Enzymes and metabolism

International Baccalaureate · IB Diploma · Biology · SL

Scope and prerequisites

This handout covers selected SL topics for the course first assessed in 2025; it is not the whole syllabus.

Prerequisites: read the stated quantities and units, and use arithmetic and the model conditions below.

The examples are original and fictional: they are not real measurements or real student investigations.

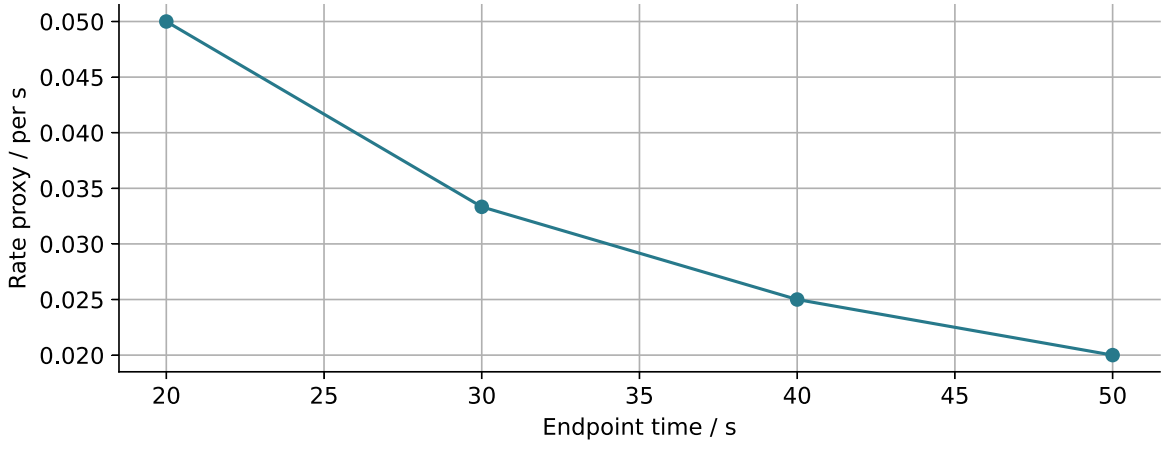
Enzyme rate and controlled measurements

What would explain this observation?

- An **enzyme** works quickly at one temperature and slowly at another. Heating can increase successful collisions, but excessive heat can change the active site.

Build the model

- An enzyme is a biological catalyst.
- The substrate binds at an active site whose shape and chemical properties support the reaction.
- A catalyst increases rate without being used up overall.
- enzyme: A biological catalyst.
- **denaturation** : A structural change that disrupts function.



A longer time to the endpoint means a slower rate: rate is proportional to 1/time

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■ **Choose evidence that can test it**

- Measure rate using product formed per unit time or a fixed endpoint.
- For an endpoint test, 1/time is a rate proxy if the same amount of product or substrate change defines the endpoint each time.

In the lab: For starch digestion, equilibrate enzyme and starch in a water bath, control pH with buffer, mix measured volumes, and test samples with iodine at fixed intervals. Use a clean spot for each test. Do not put iodine into the reaction mixture.

■ **Work from known quantities**

- Known: the endpoint is reached in 40 s.
- Use rate proxy = 1/time.
- Rate proxy = 1/40 = 0.025 per second.
- At 20 s the proxy is 0.050 per second, twice as large.
- This comparison is valid only if the same endpoint and starting concentrations are used.

Your turn: A fixed endpoint takes 50 s. Calculate the rate proxy 1/time.

■ **Check the conclusion and its limits**

- An optimum is specific to the enzyme and conditions.
- Low temperature usually slows the reaction; it does not necessarily denature the enzyme.
- Endpoint intervals limit precision.

Not true: A low temperature always permanently denatures an enzyme. Low temperature usually only slows an enzyme because molecules collide less often; the active site is unchanged and warming restores activity. Denaturation is a structural change from excessive heat or extreme pH, not a guaranteed result of cooling.

Key:

- An enzyme is a biological catalyst.
- Measure rate using product formed per unit time or a fixed endpoint.
- Watch for: an optimum is specific to the enzyme and conditions.

■ **Write from a rate proxy of 0.025 per second**

- A fixed endpoint takes 40 s.
- The rate proxy is 1 divided by time. A low temperature usually slows an enzyme. It does not permanently denature it.