Inquiry-based Learning: A Resource Guide for Bangladeshi Science Teachers

Compiled by Lizoon Nahar







Resources created by the participant teachers of the AEIF project Inquiry-based Learning to Promote Science Education

This project is funded by the U.S. Department of State and implemented by GEIST International Foundation

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DISCLAIMER

This project was made possible by an award sponsored by the U.S. Department of State's Bureau of Education and Cultural Affairs (ECA), with funding provided by the U.S. Government and administered by GEIST International Foundation. The views and information presented are the grantee's own and do not represent the U.S Department of State or GEIST.

THOUGHTS
shared

Khadija Mohamud, Assistant Cultural Affairs Officer

U.S. Embassy, Dhaka

"Congratulations to Ms. Lizoon Nahar and GEIST International Foundation for successfully leading this innovative initiative aimed encouraging the use of inquiry-based learning techniques in science education. Since its inception in 2011, the U.S. Department of State has provided Bangladeshi participants of U.S. government-funded exchange programs with grants to implement positive change in their local communities. Through this project, teachers and students from across the country gained exposure to investigative approaches to learning—encouraging learners to ask questions, make observations, think creatively, and solve problems together. In April 2022, I participated in a poster fair where students in Rangpur (a major city in northwestern Bangladesh) presented creative projects demonstrating complex scientific theories with resources readily available in their local community. This is what inquiry-based learning is all about. As we celebrate 50 years of U.S.-Bangladesh people-to-people ties this year, we reaffirm our commitment to partnering with exchange alumni in their efforts to equip young learners with the skills they need to succeed in the 21st century."

THOUGHTS
shared

Biplob Kumer Deb, President, GEIST International Foundationtion

Dhaka, Bangladesh

Science education in Bangladesh at secondary & higher secondary level is facing challenge since past few years. Several initiatives have been taken from different corners including Bangladesh Government & other supportive agencies, but the progress is not mentionable. Different research studies showed that a few reasons are working behind the issue, out of them the issue of missing student-centered learning, learn with fun, lack of scope of doing experiments, inability to relate the learning with their daily life etc. were the key issues which led to the dropping of enrollment rate in science studies at grade 8-12 at secondary & higher secondary level. In this context Inquiry based learning showed a great positive impact among the science teachers & students in their science teaching & learning cycle. I'm very pleased to see the outcome of the project "Inquiry Based Learning to Promote Science Education". I appreciate and would like to extend my sincere thanks to the project director, Ms. Lizoon Nahar to take all the challenges to draft the plan, seeking fund, conducting field work and her deep involvement in each step of the plan to make it a success. U.S. Department of State is also playing the key role of this success as we believe that without the funding from the Department of State under U.S. Embassy Dhaka it was difficult to implement the project and provide enough resource materials and project activities. On behalf of GEIST my deepest thanks to Ms. Khadiza Mahmood for her valuable guidance, notable presence, and inspiring words in different stages of the plan. Some background heroes were there to give the exact shape of the plan with the expected outcome, and they are Mr. Sohan Salek, Ms. Raihana Sultana & Mr. Shaon Karmakar from the public affairs section of U.S. Embassy Dhaka. I believe that this guidebook will be a documentation for the future users to develop new inquiries and work accordingly to make their classroom more interactive and engaging. This project will be able to keep a strong footprint in Bangladesh Science Education Promotional Activity and make the country moving forward.

