

Cellular respiration: matter and energy

Balance aerobic respiration and identify a limiting reactant.

Name: _____ Date: _____

1. Set glucose and oxygen to each pair. Record carbon dioxide, water and ATP.
2. Check the equation $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ by counting atoms.

Glucose (mol)	Oxygen (mol)	CO ₂ (mol)	Water (mol)	ATP (mol)
2	12			
2	6			
2	0			

1. Which input limits the second trial? How much glucose remains?
2. Does zero aerobic ATP mean cells can never obtain energy without oxygen?
3. Why is the ATP result a teaching approximation?

Teacher notes and answers

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Outputs: 12 CO₂, 12 water, 60 ATP; then 6, 6, 30; then 0, 0, 0 for the aerobic pathway.

Oxygen limits trial 2; 1 mol of glucose remains.

No. Glycolysis and fermentation can support energy release without oxygen. This model only accounts for the aerobic pathway.

The model fixes yield at 30 ATP per glucose; real yield and efficiency vary. Energy is transferred from chemical stores, not created.

Teaching notes

Amounts are idealised molar quantities, not a cell-scale concentration or rate. ATP production is coupled to multiple processes; the summary equation omits those steps.

Open the matching resource

<https://kiwibee.io/en/simulations/cellular-respiration-simulation>

Use the student page separately from this answer section. Model outputs are illustrative and depend on the stated settings.