Activity worksheet: density

Name	Group	Date

What you will learn

With the density simulation you will find out why two objects of the same size can have different masses, what density is and how it tells you whether something floats in water.

How to work. Each activity has three steps:

1. **Predict.** Before looking at the simulation, write down what you think will happen and why.
2. **Observe.** Set up the simulation, watch what happens and note down the data.
3. **Explain.** Compare what happened with your prediction and explain why.

If your prediction turns out to be wrong, don't rub it out: getting it wrong and understanding why is the best way to learn.

Each activity has a link that opens the simulation already set up. If you have the worksheet on paper, go to **simulaciencia.es/en/simulations/densidad** and set it up as described under “Set up the simulation”.

Units. Volume is in litres (L), mass in kilograms (kg) and density in kilograms per litre (kg/L). One litre of water has a mass of 1 kg.

Before you start

What do you think now? Write T (true) or F (false). It doesn't matter if you don't know: you will come back to this table at the end.

Statement	T or F
a) A big object always has more mass than a small one.	
b) Heavy things sink in water and light things float.	
c) If you cut a piece of iron in half, each half is less dense than the whole piece.	
d) A kilo of cork and a kilo of lead take up the same space.	
e) Ice floats because it has air inside.	

Activity 1. Two blocks of the same size

Set up the simulation: Compare mode, **Same volume**, object A made of **wood**, object B made of **iron** and 1 L. Open the simulation ready to use

Predict. The two blocks take up the same space: 1 L. If you put them on a balance, which way will it tip? Why do you think so?

My prediction

Observe. Write down the mass of each block. Then change the material of object B to each one in the table, without touching the volume.

Material	Volume (L)	Mass (kg)
Wood	1	
Iron	1	
Aluminium	1	
Cork	1	

Explain. Why do two blocks of the same size have different masses?

My explanation

Activity 2. Bigger means denser?

Set up the simulation: One object mode, material **aluminium** and a volume of 1 L. Open the simulation ready to use

Predict. If you make the aluminium block twice as big (2 L), what do you think will happen to its mass? And to its density?

My prediction

Observe. Move the “Sample volume” slider and write down the mass for each volume. Work out the last column yourself: divide the mass by the volume.

Volume V (L)	Mass m (kg)	m / V (kg/L)
1		
2		
4		

Volume V (L)	Mass m (kg)	m / V (kg/L)
8		

Explain.

1. What happens to the mass when the volume doubles?
2. What happens to the last column? Compare your result with the density the simulation gives.
3. Complete the sentence: “The density of a material is the ..... there is in each ..... . It does not depend on the ..... of the object.”

My answers

What you have calculated in the last column is the **density** (ρ, the Greek letter “rho”):

ρ = m / V

Activity 3. Does it float or sink?

Set up the simulation: One object mode, material **cork**. Open the simulation ready to use

Predict. Before choosing each material in the simulation, write down whether you think it will float or sink in water.

Observe. Choose each material from the drop-down list. Write down its density and what the simulation says under the formula.

Material	My prediction (floats / sinks)	Density (kg/L)	What happens in water?
Cork			
Wood			
Ice			
PET plastic			
Aluminium			
Iron			

Explain.

1. What do the materials that float have in common? And the ones that sink?
2. What number separates the ones that float from the ones that sink? Why do you think it is that number? Hint: choose water from the drop-down list.

My answers

Activity 4. A kilo of cork and a kilo of lead

Set up the simulation: Compare mode, **Same mass**, object A made of **cork**, object B made of **lead** and 1 kg. Open the simulation ready to use

Predict. You have 1 kg of cork and 1 kg of lead. Which way will the balance tip? Which of the two will take up more space?

My prediction

Observe. Write down the volume of each block.

Material	Mass (kg)	Volume (L)
Cork	1	
Lead	1	

Explain.

1. Why is the balance level if the blocks are so different?
2. How many times more volume does the cork take up than the lead? Write the calculation.
3. Why does the kilo of cork take up so much more space than the kilo of lead? Use the word “density”.

My answers

Activity 5. Ice and water

Set up the simulation: Compare mode, **Same volume**, object A made of **ice**, object B made of **water** and 1 L. Open the simulation ready to use

Predict. Which has more mass, 1 L of ice or 1 L of liquid water? Or do they have the same mass?

My prediction

Observe. Write down the mass and the density of each one.

Material	Volume (L)	Mass (kg)	Density (kg/L)
Ice	1		
Water	1		

Explain. A classmate says: “Ice floats because it has air inside”. What would you answer, using what you have seen?

My explanation

Activity 6. Challenge: a 15 kg object that floats

Set up the simulation: One object mode, material **Custom**, a mass of 15 kg and a volume of 10 L. Open the simulation ready to use

Predict. This object has a mass of 15 kg and takes up 10 L. Will it float in water? Calculate its density before you look.

My prediction and my calculation

Observe. Check your calculation in the simulation. Then, without changing the mass, move the volume slider until the object floats.

What is the smallest volume at which it floats?	What is its density then?

Explain. Is it true that “heavy things sink”? Explain your answer and give an example of an object with a lot of mass that floats.

My explanation

Apply what you have learnt

Solve these problems without the simulation. Write the formula, the calculation with its units and the result. Use the densities in the table if you need them.

Material	Density (kg/L)
Cork	0.18
Wood	0.60
Ice	0.92
Water	1.00
Aluminium	2.70
Iron	7.87
Copper	8.96
Lead	11.34

1. A bottle holds 2 L of olive oil, with a mass of 1.84 kg. Calculate the density of the oil. If you pour oil into a glass of water, will it stay on top or go to the bottom?
2. A metal block takes up 3 L and has a mass of 8.1 kg. Calculate its density. Which metal in the table could it be?
3. What is the mass of 5 L of copper?
4. What volume do 3 kg of wood take up?

Problem	Working and result
1	
2	
3	
4	

Review your ideas

Go back to the “Before you start” table. Would you change any of your answers? Write which one and explain why, using something you saw in the simulation.

What has changed in my ideas

Going further (Year 10)

1. Using the data from activity 2, draw the mass–volume graph for aluminium on squared paper (volume on the horizontal axis). Add the points for cork and lead for 1, 2, 4 and 8 L (take them from the simulation). What shape do the three graphs have? Which one is steepest and why?
2. Express the density of aluminium, 2.70 kg/L, in g/cm³ and in kg/m³ using conversion factors. Remember that 1 L = 1000 cm³ and 1 m³ = 1000 L.

My answers

Self-assessment

Put an X to show how confident you feel at the end.

I can...	Yes	Nearly	Not yet
Explain the difference between mass, volume and density			
Calculate a density with ρ = m / V and give the result with its unit			
Explain why the density of a material does not depend on the size of the piece			
Predict whether a material floats in water from its density			
Use a prediction and an observation to change an idea I had			

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