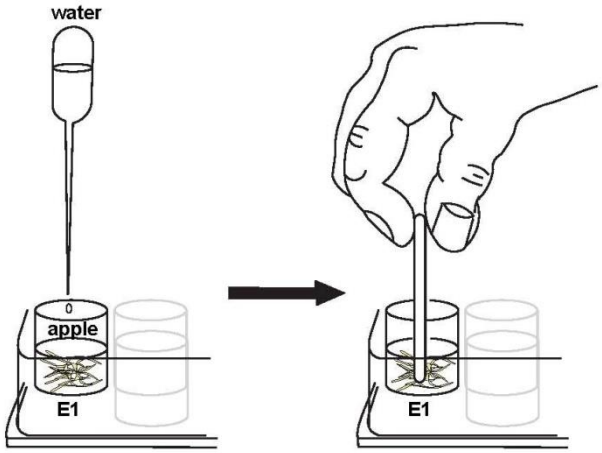
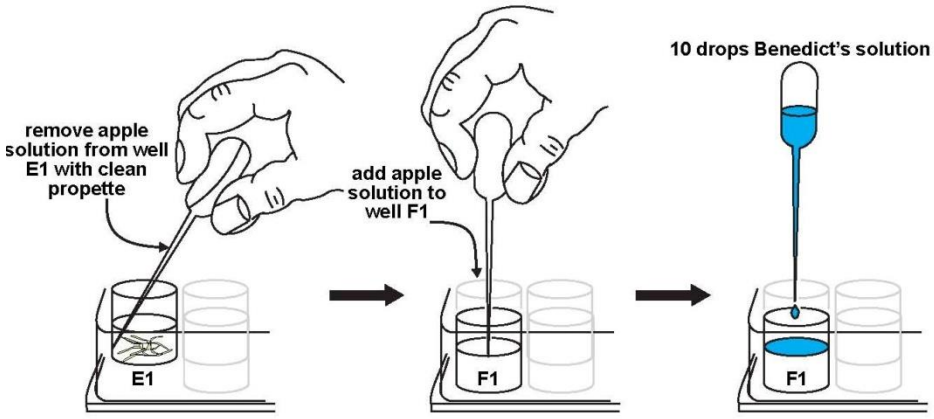
EXPERIMENT 11 – DOES THE FOOD WE EAT CONTAIN REDUCING SUGARS?

CSEC OBJECTIVE: Section B 2.6

Grade Level - 9&10

	Introduction: The greater the concentration of reducing sugar present in a particular food, the greater the amount of copper(II) ions that are reduced to copper(I) ions. However, in the Benedict's test, the blue colour of the Benedict's solution does not change to red all at once, even if a food sample contains a high concentration of reducing sugar. A series of colour changes occurs as the reduction proceeds. These are always in the same order, making it possible to compare, approximately, the concentration of reducing sugar present in different samples.
	You Need **Apparatus:** Comboplate®; 1 x glass rod; 6 x thin stemmed propettes; 1 x kitchen grater or sharp knife; 1 x water bath maintained at boiling temperature; 1 x 2 ml syringe. **Chemicals:** Tap water; 1 x fresh apple; 1 x fresh carrot; 1 x fresh potato; Cooked white rice; Cooked white mealie meal; Fresh milk; Benedict's solution. **NOTES** • The water bath can be constructed as described in Activity 1. • Any food items available may be tested, not necessarily those listed above.
	What to do 1. Finely grate a portion of each of the apple, carrot and potato. Clean the grater before grating each new food. (If a grater is not available, scrape across the flesh of each item with a sharp knife.) 2. Fill 1/3 of well E1 with the grated apple. 3. Add water from a propette to the apple, until well E1 is half full. Using the glass rod, grind the apple in the water. 

4. Fill 1/3 of well E2 with grated carrot. Add water until the well is half full. Wipe the glass rod clean and use it to grind the carrot in the water.
5. Fill 1/3 of well E3 with grated potato. Treat the potato as you have the apple and carrot.
6. Fill 1/3 of well E4 with cooked white rice. Wipe the glass rod clean and use it to break the rice into smaller pieces before adding any water to the well.
7. Add water to well E4 until the well is half full. Stir the rice in the water with the glass rod.
8. Fill 1/3 of well E5 with the cooked mealie meal. Add water to the well until it is half full. Rinse the glass rod and use it to stir the mealie meal in the water.
9. Using a clean propette, suck up the solution from well E1. The pieces of apple will be too large to enter the stem of the propette.
10. Add all of the solution from the propette into well F1.
11. Add 10 drops of Benedict's solution with a propette to the solution in well F1. Stir the solution thoroughly with a microspatula.



12. Using another propette, suck up the carrot solution from well E2 and transfer all of the solution to well F2. Add 10 drops of Benedict's solution and stir to mix.
13. Repeat step 12 with the potato solution from well E3, dispensing the solution into well F3.
14. Repeat step 12, this time transferring the rice solution from well E4 into well F4.
15. Using a clean propette, insert the tip just under the surface of the mealie meal solution in well E5. The larger particles of meal should have settled and you can remove all of the solution above the solid material without blocking the propette stem.
16. Transfer this solution to well F5 and add the 10 drops of Benedict's solution. Stir to mix.
17. Rinse a propette with water and use it to add 10 drops of fresh milk into well F6. Add 10 drops of Benedict's solution and stir to mix.
18. Pour freshly boiled water into the water bath. Carefully float the comboplate® in the water bath.
19. Leave the comboplate® in the hot water for approximately 3 minutes. After 3 minutes, add about 1 cup more of freshly boiled water to the water bath.
20. Leave the comboplate® for a further 3 - 4 minutes. Note what happens to the solutions in the wells while the comboplate® is being heated. Remove the comboplate® from the water bath and enter your results in Table 1.

Table 1

WELL	FOOD SOLUTION	COLOUR OF SOLUTION AFTER HEATING

Rinse the comboplate®, syringe and propettes with water.

QUESTIONS

Q1. How is the colour of the solution related to the concentration of reducing sugar detected in the food during the time specified? (Hint: look at the results for Activity 1.)

Q2. Which food contains the highest concentration of reducing sugar/s? Explain.

Q3. Which food contains the lowest concentration of reducing sugar/s? Give a reason for your answer.

Q4. What is the answer to the focus question?

EXTENSION QUESTIONS

Q5. Besides the colour change that occurred, what other change did you notice in the appearance of the milk when it was heated with Benedict's solution?

Q6. Why did the appearance of the milk change?

EXPERIMENT 12 – HOW CAN ONE TEST FOR THE PRESENCE OF A NON-REDUCING SUGAR IN FOOD?

CSEC OBJECTIVE: Section B 2.7

Grade Level – 9&10

Introduction:

Some disaccharides, such as sucrose, are unable to reduce the copper(II) sulphate in Benedict's solution to copper(I) oxide. In these disaccharide molecules, the functional groups that could be involved in the redox reaction, are linked together in a glycosidic bond. Such disaccharides are called non-reducing sugars. The purpose of this investigation is to discover how the reducing sugars test can be modified to detect the presence of a non-reducing sugar in a food substance.

