Digestion

- Food travels from mouth → esophagus → stomach → small intestine → colon → rectum → anus.
- Food mixes with digestive juices, moving it through the digestive tract.
- Large molecules of food are broken into smaller molecules.
- Digestion begins in the mouth and is completed in the small intestine.
- Digestive juices are first produced by the salivary gland in the mouth.
  - The saliva contains amylase that begins to digest starch.
  - In the stomach lining, acid and pepsin break down proteins.
  - In the small intestine, the pancreas produces trypsin, chymotrypsin and pancreatic amylase and lipase to further digest protein, carbohydrates and fat. The intestinal wall produces peptidases to break peptides to amino acids.
  - The liver produces bile and is stored in the gallbladder between meals. The bile mixes with fat in the intestine and forms in micelles where it can be digested by lipase.
Absorption and Transport of Nutrients

Nutrients, along with water and minerals, are absorbed through the small intestines. The many folds of the mucosa are covered with villi which creates a large surface area through which the nutrients are absorbed. Nutrients are passively or actively transport through the mucosa of the small intestine to the blood where they are transported to other parts of the body.

Carbohydrates
Starch + sugar + amylase from saliva and pancreas → maltose + maltase from intestinal lining → glucose → blood stream → liver

Protein
Protein + pepsin from the stomach + acid → small intestine, peptides + pancreatic juices + peptidases from the intestinal wall → amino acid → intestinal epithelial cells → hepatic portal vein

Fat
Fat + bile in the small intestine + lipase → fatty acid + glycerol → Fatty acid + proteins + phospholipid + cholesterol → chylomicrons → lymphatics → blood stream
The experiment will explore the digestion of carbohydrate, protein and fat by digestive enzyme and examine the role of pH in digestion and activity of the digestive enzymes.

- Start with Part C because this part requires longer incubation time.
- Label all test tubes clearly with your initial. Use either permanent pens or wax pencil. Labeling tapes peel off during extended incubation in the water bath.
- Water baths are set up. Do not pick up other students test tubes.
- When the instruction calls to measure more than 2mL use a graduated cylinder. For measurement less than 2 mL count drops – 20 drops per mL.
- Do not put any dropper into reagents. If a reagent is not in dropper bottle, pour into your own container (test tube or beaker) and use the dropper from your container.
- Never return excess chemicals in the reagent bottle.
Procedure:
Part A  Hydrolysis of Starch with Salivary Amylase

Only the saliva donor will handle it and clean the glassware that contained saliva.
  • The Benedicts test confirms the presence of reducing sugar. Amylase catalyzes the breakdown of starch to maltose, a reducing sugar.
  • Reaction

\[
\text{Reducing sugar} + \text{Cu}^{2+} \xrightarrow{\text{heat}} \text{oxidized sugar} + \text{Cu}_2\text{O}
\]

blue Benedict's solution red-colored precipitate

  • When iodine solution is added to starch, it forms a blue-black complex, the confirmation test for starch.
  • Type correction: Part A #6: Part 2→B. Part B #4: Test tubes 4 and 5 should be 2 & 4

Part B Hydrolysis of Starch with Pancreatic Amylase
The pancreas produces digestive enzymes that include amylase. Amylase is contained in
pancreatin which a combination of enzymes that also includes lipase and protease. The optimum pH for pancreatin activity will be determine.

- Both the presence of starch and its breakdown product, maltose will be tested using the iodine solution and Benedict test.
- The Benedict's test requires heating in boiling water. Get a head start by heating your water first.
- What is the significance if both the iodine test and Benedict test prove positive?

Part C Protein Digestion
The enzymatic activity of pepsin, an enzyme produced in the stomach, will be observed in neutral, basic and acidic pH.

- Because the digestion of albumen, protein found in egg white, requires 1 hour incubation, this part should be done first.
- Use a very small portion of egg white-as big as the bullet point.
- Look for a change in the color of the liquid and also the change in texture of the albumin.
Part D Digestion of Triglycerides

Bile salt, sodium choleate, and pancreatin containing lipase will be added to triglyceride. Universal indicator will also be added.

- When triglyceride is hydrolyzed, the products are 3 molecules of fatty acid and glycerol.
- Because the fatty acid is a weak acid, a pH change will occur if hydrolysis occurred.
- The pH change can observed with the change in color of the universal indicator but pH is more accurate when using the pH paper.
- To compare the change in pH, the starting pH must be determined. Add a row in the data sheet to record the pH before incubation.
- The role of the sodium choleate (bile salts) is to form an emulsion increasing the surface for lipase to react. Observe if emulsion occurs in any of the test tubes.
- Mix the reactant on the vortex mixer.
- Type correction: Introduction, second to last sentence of the paragraph. ‘will be added to triglycerides’
Lab report:

- The data here is best presented using the data table provided. The data table can be incorporated into the lab report or referred to on the Data section.

- Data Table correction
  Part C: cross out 12
  Part D: Test tube should be 12, 13, 14
  Add another row: pH before incubation.

- When discussing the results, it is a common mistake to refer to test tube # which decreases the readability of report because the reader has to refer to the data table.

- It is best to state what is in the test tube rather than using test tube #.

- Refer to the syllabus if you need to review the format of the lab report.