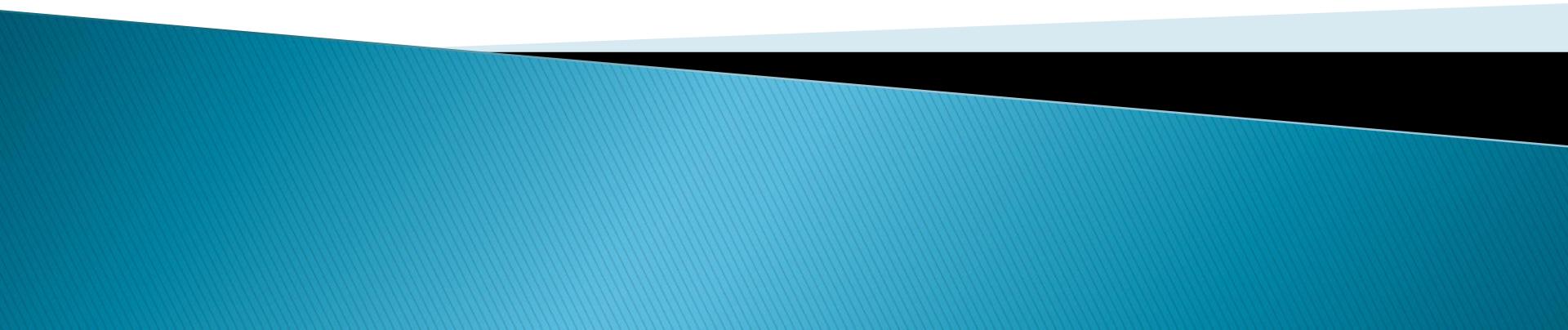


Proteins and Enzymes



Protein Variety

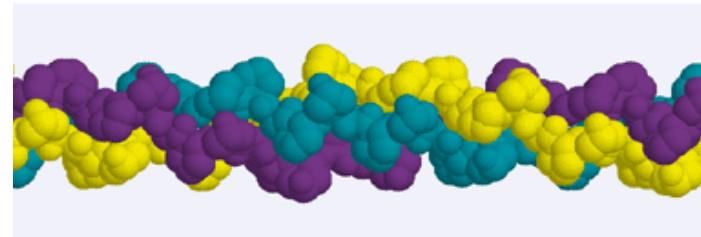
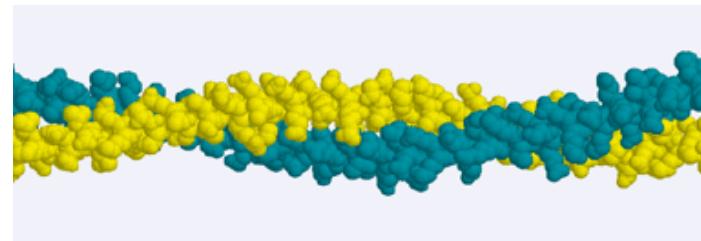
- ▶ Protein shape and function is determined by the sequence of **amino acids** that make up the protein. Amino acids are held together by **peptide bonds** to form **peptides**. Peptides are held together by **hydrogen bonds** to form **proteins**.
- ▶ The amino acid sequence is determined by the **order of bases in the DNA**

Protein Shapes

- ▶ Proteins can either be :
- ▶ * Fibrous
- ▶ * Globular
- ▶ * Conjugated

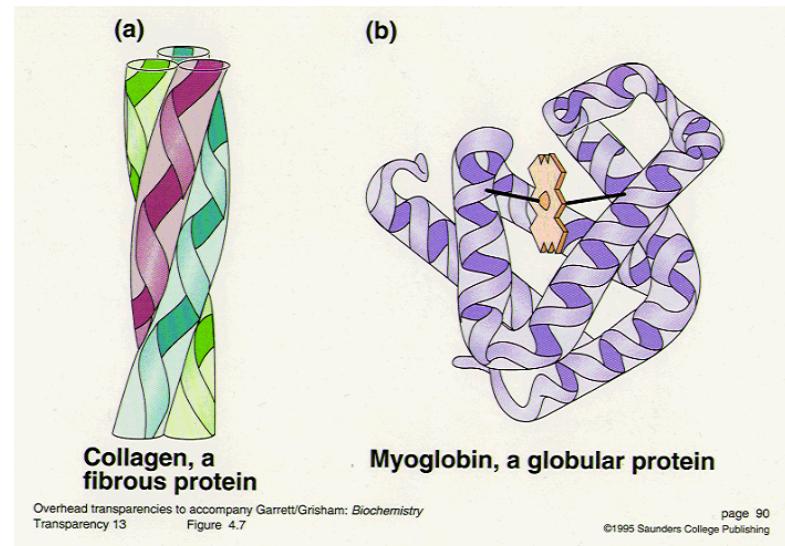
Fibrous Proteins

- ▶ Formed by several spiral shaped polypeptide molecules becoming linked together in parallel.
- ▶ Has a rope like structure
- ▶ Examples include structural proteins such as collagen and keratin.
- ▶ Diagram of collagen:



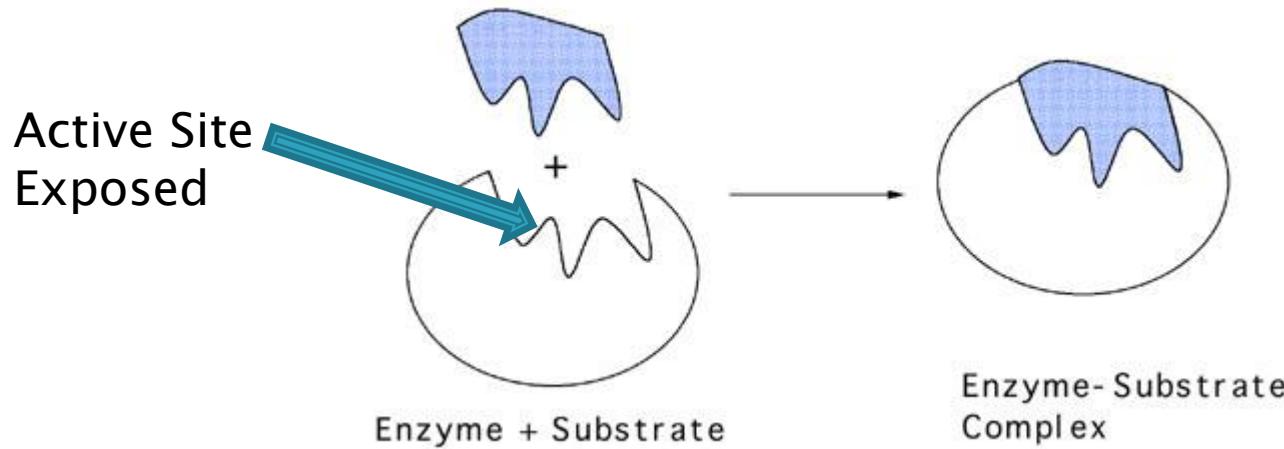
Globular Proteins

- ▶ Several polypeptide chains folded together in a roughly spherical shape
- ▶ Examples for this include enzymes, antibodies and hormones.

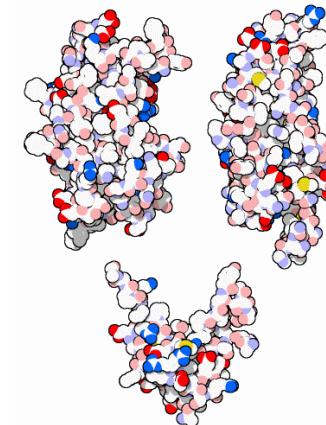


1 – Enzymes Intro Video

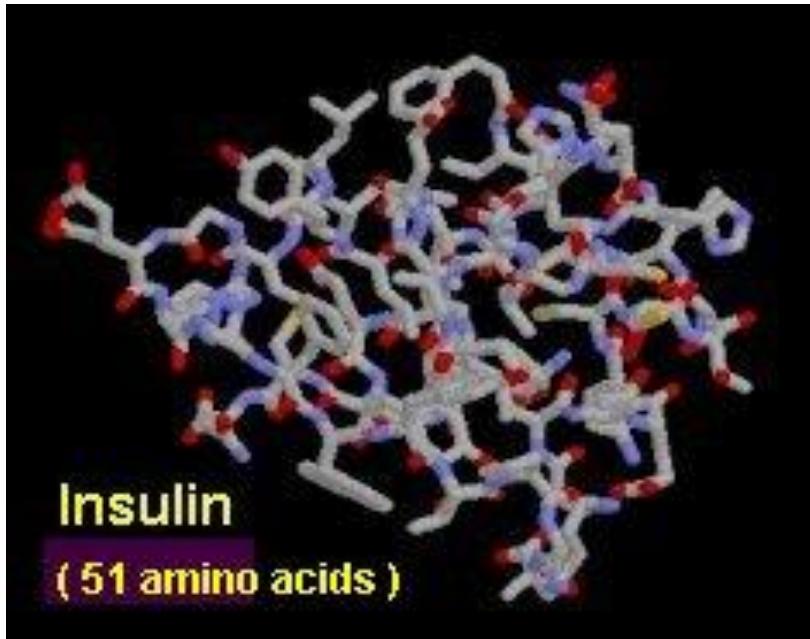
- ▶ Enzymes are folded in a way that exposes their active site – where the substrate binds
- ▶ Enzymes speed up chemical reaction and are known as biological catalysts