You Need

Apparatus: 1 x comboplate®; 2 x plastic microspatulas; 1 x 2 ml syringe; 2 x thin stemmed propettes; 1 x water bath maintained at boiling temperature; 1 x cold water bath.

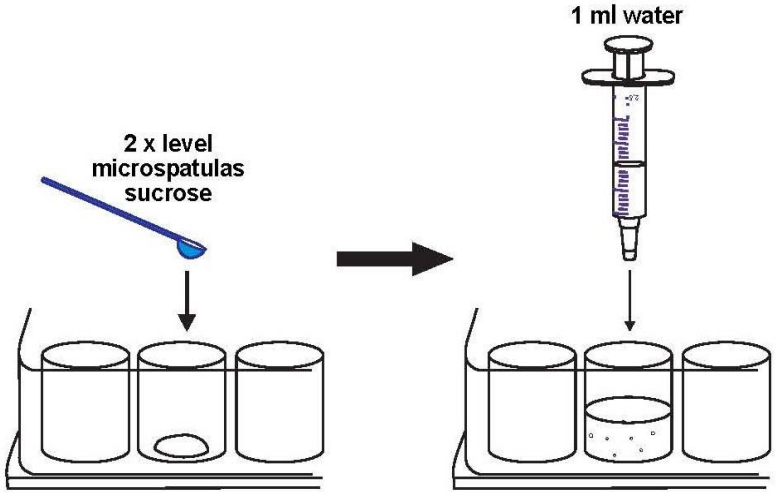
Chemicals: Sucrose/table sugar ($C_{12}H_{22}O_{11}(s)$); Benedict's solution;
Hydrochloric acid ($HCl(aq)$) [5.5 M]; Sodium bicarbonate/baking soda ($NaHCO_3(s)$);
Tap water.

*** Make a boiling water bath in the following way:**

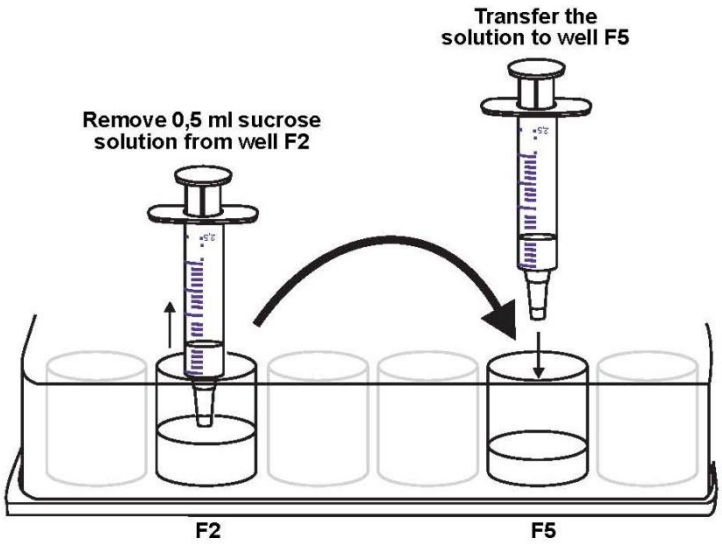
Fill a plastic container (such as a large bowl or your lunch box or an empty, 2 litre ice cream container) with boiling water from a kettle or cooking pot. It is best if each learner has their own water bath. If large containers are used, more than one learner can use them together, provided that the bath does not become too crowded with comboplates® so that they topple over when the container is replenished with boiling water.

What to do

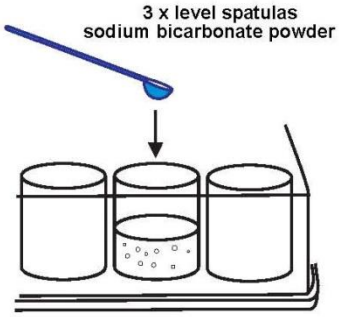
1. Using the spoon of a plastic microspatula, place 2 level spatulas of the sucrose into well F2.
2. Add 1,0 ml of tap water to the sucrose with the syringe. Stir to dissolve the sucrose.



3. Remove 0,5 ml of the sucrose solution with the syringe and transfer this to well F5.



4. Add 10 drops of Benedict's solution into the sucrose solution in well F2 only.
5. Fill the water bath with freshly boiled water. Float the comboplate® carefully in the water bath for a few minutes. *(See Question 1)*
6. Remove the comboplate® from the water bath.
7. Use a clean propette to add 3 drops of 5.5 M hydrochloric acid to the sucrose solution in well F5. Stir the contents with a microspatula.
8. Place the comboplate® in the boiling water bath for 1½ minutes. Remove the comboplate® from the hot water and place it in cold water for about 1 minute.
9. Remove the comboplate® from the cold water. Place 3 level spatulas of sodium bicarbonate with the spoon of a clean microspatula into well F5 to neutralise the solution. *(See Question 2)*
10. Add 10 drops of Benedict's solution to well F5. Stir the solution to mix.
12 Pour out the cooled water from the boiling water bath and add more freshly boiled water.
13 Return the comboplate® to the boiling water bath and leave for 5 - 7 minutes. *(See Question 3)*



Rinse the comboplate® and remaining equipment with water.

QUESTIONS

Q1. Does the colour of the solution in well F2 change after floating the comboplate in the water bath for a few minutes? What does this observation imply?

Q2. What happens when the sodium bicarbonate is added to the acidified sucrose solution?

Q3. What happens to the colour of the solution in well F5 during heating? What does this observation imply?

Q4. From your observations, what do you think is the function of the hydrochloric acid in this experiment?
Explain your answer.

Q5. Which reducing sugar/s caused the Benedict's solution to change colour? Give a reason

	for your answer. Q6. What is the name given to the reaction in this experiment where hydrochloric acid breaks up the disaccharide to form its constituent monosaccharides? Q7. What is the answer to the focus question?
	EXTENSION QUESTIONS Q8. What other biological compound will perform the same function as the hydrochloric acid in hydrolyzing sucrose? The following questions are aimed at students with a chemistry background. Q9. Write down the chemical equation for the reaction of the sodium bicarbonate with the acidified (HCl(aq)) sucrose solution. Q10. Use your answer to question 9 to explain why "fizzing" was heard when the sodium bicarbonate was added.

EXPERIMENT 13 – IODINE TEST FOR STARCH

CSEC OBJECTIVE: Section B 2.6

Grade Level – 9&10

You Need

Apparatus: 1 x comboplate®; 1 x plastic microspatula; 3 x thin stemmed propettes.

