Enzymes

Think about...

- Have you ever baked a cookie?
- When you make cookies you start with cookie dough.
- If the dough was left on the counter in your kitchen it will not turn into cookies.
- You must first put it in the oven to bake the dough.
- The chemical reactions that occur between all the ingredients in the cookie dough don't react until heat is added.
- Right ingredients, right conditions (heat and length) to give gooey cookies!

Enzymes

- In your body there are huge numbers of chemical reactions taking place every second.
- Many of these reactions only occur at high temperatures.
- However, if your body temperature gets too high then you might experience seizures or even death.
- Enzymes are a way that the body can force high temperature chemical reactions to occur at the lower body temperature.

Enzymes

sequence of amino acids

- Enzymes are proteins that have the specific function of helping chemical reactions take place.
- They are capable of speeding up chemical reactions that occur too slowly on their own and allowing the reaction to occur at lower temperatures.
- Enzymes speed up chemical reactions.

Catalysts

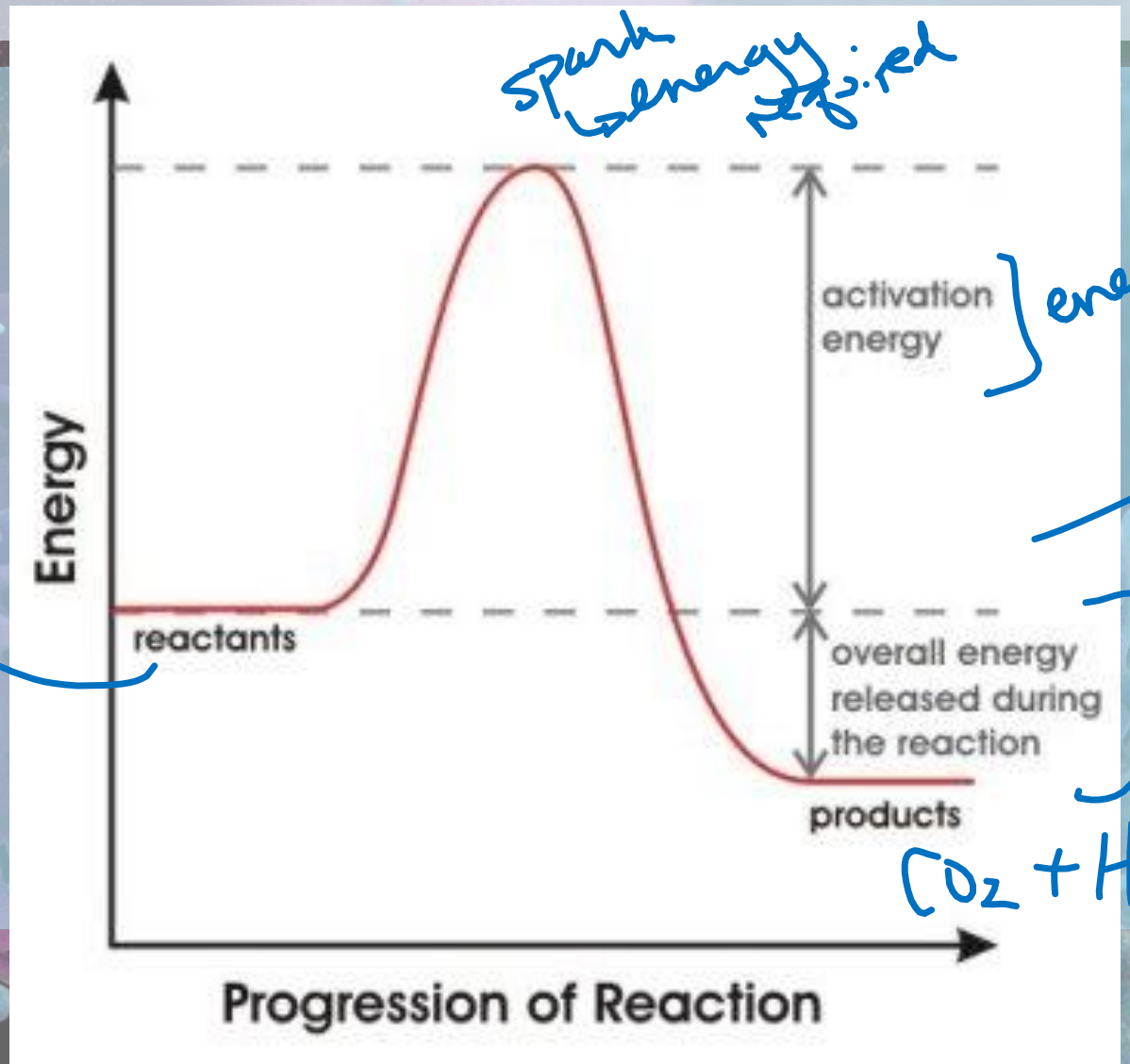
- Things that allow chemical reactions to occur at low temperature, and as a result speed them up, are called catalysts.
- Catalysts speed up a reaction without being used up in the process.
- Life Example: catalytic converter that is part of the exhaust system of a car.