THOUGHTS
shared

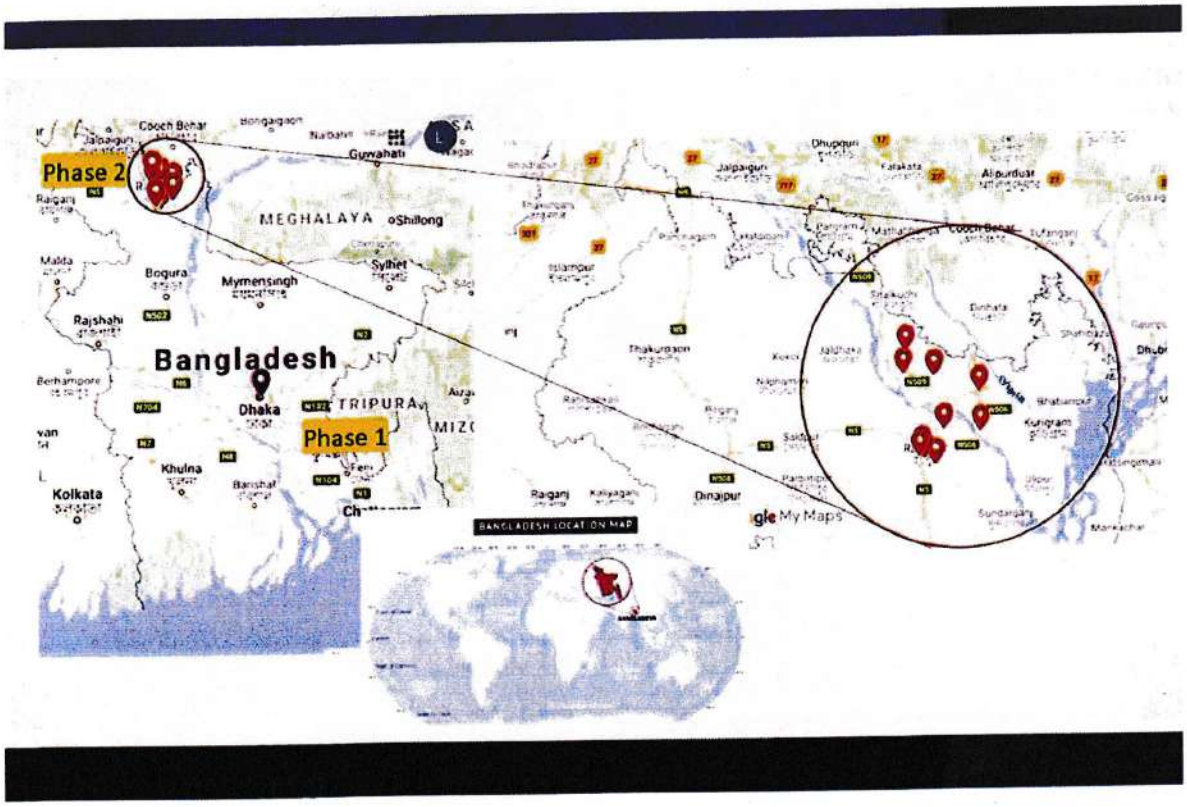
Lizoon Nahar, Project Director, Project Inquiry-based Learning to Promote Science Education

Dhaka, Bangladesh

The idea of the project Inquiry-based Learning to Promote Science Education is directly connected with my exchange program, the International leaders in education program (ILEP) 2018 in the United States. I was utterly fascinated by the strategy of learning by doing that I observed in the United States classrooms. Learning by doing provides students with opportunities to learn and construct their knowledge through active participation. One example of learning-by-doing is inquiry-based learning (IBL), which encourages students to learn at the different phases of the investigation rather than learning from readymade textbook contents, guidebooks, or teachers' lectures. IBL is more suitable for science classes. To elaborate on this, science is generally taught abstract concepts through lecture methods that students often fail to understand and relate to their daily lives. Therefore, it is always essential to grasp core science ideas instead of memorizing science facts and concepts. IBL offers an environment of exploration for students through hands-on activities, which facilitates acquiring scientific concepts. Knowing about IBL and other participatory learning methods that I became equipped with within the United States was an eye-opening experience for me. Drawing on my experience as a science teacher in Bangladesh, I was always wondering if it is possible to allow Bangladeshi students to walk through IBL lessons and learn sciences uniquely.

Unfortunately, through 12 years of teaching experience, I have realized that hands-on activities are not embedded in the traditional educational system. That was not even far different from my experience as a science student during my formative years (K-12). However, the Alumni Engagement and Innovation Fund (AEIF) 2019 of the U.S. Department of State helped me and my team members to dream of incorporating innovative science teaching through IBL. We conducted this approach at five urban schools in Dhaka in the urban phase and five rural schools in Rangpur and Lalmonirhat districts in the rural phase in Bangladesh. We have trained 40 science teachers to be efficient users of IBL instruction. In addition, 200 students have experienced how to conduct scientific investigations and write lab reports. Also, students presented findings publicly in poster fairs in two phases with the help of project implementation partner GEIST International Foundation. Apart from fulfilling the project's objectives, distributing science toolkits to schools that never have a science library, getting science teachers to share their IBL instructions on social media, getting students excitedly searching for ideas, and designing and conducting new IBL lessons was a fantastic experience of this project. I must mention the tremendous support we have received from grant officers, U.S. Embassy Dhaka, Alumni Coordinator, American Center Dhaka, the head teachers at all participating schools, site coordinators, participating teachers, and the group of volunteers of GEIST International Foundation made this project possible. Professional developmental activities for teachers to prepare them for IBL lessons were at the heart of the project activities. During the project, participant teachers practice IBL activities using a model IBL provided. In the next step, they designed IBL lessons with the help of the ideas generated by their students with locally available inexpensive materials. We encouraged teachers to use their original ideas for IBL lessons. However, considering this as a first attempt, we accepted the IBL activities they designed following textbooks and online resources. One of the core objectives of this project was to compile all IBL lessons designed by the participant teachers and their students in a published book to share the resources with other science teachers in Bangladesh. As a part of this mission, the AEIF team has embarked on publishing this book. We strongly believe that the sample IBL activities of this book will encourage other science teachers across the country to accommodate IBL in their classrooms.

