# Investigation 1: Digesting starch

Aim: To investigate the action of an enzyme found in saliva (amylase) on starch.

## Materials:

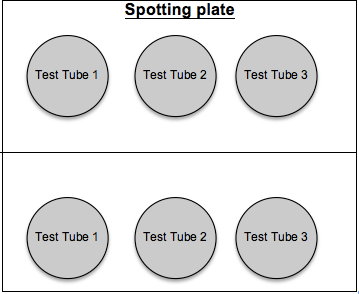
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| --- | --- |
| * 3 test tubes * 1 test tube rack * 1 rubber stopper to fit test tube * 1 x 10 mL measuring cylinder * 3 Pasteur pipettes or droppers * 3 sticky labels or a marker * 1 stopwatch | * 1 spotting plate * 1 dropper bottle of 1% starch solution * 1 dropper bottle of 10 % glucose solution * 1 dropper bottle of 1% amylase solution * 1 dropper bottle of iodine solution * 3 pieces of glucose test tape or test strips |

## Method:

1. Label the test tubes 1–3.
2. Set up the three test tubes as described in the table below.

|  |  |
| --- | --- |
| Test tube | Contents |
| 1 | Half fill the test tube with glucose solution |
| 2 | Half fill the test tube with starch solution |
| 3 | Half fill the test tube with starch solution.  Add 2 mL of amylase solution. |

1. Add a stopper to test tube 3 and shake to mix the amylase and starch solutions.
2. Share the test tubes between the members of your group and hold each test tube in a hand for 10 minutes.
3. After 10 minutes, place a few drops of liquid from test tube 1 into two depressions on the plate. Repeat this for test tubes 2 and 3. See diagram 1.
4. Test samples from each test tube for the presence of glucose and starch.

****Test for glucose

* Place a piece of test tape or dip a test strip into one of each sample.
* Is glucose present? Check the colour against the key on the packaging.

Test for starch

* Add two drops of iodine to each of one sample.
* Is starch present? If starch is present the solution will go blue/black.

1. Record your results.
2. Clean up all the equipment as directed by your teacher.

**Diagram 1:** Solution samples on the spotting plate

## Results:

**Title:** The action of the enzyme amylase on starch

|  |  |  |
| --- | --- | --- |
| Test tube | Present at the beginning | Present at the end |
| 1 | Glucose |  |
| 2 | Starch |  |
| 3 | Starch |  |

## Discussion:

1. What do your results indicate about the action of the enzyme amylase on starch?
2. What is the purpose of including test tubes 1 and 2 in the investigation?
3. What is the purpose of holding the test tubes in your hands?

## Conclusion:

Use your observations from this investigation to explain the change in texture and taste of the bread you ate at the start of this lesson.

# Investigation 2: Absorbing nutrients

Aim: To investigate what kind of nutrients can be absorbed.

## Materials:

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| --- | --- |
| Per group   * 2 lengths of dialysis tubing (~12 cm) * 3 x 250 mL beakers * 4 rubber bands or twist-ties * 1 dropper bottle of 10% glucose solution * 1 dropper bottle of 1% starch solution * 1 dropper bottle of iodine solution * 2 pieces of glucose test tape or strips * distilled water |  |

## Method:

1. Fill two of the beakers three-quarters full with water.
2. Label one beaker ‘glucose’ and the other ‘starch’.
3. Half fill the third beaker with water and place the two pieces of dialysis tubing in the water and leave for about two minutes.
4. Remove one piece of tubing and place a rubber band or twist-tie to seal off one end. Rub your fingers back and forth on the other end until the tubing opens. Blow into the tubing to open up the ‘sausage’.
5. Use the dropper to three-quarters fill the sausage with glucose solution.
6. Rinse the outside of the sausage with water.
7. Place the sausage into the beaker labelled ‘glucose’.
8. Repeat steps 4–7 but this time fill the tubing with the starch solution and place the sausage into the beaker labelled ‘starch’.
9. Leave the beakers for at least 15 minutes, the longer the better.
10. Use the glucose test tape or strips and the iodine solution to test for the presence of glucose and starch in each of the beakers.
11. Record the results in the table below.
12. Clean up all the equipment as directed by your teacher.

