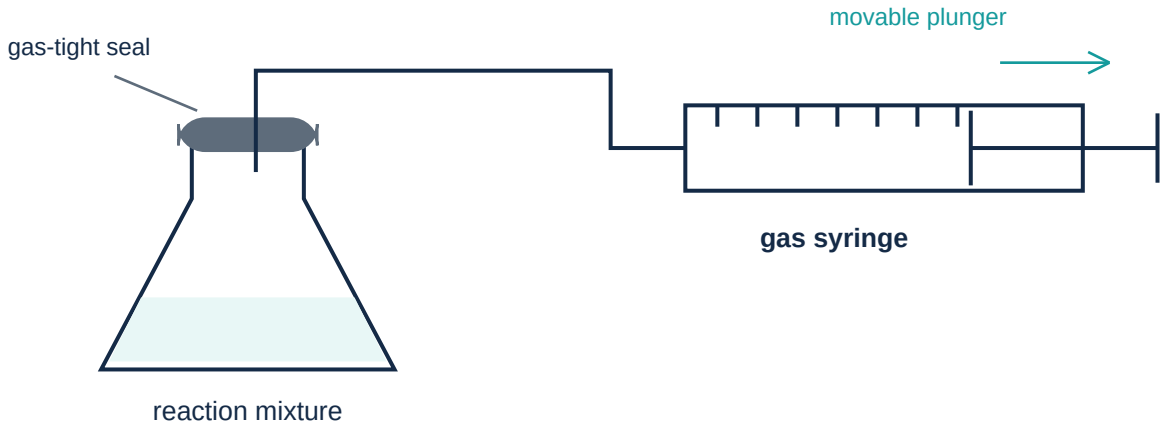
Follow product formation

A reaction can be monitored by recording product accumulation over time. Catalase converts hydrogen peroxide into water and oxygen; the gas gives a measurable signal.

CATALASE: COLLECT THE OXYGEN

$$2\ H_2O_2 \rightarrow 2\ H_2O + O_2$$



Oxygen moves through the delivery tube and pushes the plunger out. Support the flask and syringe securely; stands are omitted from this schematic.

1. COLLECT A TIME SERIES

Use measured enzyme and substrate volumes. Bring them to the chosen temperature. Start timing at mixing and record gas volume at regular intervals. A sealed-start method reduces oxygen loss before the bung is fitted.

2. TURN VOLUME INTO RATE

Average rate = change in oxygen volume / elapsed time. If volume rises from 4 to 16 cm^3 between 10 and 30 s, rate = (16 - 4) / (30 - 10) = 0.60 $cm^3\ s^{-1}$. These are illustrative values, not measured results.

Avoid leaks, blocked tubing and a sticking plunger. Bubble counts are less reliable than gas volume because bubble sizes can vary.

Practical reference: Practical Biology: catalase and hydrogen peroxide.

Scope: Cambridge Biology 9700 syllabus, section 3.1, outcome 3, p. 20.

Follow substrate disappearance

Amylase hydrolyses starch into smaller carbohydrates. Test small samples with iodine to find when starch is no longer detected: this is an endpoint measurement, not a direct sugar measurement.

IODINE TESTS ON A SEPARATE WHITE TILE

Mix starch, amylase and buffer; start the timer. Transfer equal small samples to fresh iodine drops at regular intervals, for example every 10 s.



10 s	20 s	30 s	40 s
	blue-black: starch detected		orange-brown

1. KEEP THE INDICATOR OUT OF THE REACTION

Add each withdrawn sample to iodine on the tile, not iodine to the reaction tube. Use clean sampling equipment and never return iodine-contaminated liquid to the reaction. Compare colours under the same lighting.

2. INTERPRET THE ENDPOINT CAREFULLY

In the example above, the first negative test is at 40 s. The endpoint occurred after 30 s and by 40 s. Record 40 s as the observed endpoint time; smaller sampling intervals improve timing resolution. A negative test means below the test's detection limit.