PROJECT LOCATION



AEIF

Team Members

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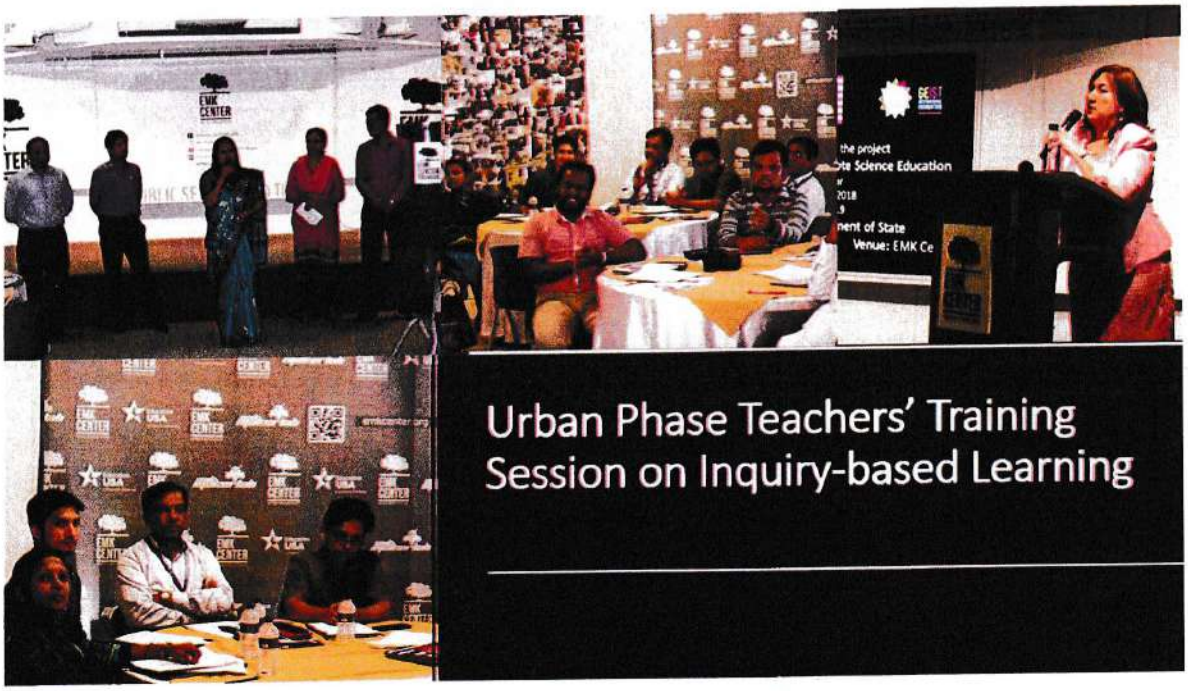
TRAINING SESSION

On Inquiry-based Learning



Teachers' Training Session on Inquiry-based Learning
Rural Phase

AEIF

Team Members

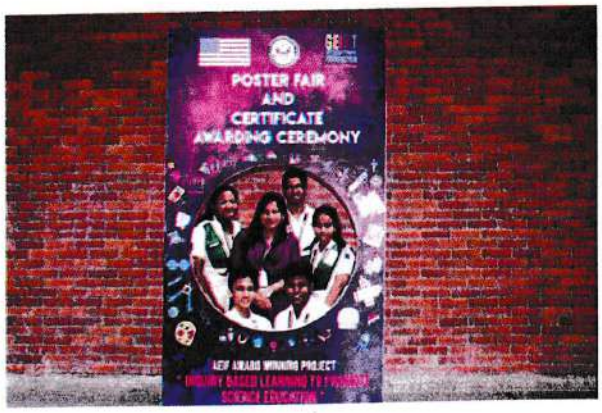
GEIST International Foundation distributed Science Toolkit to the participating urban schools