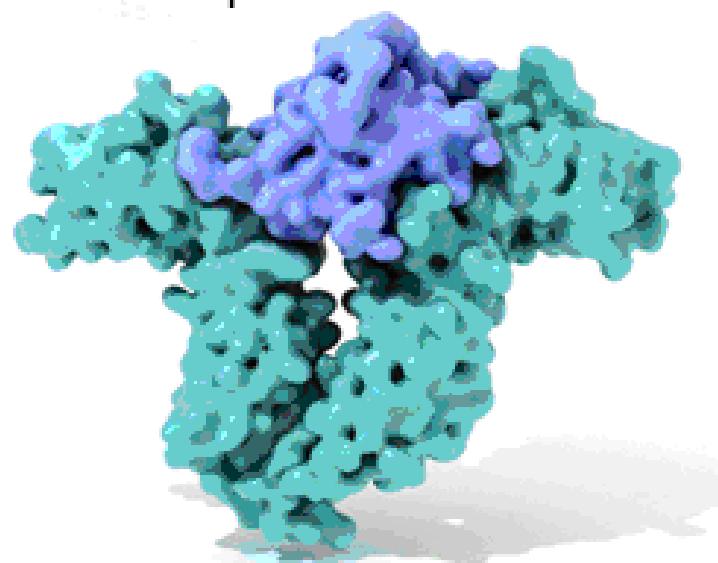
2 – Hormones



- ▶ These are chemical messengers which are transported in blood to “target” tissues where they exert a specific effect.
- ▶ Examples include:
- ▶ Insulin is released from the pancreas and lowers blood glucose levels
- ▶ Thyroxine is released by the thyroid and controls the rate of metabolic processes

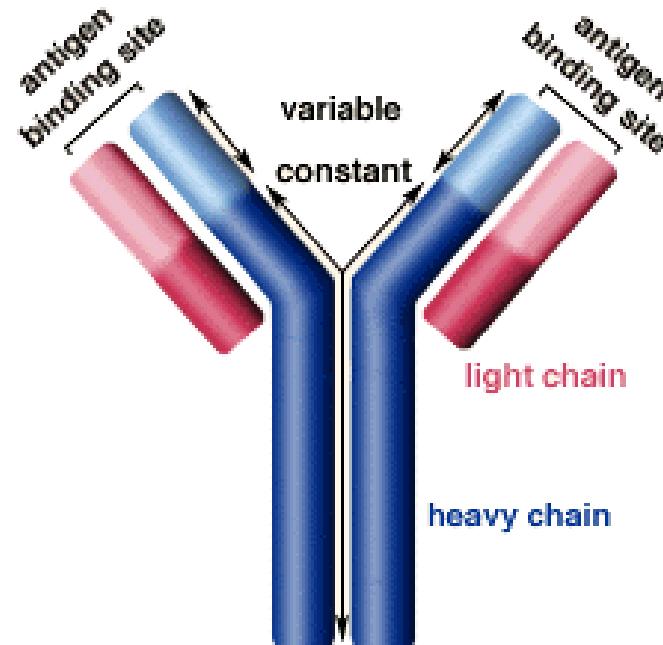
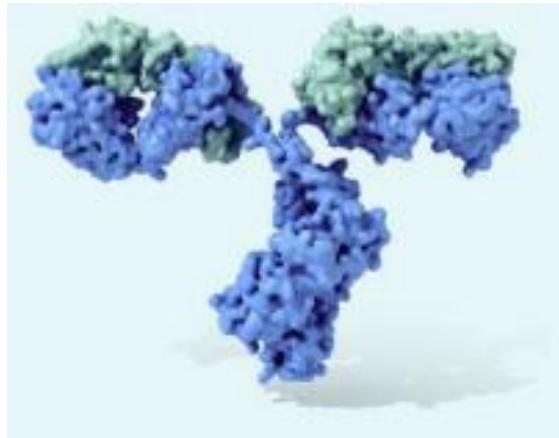