Donut
HOW DO CATS WORK?
CO
CO2
CO2

Activation Energy

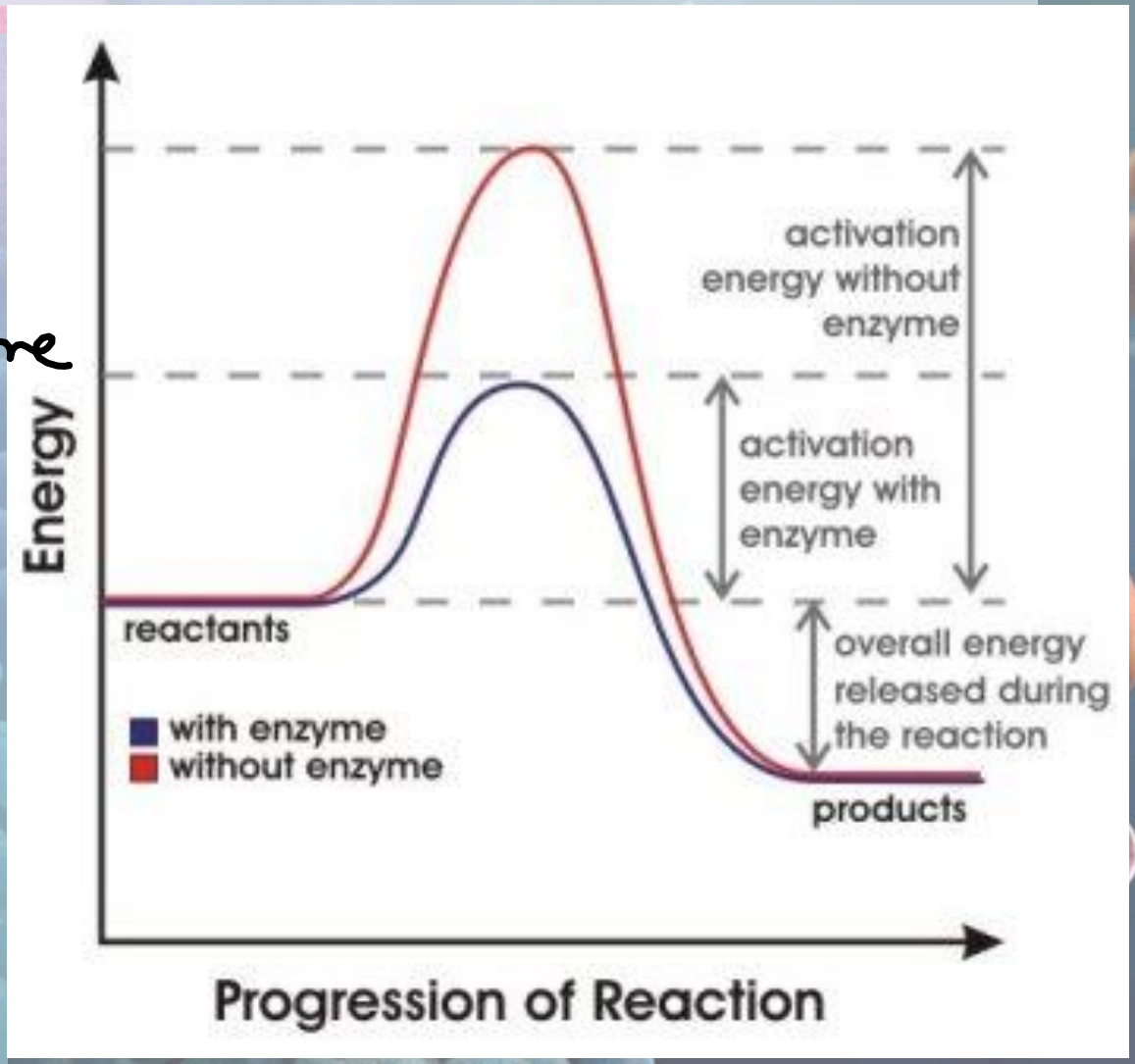
- To understand how a catalyst works we have to look at activation energy.
- Activation energy is the energy needed to allow the chemical reaction to take place.
- Example: When you light a gas barbeque, the gas does not ignite just by turning it on, you must add a spark (energy) to start the reaction that causes the propane gas to burn.

Activation Energy



Enzymes as a Catalyst

- in our cells we manufacture enzymes to decrease the E_A (Activation Energy)
- in lowering the E_A the enzyme serves 2 purposes...
  1. allow the temp to remain in "body temp" range → 37°C
  2. speeds up slower reactions
     ex. reaction of carbohydrates to sugar for energy.



How Enzymes Work

- For each type of reaction that must occur there is one enzyme acting as a catalyst for it.
- Many of the foods we eat must be broken down so that we can use them as an energy source.
- Carbohydrates are an important food source for us but we don't use them in the way we consume them; our body must break them down into mono- or disaccharides to make them useable.

