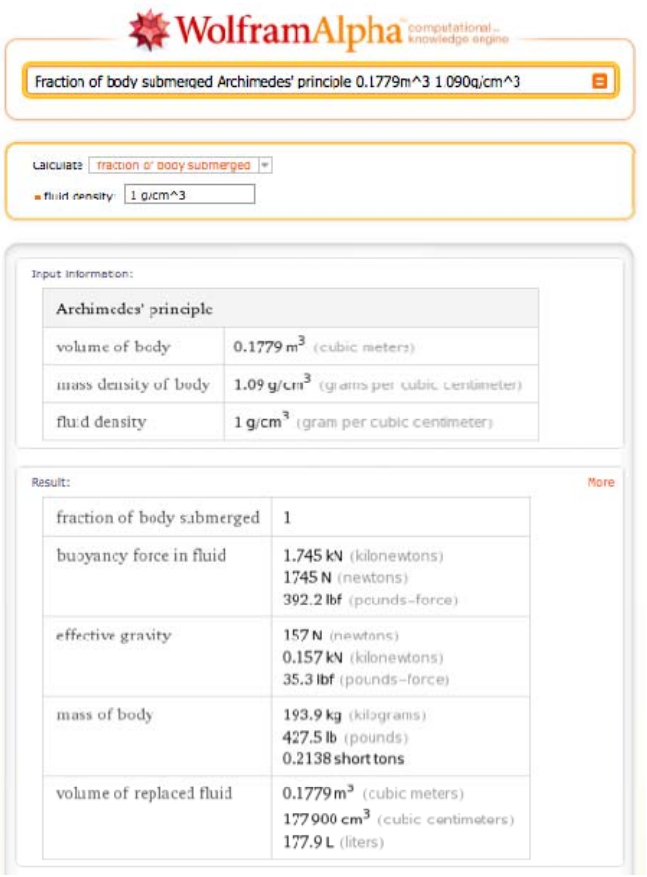
• Next, find the density of wood.



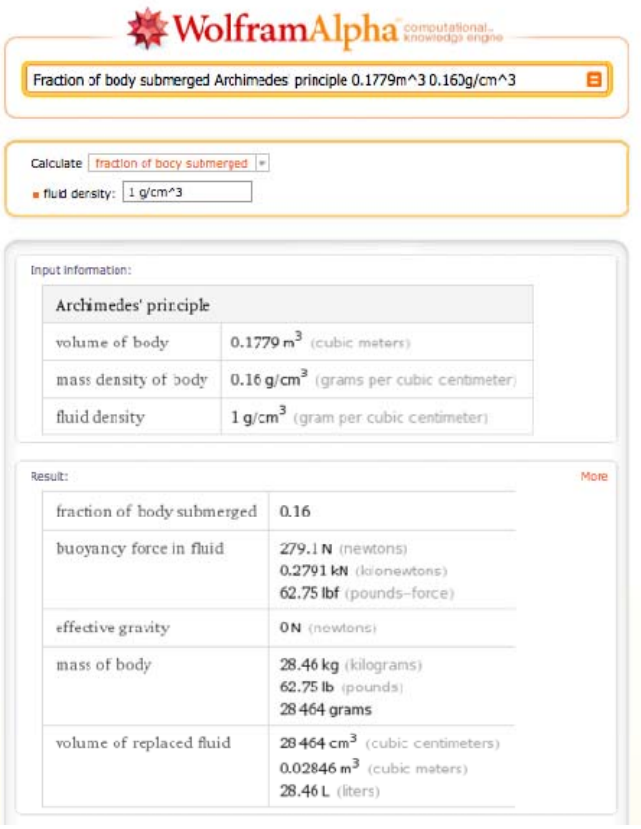


• In the previous step, students discovered that different types of wood have very different densities. Now, ask students to select one dense and one light type of wood and input the relevant information into the Archimedes' principle calculator on W|A, indicating which types of wood will float (submerged fraction < 1.0) or sink (submerged fraction = 1.0).

• Lignum vitae, the densest known wood, will sink.



• American balsa wood, one of the lightest known woods, will float with only 16% of its volume submerged.



Closing

• Ask students to make predictions about whether an apple, a piece of plastic, or a chunk of bituminous coal will sink or float. Then have them research and test these predictions using W|A.

Demonstrations

The Principle of Archimedes

Forces Exerted on an Immersed Object