Activity worksheet: electric circuits

Name	Group	Date

What you will learn

With the circuits simulation you will build circuits with a battery, a switch and bulbs, and take measurements with an ammeter and a voltmeter. You will discover Ohm's law, which links voltage, current and resistance, and you will see what changes when the bulbs are connected one after another (in series) or each in its own branch (in parallel).

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/circuitos** and set it up as described under “Set up the simulation”.

How to read the data. Voltage (V) is measured in volts (V), current (I) in amperes (A), resistance (R) in ohms (Ω) and power (P) in watts (W). The “Components” table in the “Circuit readings” panel gives R, V, I and P for each bulb and for the total.

Before you start

What do you think now? Write T (true) or F (false). You will come back to this table at the end.

Statement	T or F
a) Current is used up in the bulbs: less current reaches the last bulb.	
b) Electrons leave the battery and take a while to reach the bulb.	
c) A battery always gives the same current, whatever you connect to it.	
d) The more bulbs you put in a circuit, the more resistance it has.	
e) If one bulb blows, all the bulbs in the circuit go out.	
f) Voltage and current are the same thing: if there is a voltage, there is a current.	

Activity 1. The parts of a circuit

Set up the simulation: Ohm's law mode, **6 V** battery and **20 Ω** bulb. Open the simulation ready to use

Predict. If you open the switch, what do you think will happen to the electrons in the wires? Will they disappear, go back to the battery or stop?

My prediction

Observe. Identify each element and read the meters with the switch closed and open.

Element	What is it for?	How is it connected?	Reading with the switch closed	Reading with the switch open
Battery		—		
Ammeter				
Voltmeter				

Explain.

1. What does the ammeter measure and what does the voltmeter measure? Why is one connected in series and the other in parallel?
2. Which way do the electrons move? And the orange current arrow? Why do they not match?

My answers

Activity 2. Ohm's law

Set up the simulation: Ohm's law, **20 Ω** bulb and **2 V** battery. Open the simulation ready to use

Predict. If you double the voltage of the battery, what do you think will happen to the current?

My prediction

Observe. Change the "Battery voltage", press "Record reading" for each value and fill in the table.

Voltage V (V)	Current I (A)	V / I (Ω)
2		

Voltage V (V)	Current I (A)	V / I (Ω)
4		
6		
8		
10		
12		

Explain.

1. What shape is the current–voltage graph? How are V and I related?
2. What is special about the last column? Write Ohm's law.

My answers

Activity 3. More resistance, less current

Set up the simulation: Ohm's law, **6 V** battery and a resistance of **10 Ω**. Open the simulation ready to use

Predict. If you increase the resistance without changing the battery, what will happen to the current? And to the brightness of the bulb?

My prediction

Observe. Change the “Resistance (R)” and fill in the table.

Resistance R (Ω)	Current I (A)	Power P (W)	Brightness of the bulb
10			
20			
30			
60			

Explain. Does the battery always give the same current? What does the current that flows depend on?

My explanation

Activity 4. Bulbs in series

Set up the simulation: Series mode, 6 V battery and three bulbs of 10, 20 and 30 Ω. Open the simulation ready to use

Predict. The current flows through the three bulbs, one after another. Will less current reach the last one? If you remove bulb R_2, what will happen to the others?

My prediction

Observe. Fill in the table using the "Components" table. Then remove R_2 with the "Connected components" button.

Bulb	R (Ω)	V (V)	I (A)	P (W)
R_1				
R_2				
R_3				
Total				
When R_2 is removed, what happens?				

Explain.

1. What is the current like in the three bulbs? Is current used up?
2. What do the voltages across the three bulbs add up to? How do you calculate the equivalent resistance in series?

My answers

Activity 5. Bulbs in parallel

Set up the simulation: Parallel mode, 6 V battery and three bulbs of 10, 20 and 30 Ω. Open the simulation ready to use

Predict. Now each bulb is in its own branch. What voltage will each one have? If you remove R_2, what will happen to the others?

My prediction

Observe. Fill in the table and then remove R_2.

Bulb	R (Ω)	V (V)	I (A)	P (W)
R_1				
R_2				
R_3				
Total				
When R_2 is removed, what happens?				

Explain.

1. What is the voltage like across the three bulbs? What do the currents add up to?
2. Is the equivalent resistance bigger or smaller than that of each bulb? Why, if there are more bulbs?

My answers

Activity 6. Challenge: how are the lights at home connected?

Set up the simulation: three **identical** 20 Ω bulbs with a 6 V battery, first in series and then in parallel.
Open in series · Open in parallel

Predict. In which arrangement do you think the bulbs will shine more brightly? Which one is more like the wiring in your home?

My prediction

Observe.

Arrangement	V of each bulb (V)	I of each bulb (A)	P of each bulb (W)	Total current (A)	Do the others go out when you remove one?
Series					
Parallel					

Explain. How are the appliances and lights in a home connected? Give two reasons based on what you have observed.

My explanation

Apply what you have learnt

Solve these without the simulation. Write the formula, the calculation with its units and the result.

1. A 30 Ω bulb is connected to a 9 V battery. What current flows?
2. What resistance lets 0.240 A flow with a 12 V battery? Check it with the simulation.
3. Two resistors of 15 Ω and 45 Ω are connected in series to 12 V. Calculate the equivalent resistance, the current and the voltage across each one.
4. The same resistors are connected in parallel to 12 V. Calculate the current in each branch, the total current and the equivalent resistance.

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 11)

1. The bulb in activity 1 uses 1.80 W. How much energy does it use in one hour? Use $E = P \cdot t$.
2. In activity 6, how many times more power does each bulb use in parallel than in series? Explain it with $P = V \cdot I$.
3. With the values in activity 4 (series), which bulb shines most brightly? And in activity 5 (parallel)? Is it true that the bulb with the most resistance always shines least?

My answers

Self-assessment

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

I can...	Yes	Nearly	Not yet
Name the elements of a circuit and what they are for			
Measure current and voltage and use their units			
Apply Ohm's law to calculate V, I or R			
Calculate the equivalent resistance in series and in parallel			
Explain how voltage and current are shared out in series and in parallel			
Use a prediction and an observation to change an idea I had			

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