How Enzymes Work

- The process of breaking down carbohydrates starts in our mouth.
- Our saliva contains an enzyme called amylase that breaks down amylose (starch) into glucose.
- Notice that the name of an enzyme ends in the suffix “-ase”. Just like all sugars end in the suffix “-ose”.

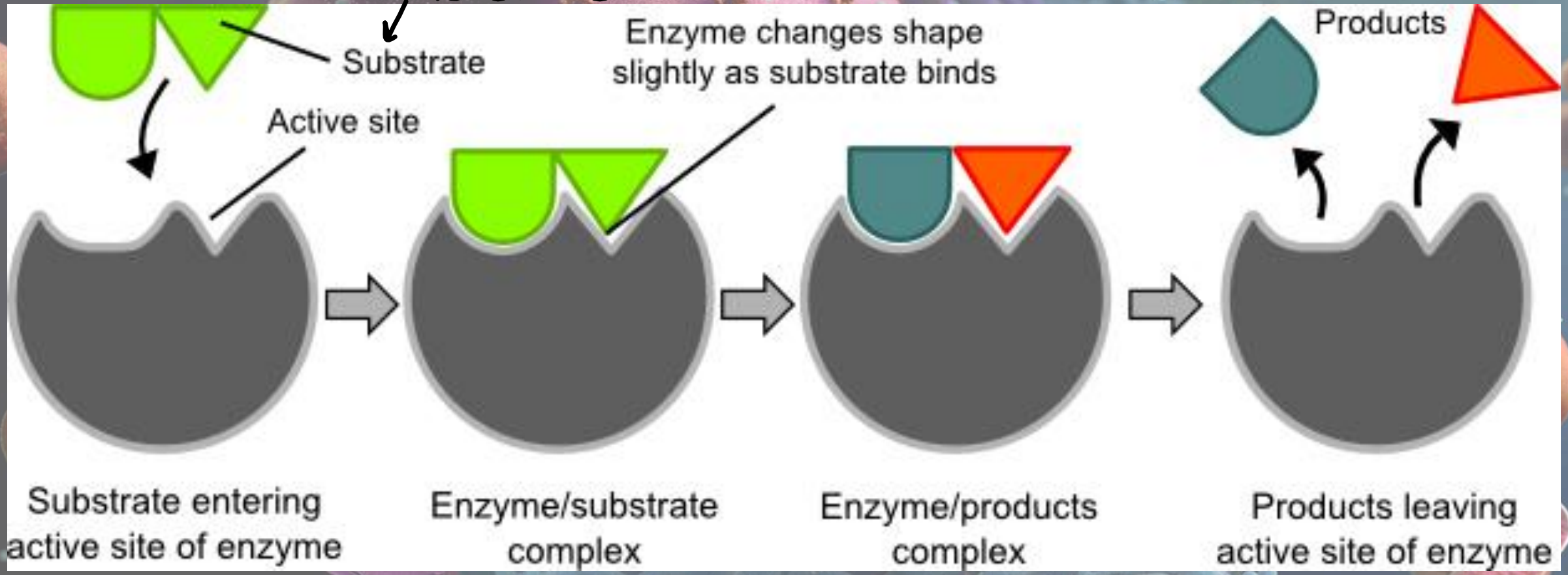
How Enzymes Work

- Enzymes work by something called the induced-fit model.
- There is only one site on the enzyme that the reactants can fit into.
- **This is why there is only one enzyme for each reaction.
- In other words, the active site has a specific shape that only fits the one molecule that it acts as a catalyst for.

How Enzymes Work

- In the induced-fit model an enzyme has a specific active site that a molecule can attach to.
- The reactants the substrate - only one substrate can bond to the active site on an enzyme.
- In an enzyme like amylase the enzyme also changes shape when a specific substrate bonds to it. That substrate is amylose (starch).

How Enzymes Work




Enzymes
with the Amoeba Sisters

Factors Affecting Enzymes

molecule is modified and can not do its job

- Enzymes are proteins and they can be denatured just like any other protein.
- That is why enzymes only work in a specific environmental range
  - → pH → stomach enzymes function at a pH of 1–3 small intestine the pH raises to a "base" pH above 7. and this denatures the protein
  - → temp. → most enzymes function at range 36–38°C

Application	Enzyme	Uses
Baking	Proteases	Reduces the amount of protein in flour by breaking them down
Baby food	Trypsin	Predigests food
Brewing	Amylase	Breaks down starch into maltose that can be fermented
Fruit juice	Pectinase	Breaks down amylopectin to make the juice clear
Cheese	Rennin	Causes cheese to form curds
Meat tenderizer	Papain	Breaks down proteins
Contact lens cleaner	Proteases	Breaks down protein build up on lenses
Detergent	Lipases	Breaks down oily stains on clothing
DNA research	Restriction enzymes	Breaks up DNA for use in forensic science

Reflection on Learning Quiz

- How does an enzyme affect the activation energy needed for an exothermic reaction?
- Do enzymes work at all temperatures and pHs? Why?
- Will any molecule fit into the active site of an enzyme?
- Are catalysts used up as they help speed up a reaction?
- Why do living things need catalysts to function properly?