## Results:

**Title:** The movement of nutrients through a membrane

|  |  |  |
| --- | --- | --- |
| Nutrient in dialysis tubing sausage | Nutrients found in the beaker at the end of the experiment | Did the nutrients move through the dialysis tubing?  (yes/no) |
| Glucose |  |  |
| Starch |  |  |

## Discussion:

What can you infer about comparative particle size? Which particles are smaller, starch or glucose? How do your results support this?

## Conclusion:

The dialysis tubing behaves the same way as the wall of the small intestine. Use your results to describe the movement of substances out of the small intestine.

Use what you have learnt in Investigation 1 and 2 to explain why food has to be digested before the body can use it

## Find out more:

Use available resources to answer the following questions.

1. One of the functions of the small intestine is the absorption of nutrients. This occurs by a process called diffusion.
2. What is diffusion?
3. Describe how diffusion occurs.
4. One of the functions of the large intestine is the absorption of water. This occurs by a process called osmosis.
5. What is osmosis?
6. Describe how osmosis occurs.

# Investigation 3: Digesting proteins

Aim: To investigate the effect of the enzyme pepsin on protein.

## Materials:

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| --- | --- |
| Per group   * 1 test tube * 1 rubber stopper to fit test tube * 1 test tube rack * 2 x 10 mL measuring cylinders or graduated Pasteur pipettes * 1 dropper bottle of 2M hydrochloric acid * 1 stopwatch | Per class   * 1% pepsin solution + 100 mL beaker (to pour pepsin into measuring cylinder) * 1 L of egg white suspension + 100 mL beaker (to pour egg white into measuring cylinder) |

## Method:

1. Place 2 mL of an egg white suspension into a test tube.
2. Add 1 mL of pepsin and 3 drops of hydrochloric acid.
3. Add a stopper to the test tube and shake to mix the solutions.
4. Hold the test tube in your hand for 10 minutes.
5. Record your results.
6. Clean up all the equipment as directed by your teacher.

## Results:

Describe any change you observed in the test tube.

## Discussion:

1. How do your results indicate the action of the enzyme pepsin on proteins?
2. Why do you think acid was added to the test tube?

**Find out more**

*Use available resources to answer the following questions.*

1. What substance(s) are proteins broken down into in the digestive system?
2. What is the role of acid in the stomach?

# Investigation 4: The effect of temperature on enzyme activity

## Part A: Planning

*Question:* (What is the question or problem you are trying to investigate?)

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*Prediction:* (What do you think will happen?)

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*Variables:* (To make the investigation fair, which variable are you going to …)

* **Change?** (Independent variable)

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|  |

* **Measure?** (Dependent variable)

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* **Keep the same?** (Controlled variables)

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# Investigation 4: The effect of temperature on enzyme activity

## Part B: Conducting

## Materials:

Equipment needed per class:

* 1% pepsin solution + 100 mL beaker (to pour pepsin into measuring cylinder)
* 1 L of egg white suspension + 100 mL beaker (to pour egg white into measuring cylinder)
* kettle or urn
* ice
* cold water

Equipment needed per group:

* 9 test tubes
* 3 rubber stoppers to fit test tubes
* 2 test tube racks
* 3 x 250 mL beakers (to use as water baths)
* 2 x 10 mL measuring cylinders or graduated Pasteur pipettes
* 1 dropper bottle of 2M hydrochloric acid
* 3 thermometers
* 3 stopwatches

## Risk assessment:

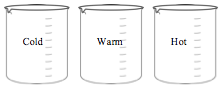
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| --- | --- |
| Possible hazard | Planned solution |
| *Example:*  *Knocking over the equipment during the investigation* | *Keep a neat and tidy work bench* |
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## Method:

1. Prepare the water baths as follows:

**Note:** Each beaker should contain 150–200 mL of water.

1. Label the three beakers as shown in the diagram below.



1. To the ‘cold’ beaker add some ice and cold water to get a temperature of less than 20 oC.
2. In the ‘warm’ beaker mix some hot and cold water to get a temperature of 35–40 oC.
3. Add hot water to the ‘hot’ beaker. The temperature should be at least 70 oC.
4. Prepare the test tubes as follows:
5. Place 2 mL of egg white suspension into each test tube.
6. Add 1 mL of Pepsin and 3 drops of hydrochloric acid to each test tube.
7. Place the stopper on each test tube and shake to mix.
8. Record the temperature of each water bath.
9. Set up the test as follows:
10. Label three test tubes A, B and C, place them into the ‘cold’ beaker and start the stopwatch.
11. Label three test tubes A, B and C, place them into the ‘warm’ beaker and start the stopwatch.
12. Label the last three test tubes A, B and C, place them into the ‘hot’ beaker and start the stopwatch.
13. Record how long it takes for each test tube to become clear. If the test tubes haven’t gone clear by the end of the experiment, record a '–' in the table.
14. Clean up all the equipment as directed by your teacher.

## Data Collection and Results:

**Title**: The effect of temperature on enzyme activity

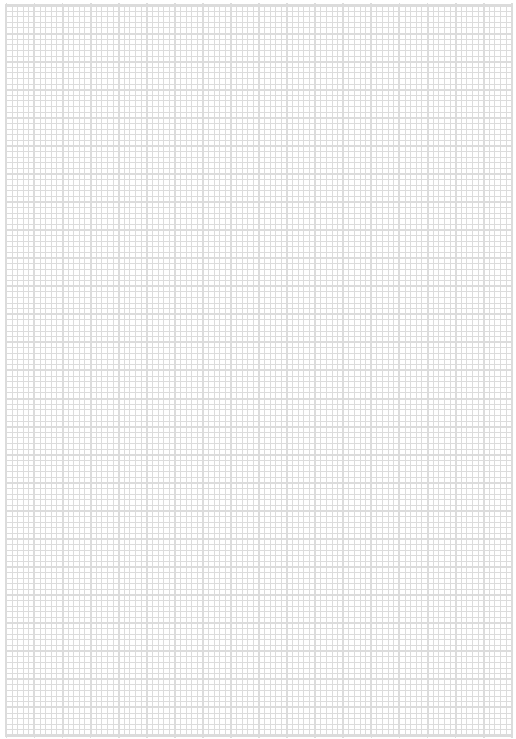
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| --- | --- | --- | --- | --- |
| Beaker | Temperature of the water bath  (oC) | Test tube | Time taken to become clear  (min) | Average time taken to become clear  (min) |
| Cold |  | A |  |  |
| B |  |
| C |  |
| Warm |  | A |  |  |
| B |  |
| C |  |
| Hot |  | A |  |  |
| B |  |
| C |  |

# Investigation 4: The effect of temperature on enzyme activity

## Part C: Processing and evaluating

## Processing the investigation

Graph your data:



## Conclusion:

(What did your results tell you about your question or problem? Was your prediction correct?)

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## Evaluating—Judging the investigation:

What problems did you encounter when doing your investigation?

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How did you overcome any problems you had with the investigation?

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Except for what you were testing, all other variables in your investigation should have been kept the same. Then it is a fair investigation.

**Was your investigation fair? Yes or No**

If you were to do this investigation again, what changes would you need to make it a fair (valid) investigation?

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What could you do to make your results more reliable?

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# The human digestive system

1. The processes that occur in the digestive system are listed below. Write a definition for each process

|  |  |
| --- | --- |
| 1. Ingestion |  |
| 1. Digestion |  |
| 1. Absorption |  |
| 1. Egestion |  |

1. What are the two types of digestion that occur in the digestive system? List the organs in which each occurs.
2. What is the function of enzymes in the digestive system?
3. Prepare a summary of the human digestive system by following the instructions below.
4. Draw a labelled diagram of the human digestive system that includes the following structures:

* mouth;
* oesophagus;
* stomach;
* small intestine;
* large intestine;
* rectum;
* anus.

1. Underneath each structure write its function.
2. If the structure is involved in chemical digestion identify the enzyme released, the food it acts on (substrate) and the substance it is broken down to (product).