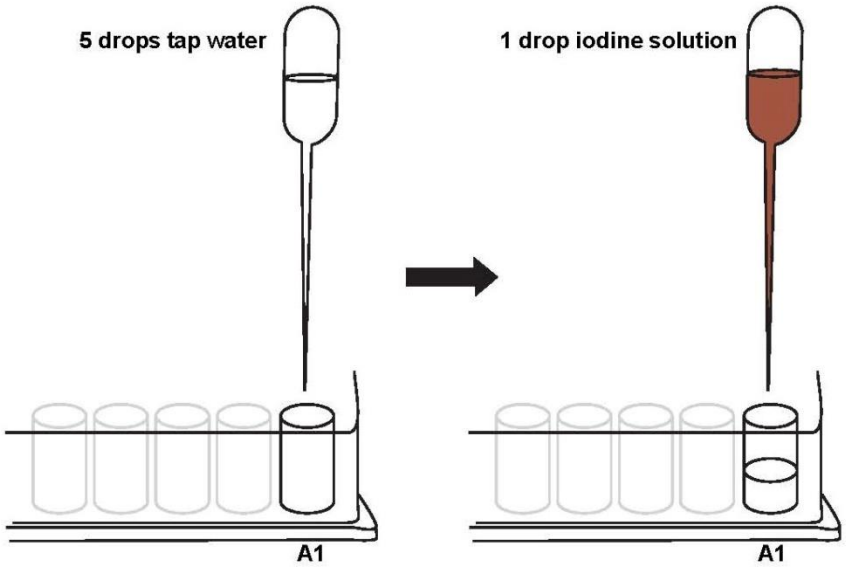
Chemicals: Starch solution ((C6H10O5)n(aq)) [1%]; Iodine solution (I2/KI(aq)) [1%]; Tap water.

NOTES

- $ If iodine and/or potassium iodide are not available, use the tincture of iodine obtainable from a chemist at low cost.

What to do

1. Use a propette to place 5 drops of tap water into well A1.
2. Place one drop of iodine solution from a propette into the water in well A1. (*See Question 1*)



3. With a clean propette, place 5 drops of the 1% starch solution into well A2.
4. Place one drop of iodine solution into the starch solution in well A2. (*See Question 2*)

Rinse the comboplate® and propettes with water.

QUESTIONS

Q1 What is the colour of the solution in well A1 after adding a drop of iodine solution?

Q2 What is the colour of the solution in well A2 after adding a drop of iodine solution?

Q3 How can one test for the presence of starch in food?

EXPERIMENT 14 – DOES THE FOOD WE EAT CONTAIN STARCH?

CSEC OBJECTIVE: Section B 2.6

Grade Level – 9&10

You Need

Apparatus: 1 x comboplate®; 1 x 2 ml syringe; 1 x glass rod; 6 x thin stemmed propettes; *1 x kitchen grater or sharp knife (not in the kit).

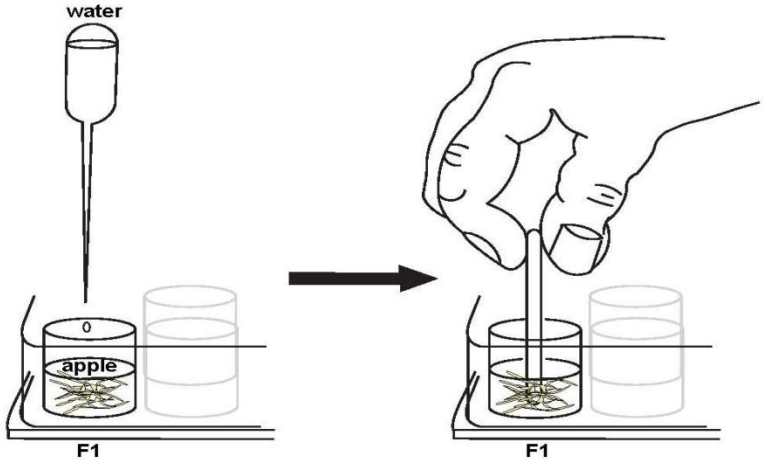
Chemicals: Iodine solution (I2/KI(aq)) [1%]; Tap water; 1 x fresh apple; 1 x fresh carrot; 1 x fresh potato; Fresh milk; Cooked white rice; Cooked white mealie meal.

NOTES

- The food items are not included in the kit.
- Any food items may be used; not necessarily those listed above.

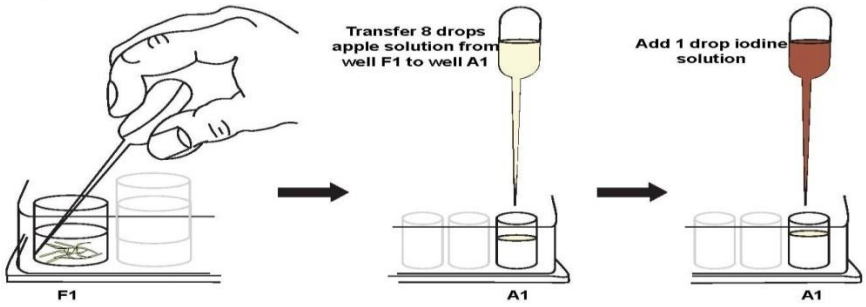
What to do

1. Finely grate a portion of each of the apple, carrot and potato. Clean the grater before grating each new food. (If a grater is not available, scrape across the flesh of each item with a sharp knife.)
2. Fill 1/3 of well F1 with the grated apple. Add water from a propette to the apple until well F1 is half full.
   Using the glass rod, grind the apple in the water.



3. Fill 1/3 of well F2 with grated carrot. Add water until the well is half full. Wipe the glass rod clean and use it to grind the carrot in the water.
4. Fill 1/3 of well F3 with grated potato. Treat the potato as you have the apple and carrot.
5. Fill 1/3 of well F4 with cooked, white rice. Rinse the glass rod and use it to break the rice into smaller pieces before adding any water.
6. Add water from a propette to the rice, until well F4 is half full. Stir the mixture with the glass rod.
7. Fill 1/3 of well F5 with cooked, white mealie meal. Add water to well F5 until it is half full.
8. Rinse the glass rod and use it to stir the mixture in well F5.

9. Using a clean propette, suck up the solution from well F1. The pieces of apple will be too large to enter the stem of the propette. Add 8 drops of the apple solution into well A1.
10. Add one drop of the iodine solution to well A1 and stir the contents of the well. (*See Question 1*)



11. With another propette, suck up all of the carrot solution from well F2. Add 8 drops of the solution into well A3. Add one drop of iodine solution and stir the contents of the well. (*See Question 1*)
12. Repeat step 11 with the potato solution from well F3, transferring this solution into well A5. (*See Question 1*)
13. Place 8 drops of fresh milk into well A7 with a clean propette. Add one drop of iodine solution. (*See Question 1*)
14. Repeat step 11 with the rice solution from well F4, adding the solution to well A9. Add 1 drop of the iodine solution to well A9. (*See Question 1*)
15. Allow the solid material in well F5 to settle. Insert the tip of a clean propette just under the surface of the solution in well F5 and suck up all of this solution.
16. Add 8 drops of the mealie meal solution into well A11. Add 1 drop of the iodine solution to well A11 and record your result in Table 1. (*See Question 1*)

Rinse the comboplate®, syringe and propettes with water.

QUESTIONS

Q1. Prepare a table like Table 1 below in your books. Record your results in Table 1.

Table

WELL	FOOD SOLUTION	COLOUR OF SOLUTION AFTER IODINE ADDED
A1		
A3		
A5		
A7		
A9		
A11		

Q2. What is the answer to the focus question?

	EXTENSION QUESTIONS Q3. Starch is a polymer of glucose. What does this statement mean? Q4. Starch molecules (polymers) can be broken down into glucose molecules (monomers) by hydrolysis, in the same way that sucrose is broken down into fructose and glucose. Using this information, choose the food/s from Table 1 above which you would eat the most of if you were going to run a long race the next day. Explain your choice. Q5. Consider the statement made above in question 4. What result would you expect in the Benedict's test if the potato, rice or maize solutions were heated with 5.5 M HCl(aq), neutralised with sodium bicarbonate, treated with Benedict's solution and then placed in a boiling water bath? Explain your answer.