Growth hormone bound
to receptor



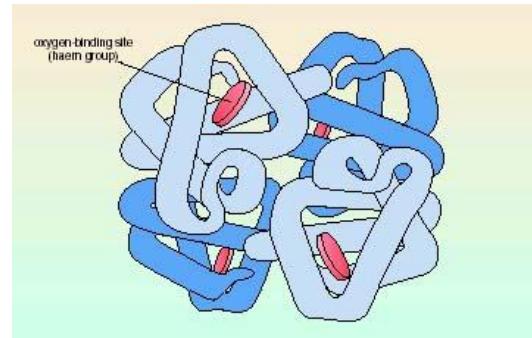
3 – Antibodies

- ▶ These are Y-shaped proteins
- ▶ They have receptors at either end
- ▶ They bind to antigens rendering them harmless



Conjugated Proteins

- ▶ These are **globular** proteins with a non-protein chemical attached
- ▶ Examples include:
- ▶ 1. Haemoglobin – globin protein + haem



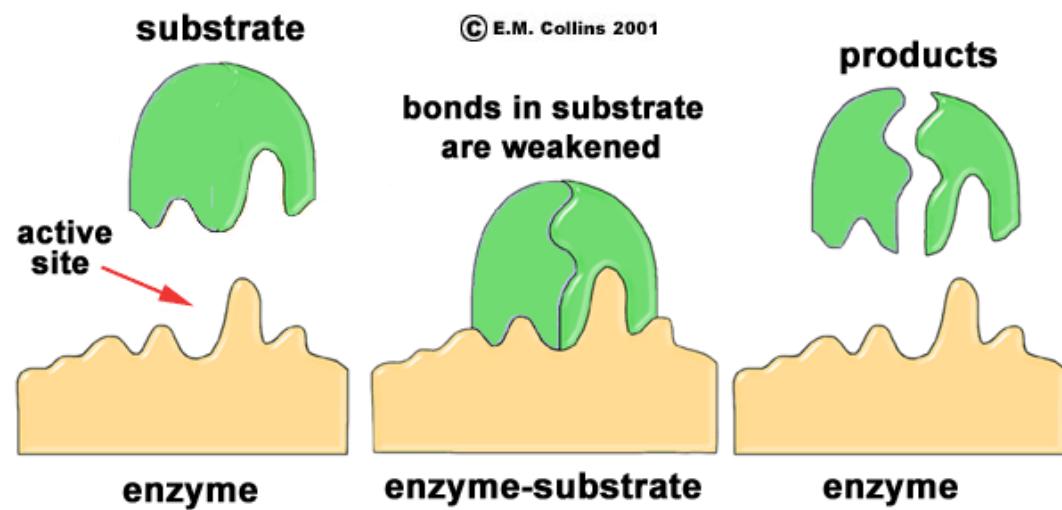
- ▶ 2. Glycoprotein – protein + carbohydrate (for example mucus!)

Focus on Enzymes!

- ▶ Enzymes are made by all living cells
- ▶ They speed up cellular reactions
- ▶ They remain **unchanged** by reactions and are therefore used multiple times
- ▶ Each enzyme only works with **one substrate**. Enzymes are said to be **specific**
- ▶ The shape of the **active site** of each enzyme is **complimentary** to the substrate. This is known as the **lock and key hypothesis**.