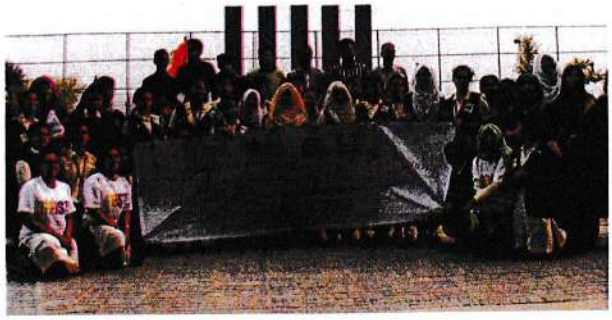
POSTER FAIR

Urban Phase

Poster Fair

1. Participant teachers submitted the final draft of their designed Inquiry-based learning.
2. Students designed a poster showing what they have learned
3. Students wrote reports on the IBLs
4. Sharing works with teachers, students, school leaders, and parents.





MODEL INQUIRY-BASED LEARNING LESSON

Lizoon Nahar, Project Director, Project Inquiry-based Learning to Promote Science Education

This project is designed for the school students to inquire about the relative vitamin C content of different local foods they eat or drink every day. This three-day long investigation is designed based on the three hypotheses, which will be tested on three consecutive day. Vitamin C also known as ascorbic acid, is a vitamin. It is one of the water-soluble vitamins. Vitamin C is important in wound healing. Without enough vitamin C, a person can get a sickness called scurvy.

Vitamin C has the chemical name ascorbic acid. This compound dissolves in water, so we can take vitamin C into our bodies easily in a drink. In this experiment, students can find out which food is best to get lots of vitamin C.

Testing for vitamin C

Vitamin C, or ascorbic acid can react with iodine.

Iodine has a brown color when in solution and iodide ions are colorless in solution.

To make the iodine color easier to see, starch is added – this makes a blue-black colored complex.

We can use this reaction to compare the amounts of vitamin C in different food.

Ascorbic Acid react with iodine and turn it into iodine ions, which disappears the blue -black color.

How Iodine-starch indicator can help to determine the Vitamin C content of a food?

• If less volume of the food content (prepared juice from suitable food) is required to make a specific amount of starch- iodine solution of blue-black color to make colorless, it contains more Vitamin C.

• If more volume of the food content (prepared juice from suitable food) is required to make a specific amount of starch- iodine solution of blue-black color to make colorless it contains less Vitamin C.

General Instruction for students: Please read the instruction below, discuss with all group members before you start working on this project. 1. Please read the guide book properly before you start. 2. Secure all apparatus and material you need to do this project. 3. Discuss and make a distribution of work among all group members. This will help to conduct the project smoothly. 4. Frozen food is required for Day 1. Please consider the issue on the first day and keep a food rich in vitamin C in the refrigerator of your home on the Day 1. 5. Corn starch should be prepared with hot water. Please take help from your teacher to get hot water in the school. 6. Recording of the result is very important. Please record the result during the test. Do not try to predict the result. Be honest with the recordings. If you have any confusion with the result, repeat the whole procedure again.

EXPLORING THE VITAMIN C CONTENT OF BANGLADESH

Hypothesis 1: Natural food contains more vitamin C than processed food.

Hypothesis 2: Raw food contains more vitamin C than cooked food.

Hypothesis 3: Fresh food contains more vitamin C than frozen food.

Purpose: To determine and compare the vitamin C content of local food samples In Bangladesh

Day 1

Hypothesis: Natural food contains more vitamin C than processed food.

Assumption: [The students will discuss with all group members and assume which type of the food may contain vitamin C content. They will write their assumption below]

Materials and chemicals:

1. Syringe (20 ml syringe) 2. Mortar and Pestle 3. Beaker 4. Spatula	5. Electrical Balance 6. Filter Paper 7. knife 8. Funnel	9. Corn starch 10. Warm water 11. Iodine solution 12. Food containing vitamin C

Procedure: [Choose any natural food, which is rich in vitamin C from your locality. You can learn about food items rich in vitamin C from the chart provided in this guidebook. One processed food item is provided with the toolkit which should be used as the source of processed food required for this experiment]