EXPERIMENT 15 – EMULSION TEST FOR LIPIDS

CSEC OBJECTIVE: Section B 2.6

Grade Level – 9&10

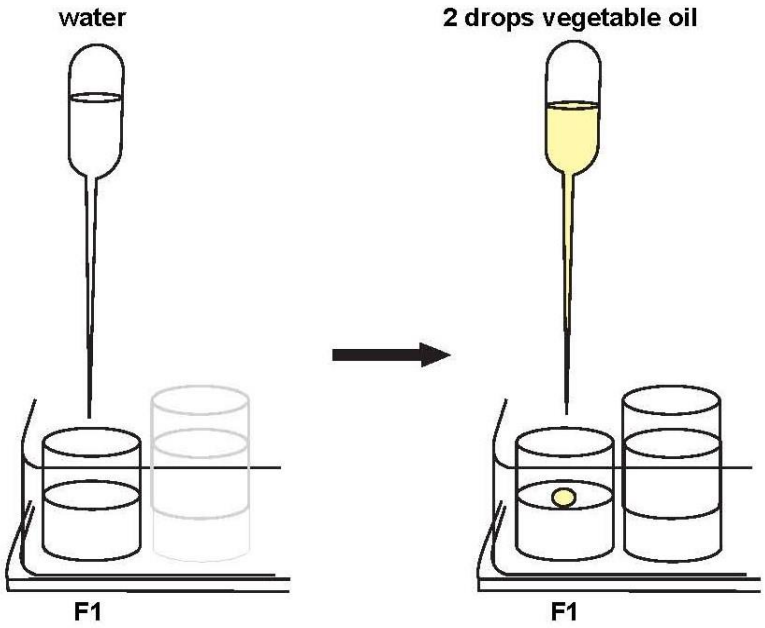
You Need

Apparatus: 1 x comboplate®; 5 x thin stemmed propettes.

Chemicals: Ethanol ($C_2H_5OH(l)$); Vegetable oil (eg. corn oil, olive oil etc.); Tap water.

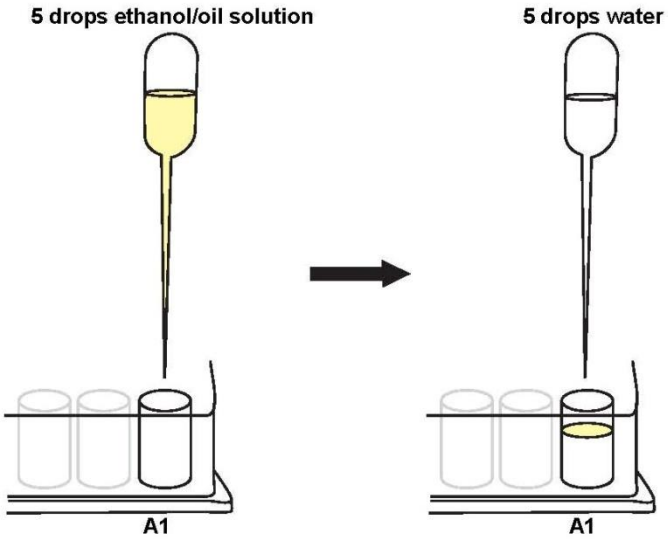
What to do

1. Fill ½ of well F1 with water from a propette.
2. Add 2 drops of vegetable oil using a clean propette. (*See Question 1*)



3. 3. Stir the contents of well F1 vigorously with a plastic microspatula.
   (*See Question 2*)
4. 4. Place 2 drops of oil into well F3. Add ethanol to well F3
   from a clean propette until the well is half full.
   (*See Question 3*)

6. Suck up the ethanol/oil solution in well F3 with a clean propette and place 5 drops of this solution into well A1.
1. Add 5 drops of water to the solution in well A1. (*See Question 4*)



Keep both the oil/water and oil/ethanol mixtures for the next experiment.

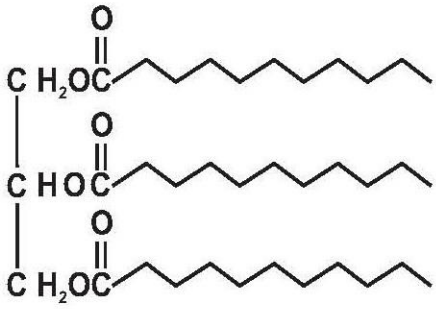
QUESTIONS

Q1. What do you observe in well F1 after adding the vegetable oil?
Q2. What do you see in well F1 after stirring?
Q3. What happens to the oil in well F3 when the ethanol is added?
Q4. What happens in well A1 after adding the water to the ethanol/oil mixture?
Q5. What is the general name given to the kind of cloudy liquid observed in well A1?
Q6. How can one identify lipids in food using the emulsion test?

EXTENSION QUESTION

(The following question is aimed at students with a chemistry background.)

Q7. The structure of a a complete lipid molecule is given below. Use this structure to explain your observation when oil was added to water.



a lipid molecule

EXPERIMENT 16 –GREASE SPOT TEST FOR LIPIDS

CSEC OBJECTIVE: Section B 2.6

Grade Level – 9&10

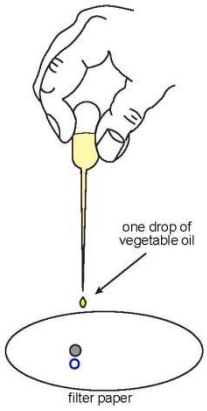
You Need

Apparatus: 1 x comboplate®; 5 x thin stemmed propettes; Filter paper or brown paper (not in the kit).

Chemicals: Ethanol/oil solution from Lipid Activity 1; Water/oil mixture from Lipid Activity 1; Ethanol ($C_2H_5OH(l)$); Vegetable oil (eg. corn oil, olive oil etc.); Tap water.

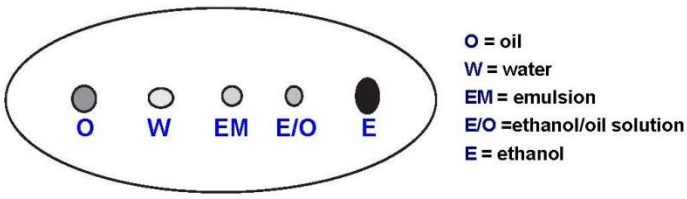
What to do

1. Place 1 drop of vegetable oil onto a piece of filter paper. Write the letter **O** on the filter paper beneath the spot with a pencil.



2. Place 1 drop of water next to the oil spot on the filter paper. Write the letter **W** on the filter paper beneath the water spot.
3. Shake the oil/water mixture in the propette so that a temporary emulsion forms inside the bulb of the propette.
4. Immediately place a drop of the emulsion on the filter paper next to the water spot. Write the letters **EM** beneath the emulsion spot.
5. Place 1 drop of the ethanol/oil solution next to the spot of the emulsion on the filter paper. Write **E/O** beneath the spot with a pencil.
6. Finally, place 1 drop of ethanol next to the ethanol/oil spot on the paper. Write the letter **E** beneath the spot with a pencil.
7. Leave the filter paper to dry. Observe the dry paper. *(See Question 1)*
8. Hold the paper up to the light. *(See Question 2)*

Rinse the comboplate® with a soap solution.



