

Enzymes • The Active Site

Learning objective 3.1.A Explain how enzymes catalyze reactions, and how the structure of an enzyme determines which reaction it catalyzes.

Name: _____

Date: _____

Period: _____

Use the tool **The Shape of the Site**. Work on the **Fit the substrate** tab for Parts 1 and 2, **Watch one cycle** for Part 3, and **Is it used up?** for Part 4. Drag every substrate at every enzyme — the ones that nearly work are the point of the exercise.

Part 1 • Which substrate goes in

Select **Enzyme A** and drag each of the six substrates at its active site in turn. Record the properties of each substrate and whether it bound.

Substrate	Shape	Chemistry	Binds to Enzyme A?
Substrate 1			
Substrate 2			
Substrate 3			
Substrate 4			
Substrate 5			
Substrate 6			

1. Enzyme A's active site is wedge-shaped and polar. State which substrate bound, and explain why that one and no other.

Part 2 · The two ways a substrate can fail

Still with Enzyme A, look carefully at the two substrates that **nearly** worked.

Substrate	What was right about it	What was wrong	Did it bind?
Substrate 2			
Substrate 6			

2. A substrate has exactly the right shape for an active site and still does not bind. Explain why.

3. Define the active site, and state what determines which substrate an enzyme will act on.

4. Open the nine-site table in the tool. Every possible active site accepts exactly one substrate profile. Explain what that shows about where specificity comes from.

Part 3 · One substrate, start to finish

Switch to **Watch one cycle** and step through all five stages. Watch the **site opening** readout at every step.

Step	What happens	Substrate bound?	Site opening
1			
2			
3			
4			
5			

5. Name what the enzyme and its bound substrate are called together.

6. Describe what happens to the enzyme's shape when the substrate binds, and name that effect.

7. Explain why the product leaves the active site when the substrate did not.

Part 4 · Is the enzyme used up?

Switch to **Is it used up?**. Set 2 enzymes and 24 substrates, then run rounds one at a time. **Predict the enzyme column before you press anything.**

After...	Enzyme	Substrate left	Product	Substrate + product
the start				
1 round				
3 rounds				
all rounds				

8. One column never changed. Name it and explain what that tells you about the role of an enzyme in a reaction.

9. Now set the enzyme slider to 6 and run to completion again. State what changed and what did not, and explain the difference.

10. Explain why one enzyme molecule can catalyze many reactions.

What the model simplifies

An active site is drawn as a shape with a color for its chemical character. A real active site is a pocket formed by particular amino acid side groups, and its chemistry is the sum of all of them.

Binding here is all-or-nothing. Real binding varies in strength, and an enzyme will often act slowly on a substrate that is a poor but not impossible fit.

Induced fit is shown as the site closing by a fixed amount. The real change is small, continuous, and different for every enzyme.

Each enzyme completes one reaction per round, so all of them work at the same speed. Real enzymes differ enormously in how fast they cycle, and Topic 3.2 is about what changes that speed.

The CED places the specific chemical structures of individual enzymes and their substrates beyond the scope of the exam, so this tool deliberately models shape and chemical properties rather than real molecules.