Lock and Key Hypothesis

Degradation
Reaction –
substrate
broken down to
form product



Synthesis
reaction –
substrate built
to form
product

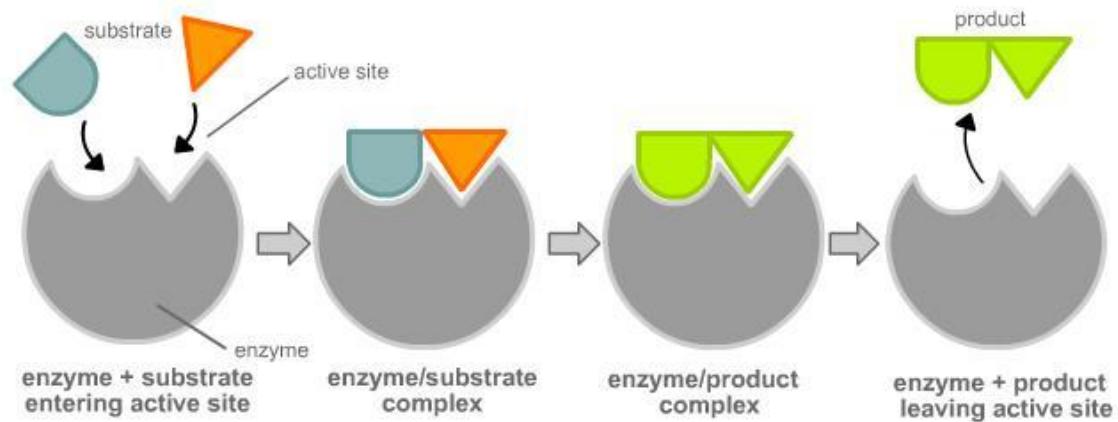


Diagram of the lock and key hypothesis...

Degradation Enzyme:

Synthesis Enzyme:

Review Questions:

1. What is the general name given to biological catalysts?
2. State TWO properties of a biological catalyst
3. Where are enzymes found in a living organism?
4. Of what type of substance are enzyme molecules composed?
5. Briefly explain why enzymes are needed for the functioning of all living cells
6. What term is used to refer to the substance upon which an enzyme acts?
7. Why is an enzyme said to be specific in its relationship with its substrate?

What effects enzyme activity?

- ▶ Each enzyme has conditions at which it works best at. These are known as **optimum conditions**
- ▶ Temperature and pH are 2 examples of factors that effect enzyme activity

Effect of temperature on enzymes

- ▶ Catalase is an enzyme that breaks down hydrogen peroxide (the substrate) to oxygen and water (the products).
- ▶ It is a degradation enzyme

Experiment Method

- ▶ Measure 5 ml of hydrogen peroxide using a syringe and pour into a boiling tube
- ▶ Add 5 drops of detergent
- ▶ Place at appropriate temperature until hydrogen peroxide reaches required temp
- ▶ Using a cork borer cut cylinders of potato
- ▶ Using a ruler measure the potato cylinder to 20mm and cut using a scalpel
- ▶ Add potato to the hydrogen peroxide and leave for 10 minutes
- ▶ Measure the height of foam produced with a ruler

Temperature – results

Temperature (°C)	Height of foam (mm) Experiment 1	Height of foam (mm) Experiment 2	Average height of foam (mm)
4			
24			
40			
65			

Temperature Results

- ▶ What kind of graph should be used to show the results?
- ▶ Draw a **line graph** of your results
- ▶ Temperature ($^{\circ}\text{C}$) will be on the X-axis and Height of foam (mm) on the Y-axis

Temperature – Conclusion and evaluation

- ▶ What trend do the results show?
- ▶ As temperature increases the height of foam produced increases, until 60°C, after which the height of foam decreases.
- ▶ What is happening to the enzymes at very high temperatures?
- ▶ The enzymes are becoming denatured – the shape of the active site has changed so that the substrate is no longer able to bind
- ▶ Were there any errors in the experiment?
- ▶ YES! – You should have brought hydrogen peroxide to the appropriate temperature before adding the enzyme (potato)
- ▶ How could we improve the experiment?
- ▶ Repeat it to increase reliability and improve accuracy of temperature measurements.

Effect of pH on enzymes

- ▶ Investigating the effect of pH on catalase activity
- ▶ Method:
- ▶ Cut 4 cylinder of potato using a 5mm cork borer and cut to 2 cm using a scalpel
- ▶ Measure out 5ml of each hydrogen peroxide with pH buffer included
- ▶ Add 3 drops of detergent
- ▶ Add potato cylinder and leave for 10 minutes
- ▶ Measure height of foam produced with ruler

Variables

- ▶ The variable being changed is _____
- ▶ The variables that must be kept constant are:

pH Results

pH	Height of foam 1 (mm)	Height of foam 2 (mm)	Average height of foam (mm)

pH Results

- ▶ Draw a bar graph of your results

Conclusion

- ▶ The optimum pH for catalase is _____

Review Task – Instructions

- ▶ Working on your own produce a leaflet about enzymes. You must include the following information:
 - ▶ What enzymes are and where they are found
 - ▶ The main function of an enzyme
 - ▶ Define the terms active site and substrate
 - ▶ Explain the relationship between the active site of an enzyme and its substrate
 - ▶ A diagram to illustrate the lock and key hypothesis
 - ▶ The meaning of the term optimum
 - ▶ The factors that affect enzymes and their effect
 - ▶ A definition of denaturation and explanation of when it happens