	QUESTIONS Q1. What do you see on the surface of the filter paper once it has dried? Q2. What do you notice about the oil stains on the paper when the paper is held up to the light? Q3. It was found in the emulsion test that oil dissolves in ethanol. Why, then, was an oil stain left where the ethanol/oil spot was placed on the filter paper? Q4. Explain your observations concerning the spot of the oil/water mixture. Q5. What would you have seen on the dried filter paper if the oil and water were not shaken together in the propette before placing a spot on the paper? Explain. Q6. How can the grease spot test distinguish between lipids and non-lipids in food?

EXPERIMENT 17 – DOES THE FOOD WE EAT CONTAIN LIPIDS?

CSEC OBJECTIVE: Section B 2.6

Grade Level – 9&10

You Need

Apparatus: 1 x comboplate®; 6 x thin stemmed propettes; 1 x kitchen grater or sharp knife; Filter paper or brown paper.

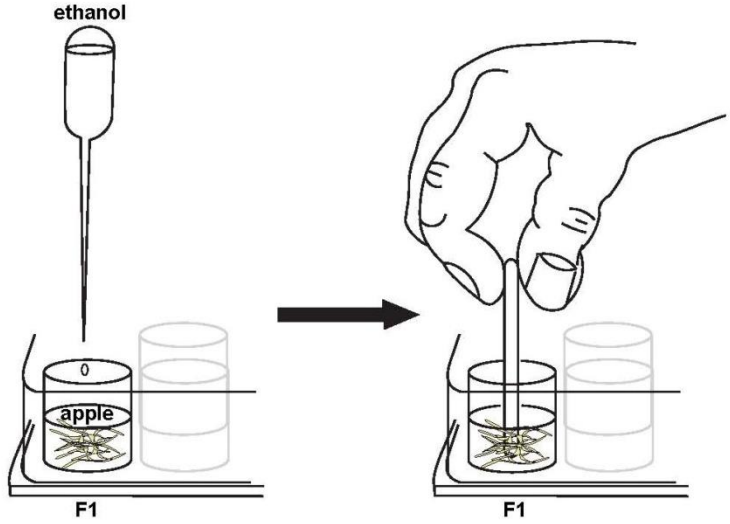
Chemicals: Ethanol ($C_2H_5OH(l)$); 1 x fresh apple; 1 x fresh carrot; Cooked white mealie meal; Cooked white rice; Fresh full cream milk; Tap water.

NOTE

- The food items are not included in the kit.
- The meal and rice must be cooked in plain water. No milk, sugar, salt, butter, etc. may be added.

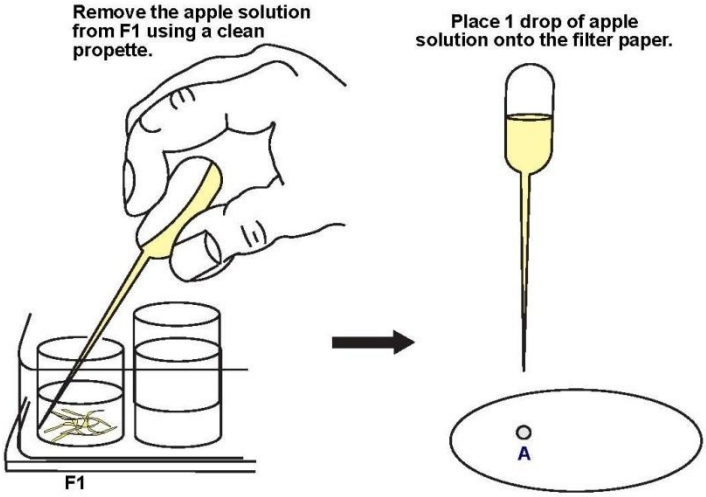
What to do

1. Use the kitchen grater to grate a portion of each of the apple and carrot. Clean the grater between each food item. (If a grater is not available, use a sharp knife to scrape across the flesh of each item.)
2. Fill 1/3 of well F1 with grated apple. Add ethanol from a clean propette to the apple in well F1 until the well is half full.
3. Grind the apple in the ethanol with a glass rod. Any food items may be used; not necessarily those listed above.

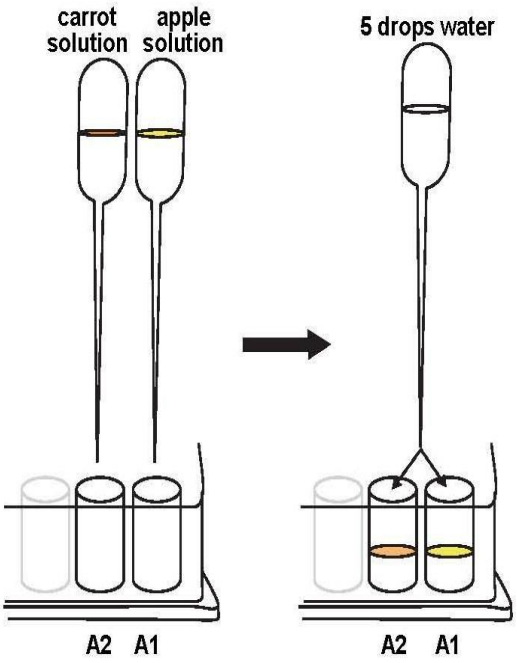


4. Fill 1/3 of well F2 with grated carrot. Add ethanol to the carrot until the well is half full. Wipe the glass rod clean and use it to grind the carrot in the ethanol.
5. Fill 1/3 of well F3 with cooked, white rice. Wipe clean the glass rod and use it to break the rice into smaller pieces before adding any ethanol.
6. Add ethanol to the rice until well F3 is half full. Stir the solution with the glass rod.
7. Fill 1/3 of well F4 with cooked, white mealie meal. Add ethanol to the meal until the well is half full.

8. Rinse the glass rod and use it to stir the mixture in well F4. (After stirring the meal should settle at the bottom of the well.)
9. Remove all of the solution from well F1 with a clean propette and place 1 drop of this solution onto a piece of filter or brown paper. Write the letter **A** under the spot.



10. Remove all of the carrot solution from well F2 with a clean propette and place 1 drop of this solution onto the filter paper next to the apple spot. Write the letter **C** under the carrot spot.
11. Repeat the above step with the rice solution in well F3 . Write the letter **R** under the rice spot.
12. Repeat the above step with the maize solution in well F4. Write the letters **MM** under the spot.
13. Using a propette, place one drop of full cream milk next to the meal on the filter/brown paper. Write the letter **M** under the milk spot.
14. Place the paper on one side and allow it to dry. While you are waiting, place 5 drops of the apple solution into well A1. Add 5 drops of water to well A1. (*See Question 1*)
15. Place 5 drops of the carrot solution into well A3. Add 5 drops of water to well A3. (*See Question 2*)
16. Repeat the emulsion test with both the rice and mealie meal solutions. (*See Question 3*)
17. Examine the dry piece of filter paper and record your results in Table 1. (*See Question 4*)



Rinse the comboplate® with a soap solution.