RELATIVE RATE: 1 / ENDPOINT TIME

For identical starting starch amounts and the same endpoint criterion: $1 / 40 = 0.025\ s^{-1}$. A 20 s endpoint gives $0.050\ s^{-1}$, twice the relative rate. This proxy is not a concentration change per second or an initial rate.

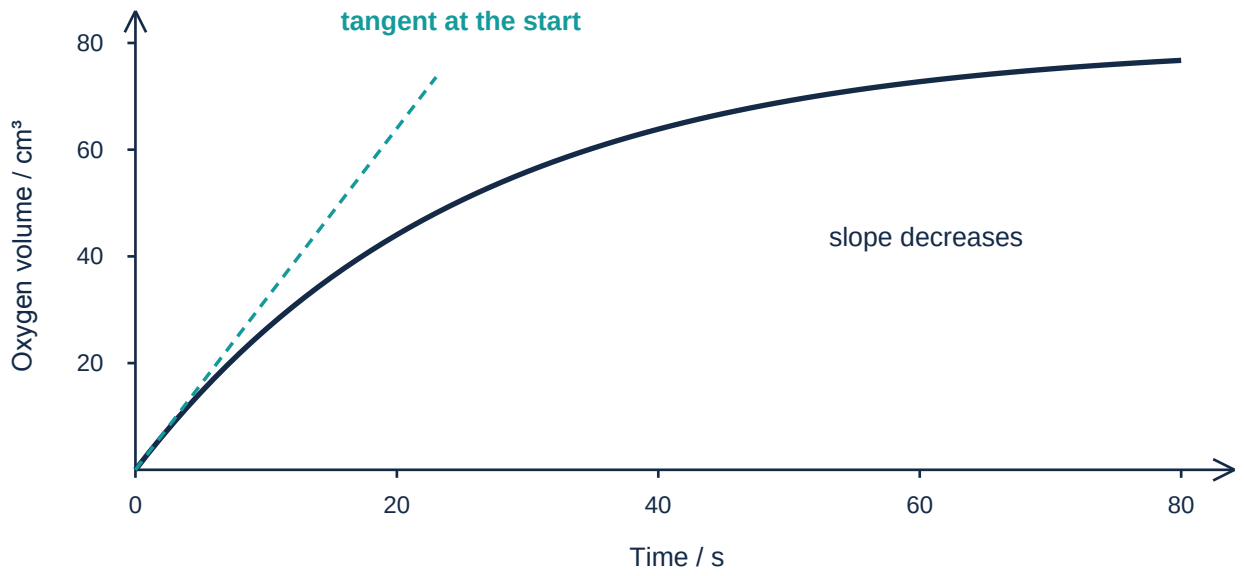
Practical reference: Practical Biology: amylase activity and iodine sampling.

Scope: Cambridge Biology 9700 syllabus, section 3.1, outcome 3, p. 20.

Read rate from the slope

Continuous product measurements show how rate changes during a reaction. A time to endpoint gives a useful comparison, but it does not show the full progress curve.

ILLUSTRATIVE PRODUCT-TIME CURVE



1. INITIAL RATE IS THE INITIAL GRADIENT

Draw a tangent at time zero, choose two widely separated points on that tangent, and calculate change in volume / change in time. Do not use two points on the curved line to claim an exact initial rate.

2. MAKE COMPARISONS VALID

Change only the chosen independent variable. Keep other conditions constant: temperature, pH, enzyme and substrate concentrations, volumes and mixing. Repeat each condition, investigate anomalies and compare mean rates with their spread.

A plateau means no further measurable product accumulation; it does not prove enzyme denaturation. Substrate depletion is one possible explanation.

Safety: follow the teacher's risk assessment; wear eye protection, avoid chemical contact and never block a gas-producing system.

Practical reference: SSERC: catalase gas-syringe investigation.

Scope: Cambridge Biology 9700 syllabus, section 3.1, outcome 3, p. 20.