QUESTIONS

Q1. Does an emulsion form in well A1 when the water is added to the apple solution?

Q2. Does an emulsion form in well A3 when the water is added to the carrot solution?

Q3. Do emulsions form with rice and mealie meal?

Q4. Prepare a table like table 1 below in your books. Complete the table.

Table 1

FOOD TESTED	APPEARANCE OF PAPER AFTER DRYING

Q5. What is the answer to the focus question?

Q6. Give reasons for your answer to question 5.

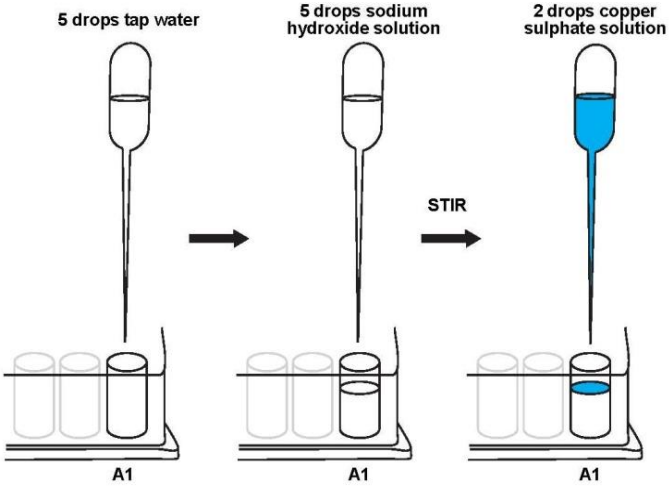
EXTENSION QUESTION

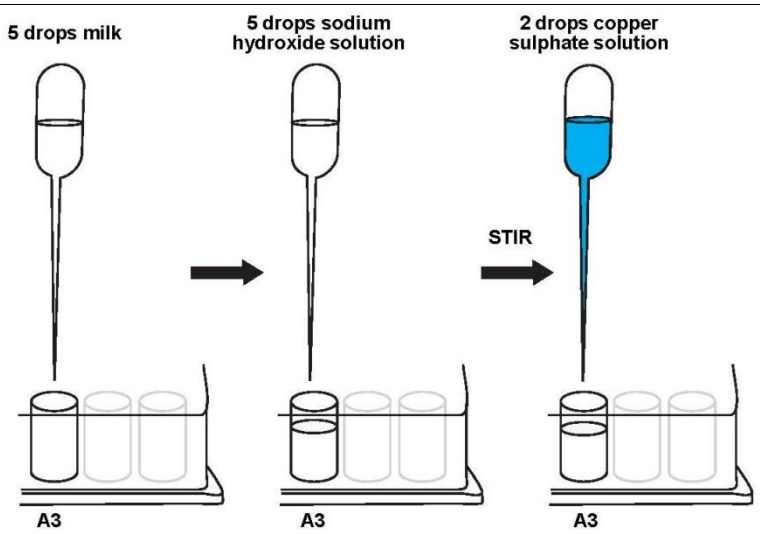
Q7. Why was the emulsion test not carried out on the milk? (Hint: what does milk look like?)

EXPERIMENT 18 – BIURET TEST FOR PROTEINS

CSEC OBJECTIVE: Section B 2.6

Grade Level – 9&10

	Introduction The Biuret test uses a dilute solution of copper(II) sulphate, which is made alkaline by the addition of sodium hydroxide. When the copper(II) ions come into contact with peptides or complete proteins, they form a complex with the nitrogen atoms in the peptide chain. The purpose of this experiment is to establish the colour of this complex as an indication of the presence of proteins in food.
	You Need **Apparatus:** 1 x comboplate®; 5 x thin stemmed propettes; 2 x plastic microspatulas. **Chemicals:** Sodium hydroxide solution (NaOH(aq)) [10%]; Copper sulphate solution (CuSO4(aq)) [1%]; Fresh milk; Tap water. **NOTE** • The food item (milk) is not included in the kit. • A dilute suspension of egg white (albumin) can be used in place of the milk as a source of protein.
	What to do 1. Using a propette, place 5 drops of water into well A1. 2. Add 5 drops of 10% sodium hydroxide solution to the water in well A1. Stir the solution with a plastic microspatula. 3. Add 2 drops of 1% copper sulphate solution with a clean propette. (*See Question 1*)  4. Place 5 drops of fresh milk into well A3. 5. Add 5 drops of 10% sodium hydroxide solution to the milk in well A3. Stir the solution with the microspatula. 6. Add 2 drops of 1% copper sulphate solution. (*See Question 2*)



7. Stir the solution in well A3 with a microspatula. (*See Question 3*)

Rinse the comboplate® and remaining equipment with water .

QUESTIONS

Q1. What do you observe in well A1 after adding the copper sulphate solution?

Q2. What do you observe in well A3 after adding the copper sulphate solution?

Q3. What happens to the solution in well A3 when it is mixed with the copper sulphate?

Q4. How can one test for the presence of proteins in food?

EXPERIMENT 19 – DOES THE FOOD WE EAT CONTAIN PROTEIN?

CSEC OBJECTIVE: Section B 2.6

Grade Level – 9&10

INTRODUCTION

The longer the peptide chain, the greater the number of peptide bonds in the chain and therefore the greater the number of complexes that will form between the copper(II) and the -NH- bonds present in the peptide chain, during the Biuret test. As a result, the complexity of the protein in a sample can be determined by the difference in the colours of the solutions. Proteins with only a few amino acids and hence few peptide bonds, are termed simple or lower proteins. Proteins with large numbers of peptide bonds are the complex or higher proteins, especially since they may also show secondary and/or tertiary structure. In the Biuret test, violet-purple indicates the higher proteins, red indicates the lower proteins and a pale blue colour indicates that no proteins are present.

You Need

Apparatus: 1 x comboplate®; 6 x thin stemmed propettes; 2 x plastic microspatulas; 1 x glass rod; 1 x food grater or sharp knife.

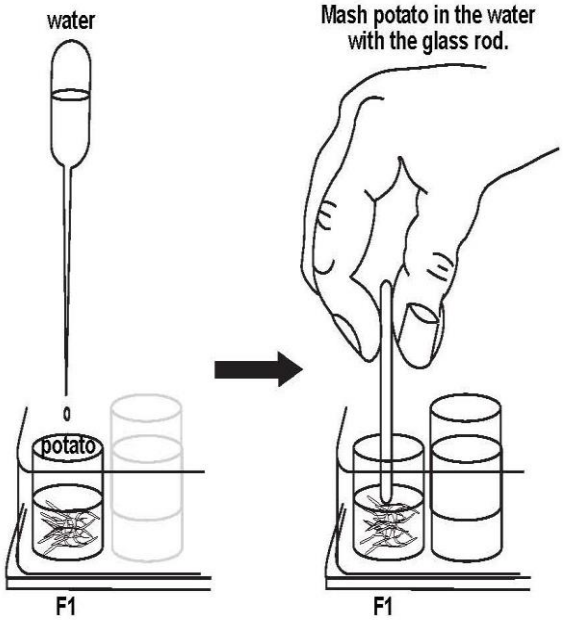
Chemicals: Sodium hydroxide solution (NaOH(aq)) [10%];
Copper sulphate solution (CuSO4(aq)) [1%]; 1 x fresh potato; 1 x fresh apple;
1 x fresh carrot; Cooked white rice; Cooked white mealie meal; Tap water.

NOTE

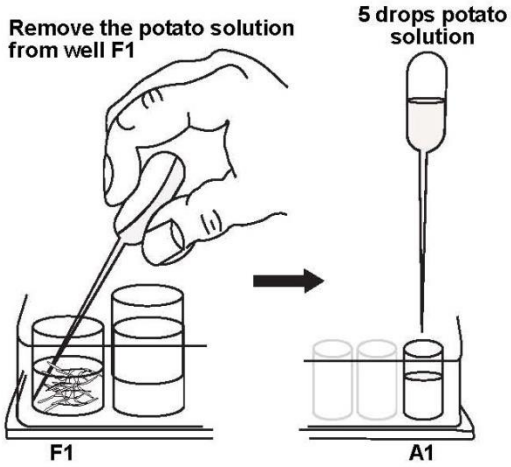
- The food items are not included in the kit.
- The meal and rice must be cooked in plain water. No milk, sugar, salt, butter, etc. may be added.
- Any food items may be used; not necessarily those listed above.

What to do

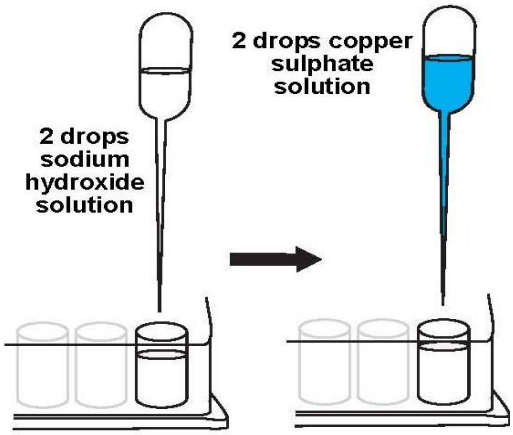
1. Use the food grater to grate a portion of each of the potato, apple and carrot. Wipe the grater clean before each new food is grated. (If a grater is not available, then scrape across the flesh of each item with a sharp knife.)
2. Fill 1/3 of well F1 with grated potato. Add water to the potato from a propette until well F1 is half full. Mash the potato in the water with the glass rod.



3. Fill 1/3 of well F2 with grated apple. Add water to the apple until well F2 is half full.
4. Wipe the glass rod and mash the apple in the water with the rod.
5. Fill 1/3 of well F3 with grated carrot. Treat the carrot in the same manner as you have the potato and apple.
6. Fill 1/3 of well F4 with cooked white rice. Rinse the glass rod and use it to break the rice into smaller pieces before adding any water.
7. Add water to the rice until well F4 is half full. Stir the mixture with the glass rod.
8. Fill 1/3 of well F5 with cooked, white mealie meal. Add water to the meal until the well is half full. Rinse the glass rod and use it to stir the meal in the water.



9. Use a clean propette to remove the Potato solution from well F1. Place 5 drops of this solution into well A1.
10. Add 2 drops of 10% sodium hydroxide solution and stir with a microspatula.
11. Add 2 drops of the 1% copper sulphate solution and stir. Record your results in Table 1 (*See Question 1*).



12. Remove the apple solution from well F2 with another propette. Place 5 drops of this solution into well A3.
13. Add 2 drops of 10% sodium hydroxide solution and stir with a microspatula.
14. Add 4 or 5 drops of 1% copper sulphate solution. Stir and record your results. (*See Question 1*)
15. Remove all of the carrot solution from well F3 and place 5 drops into well A5. Add 2 drops of 10% sodium hydroxide solution and stir with a microspatula.
16. Add 5 drops of copper sulphate solution. Stir and record your results. (*See Question 1*)
17. Repeat steps 15 - 16 with the rice solution from well F4. Place the solutions into well A7. Record your results in Table 1. (*See Question 1*)
18. The particles of mealie meal in well F5 will block the stem of a propette. Therefore, make sure that all solid material has settled in the well before attempting to remove the mealie meal solution with a propette.
19. Place 5 drops of this solution into well A9 and add 10 drops of 10% sodium hydroxide solution. Stir with a clean microspatula.
20. Add about 5 drops of the copper sulphate solution to well A9 and stir. Record your results in Table 1. (*See Question 1*)

Rinse the comboplate® and remaining equipment with water.

QUESTIONS

Q1. Prepare a table like Table 1 below in your workbooks. Record your results with the different foods tested.

Table 1

WELL	FOOD SOLUTION	COLOUR WITH COPPER SULPHATE

Q2. What is the answer to the focus question?

Q3. What does the colour of the potato solution tell you about the type of proteins present in potato?

EXTENSION QUESTION

Q4. It is often stated that rice and mealie meal contain protein. Mealie meal is a staple food in many African countries. How can the results obtained in this experiment help to explain the high incidence of Kwashiorkor (an illness related to a lack of protein in the diet) in Africa?

EXPERIMENT 20 – TESTING A LEAF FOR STARCH

CSEC OBJECTIVE: Section B 2.2

Grade Level – 9&10

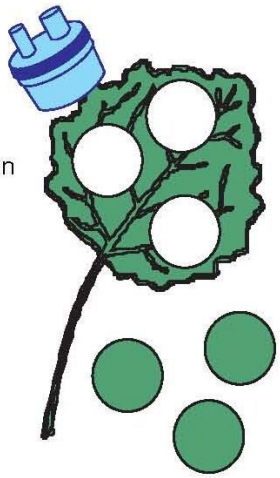
You Need

Apparatus: Comboplate®; 2 x propettes; lid 1; 2 x plastic lunch boxes; Geranium leaf; Needle.
Chemicals: I2/KI solution (iodine solution); 70% alcohol.

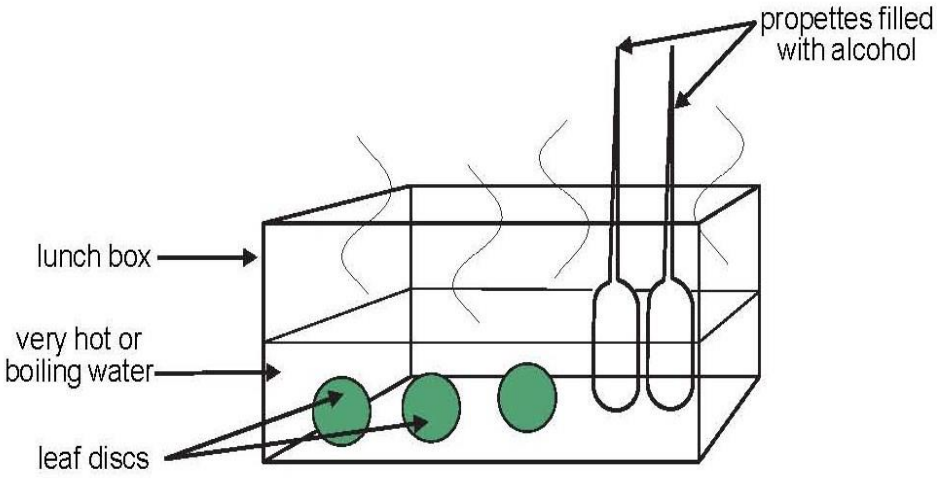
What to do

Follow the instructions as set out.

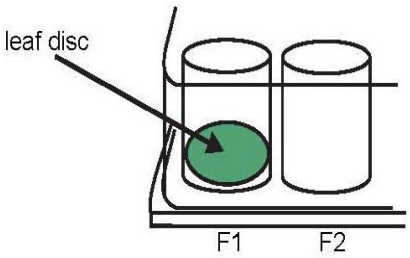
1 Use the lid to cut discs from a green geranium leaf.



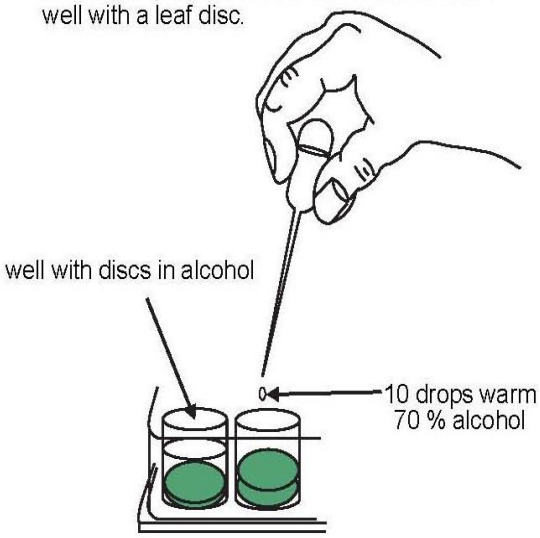
2 Place the discs in very hot water, (boiling if possible), in the lunch box for 5 minutes. In this way, the cell walls are broken down. At the same time, place the propettes, filled with alcohol, bulb down into the hot water. In this way, the alcohol is heated too.



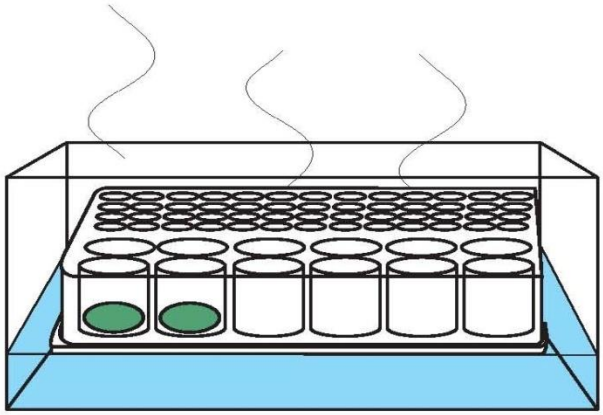
3 Use a needle to place 2 leaf discs in each of wells F1 and F2 of the comboplate®.



4 Add 10 drops of warm 70 % alcohol to each well with a leaf disc.



5 Fill the lunch box with hot water again and float the comboplate® on the water in the lunch box. (*See Questions 1, 2, 3*)



6 Use the needle to remove the leaf discs from the wells (CARE!) Place the discs in another lunch box of water at room temperature for a minute. In this way, the alcohol is rinsed from the discs.

7 Collect the chlorophyll extract from all the comboplate®s and place it in the empty lunch box in a cool place.

8 Rinse the comboplate®.

9 Use the forceps to place the leaf discs back in wells F1 and F2 of the comboplate®.

10 Use a propette to add 5 to 10 drops of I2/KI solution (iodine solution) to each disc.

11 Observe any changes.

QUESTIONS

1. What is the colour of the alcohol after 10 minutes?
2. What is the colour of the leaf after 10 minutes?
3. What has the alcohol done to the leaf?
4. What colour did the leaf discs turn after the iodine was added?
5. What does this colour change tell you about the storage product in these leaves?

EXPERIMENT 21 – IS CHLOROPHYLL NECESSARY FOR PHOTOSYNTHESIS?

CSEC OBJECTIVE: Section B 2.2

Grade Level – 10

You Need

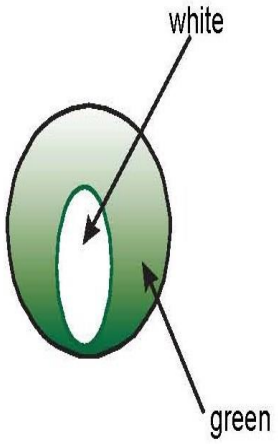
Apparatus: Comboplate®; 3 x propettes; lid 1 or lid 2; Plastic lunch box; Variegated leaf.
Chemicals: I2/KI solution (iodine solution); Hot water; 70 % alcohol.
Notes

1. Use the plastic lunch box as a water bath.
2. This investigation uses a **variegated** leaf. Such a leaf has more than one colour. The type of variegated leaf you need is one which has both green and white parts in the same leaf.

What to do

Follow the instructions as set out underneath.

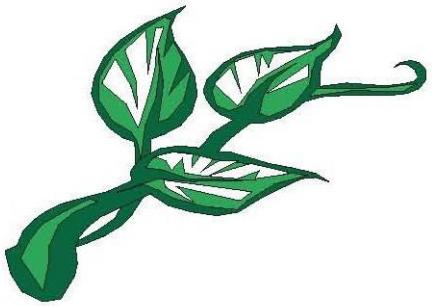
1. Pick a variegated geranium leaf around noon on a sunny day.
2. Cut discs from the leaf in the same way as you did for the first investigation.
   Ensure that you have discs which have BOTH green and white parts.
3. DRAW the discs showing the position of both the colours.
   A drawing could look something like the figure shown.



4. Soften the discs by placing them in hot water in the plastic lunch box.
5. At the same time, partly fill two propettes with alcohol and place these, bulb downwards into the hot water in the plastic lunch box.
   Doing this heats the alcohol and makes the chlorophyll extraction easier.
6. Place the discs in one or more of the F wells of the comboplate® as in previous activities.
7. Add 10 to 20 drops of warmed alcohol to each well which contains a disc. Extract the chlorophyll by allowing the discs to float in the warm alcohol. Ensure that the water in the plastic lunch box is as warm as possible.
8. When the discs have been decoloured, rinse them with water as in Photosynthesis Activity 1.
9. Rinse the comboplate® and then replace the leaf discs in the F wells of the comboplate® .
10. Use a clean propette to add a few drops of iodine solution to the leaf discs.
11. Observe any changes.

QUESTIONS

1. What was the final colour of the leaf discs which were originally green and white?
2. Make a drawing of a leaf disc which was originally both green and white.

	 3. What do your results suggest about the role of chlorophyll in photosynthesis? 4. The white parts of the leaf discs had no starch. This means that there is no food for the plant in the white parts of the plant. The white parts of the leaf must get food, otherwise they would die. How do you suppose these parts get their food?
	SOMETHING TO THINK ABOUT Consider the leaves pictured alongside.  They are not variegated leaves. They are from a plant which is suffering from a deficiency of one or more essential nutrients. It may be possible to correct the problem by placing Epsom Salts on the soil around the plant and watering well. Find out why Epsom Salts could help to correct this problem.