1. Take 10 g of the natural food sample that you want to test for vitamin C content. Use electrical balance to measure the food properly.
2. Grind the food sample with mortar and pestle, make a smooth paste.
3. Take the food content into a beaker and add 50 cm3 of water into it.
4. Stir the content thoroughly.
4. Filter the content with filter paper, collect liquid in another beaker. [Please see the procedure of filtering using filter paper at page 9]
5. Now take 10 cm3 of food content into a syringe.
6. Take 1 g of corn starch into a beaker. Add 100 ml warm water into it. Stir the content continuously until it mixes with water completely.
7. Add 1 cm3 of iodine solution. This will turn the starch solution blue black.
8. Add liquid food content onto the blue-black solution drop by drop using the syringe and shake the beaker. Keep adding until the blue-black color of the solution turn colorless.
9. Check the volume of liquid food content that is used make the blue-black solution colorless.
10. Repeat the procedure three times and record the data on the given table.
11. Repeat no. 1 to 10 with the provided processed food

Recording of the observations:

Sample number	Food sample	Initial reading	Final reading	Volume of liquid food sample used	Average volume of liquid food sample
Trial 1					
Trial 2					
Trial 3					

Table 1: The volume of the food sample (natural) containing vitamin C required to make 10 cm3 of starch- iodine solution colorless.

Sample number	Food sample	Initial reading	Final reading	Volume of liquid food sample used	Average volume of liquid food sample
Trial 1					
Trial 2					
Trial 3					

Table 2: The volume of the food sample (processed) containing vitamin C required to make 10 cm3 of starch- iodine solution colorless.

[Students will analyze the findings from the table and write the results on the spaces provided. The food contains more Vitamin C content will be required in less amount to make the blue-black solution colorless]

Result:

Day 2

Hypothesis: Raw food contains more vitamin C than cooked food

Assumption: [The students will discuss with all group members and assume which type of the food may contain vitamin C content. They will write their assumption below]

Materials and chemicals:

1. Syringe (20 ml syringe) 2. Mortar and Pestle 3. Beaker 4. Spatula	5. Electrical Balance 6. Filter Paper 7. knife 8. Funnel	9. Corn starch 10. Warm water 11. Iodine solution 12. Food containing vitamin C

[Choose any fresh food rich in vitamin C from your locality and divide it into two halves. You can learn about food items rich in vitamin C from the chart provided in this guidebook. Keep half of the food to test as raw food and boil the other half to test the vitamin c content of cooked food. Food boiling must be supervised by adults]

Procedure:

1. Take 10 g of the raw food sample that you want to test for vitamin C content. Use electrical balance to measure the food properly.
2. Grind the food sample with mortar and pestle, make a smooth paste.
3. Take the food content into a beaker and add 50 cm3 of water into it.
4. Stir the content thoroughly.
4. Filter the content with filter paper, collect liquid in another beaker. [Please see the procedure of filtering using filter paper at page 9]
5. Now take 10 cm3 of food content into a syringe.
6. Take 1 g of corn starch into a beaker. Add 100 ml warm water into it. Stir the content continuously until it mixes with water completely.
7. Add 1 cm3 of iodine solution. This will turn the starch solution blue black.
8. Add liquid food content onto the blue-black solution drop by drop using the syringe and shake the beaker. Keep adding until the blue-black color of the solution turn colorless.
9. Check the volume of liquid food content that is used make the blue-black solution colorless.
10. Repeat the procedure three times and record the data on the given table.
11. Repeat no. 1 to 10 with the boiled/ cooked food.

Recording of the observations:

Sample number	Food sample	Initial reading	Final reading	Volume of liquid food sample used	Average volume of liquid food sample
Trial 1					
Trial 2					
Trial 3					

Table 3: The volume of the food sample (raw) containing vitamin C required to make 10 cm3 of starch- iodine solution colorless.

Sample number	Food sample	Initial reading	Final reading	Volume of liquid food sample used	Average volume of liquid food sample
Trial 1					
Trial 2					
Trial 3					

Table 4: The volume of the food sample (boiled/ cooked) containing vitamin C required to make 10 cm3 of starch- iodine solution colorless.

[Students will analyze the findings from the table and write the results on the spaces provided. The food contains more Vitamin C content will be required in less amount to make the blue-black solution colorless]

Result:

Day 3

Hypothesis: Fresh food contains more vitamin C than frozen food

Assumption: [The students will discuss with all group members and assume which type of the food may contain vitamin C content. They will write their assumption below]

Materials and chemicals:

1. Syringe (20 ml syringe) 2. Mortar and Pestle 3. Beaker 4. Spatula	5. Electrical Balance 6. Filter Paper 7. knife 8. Funnel	9. Corn starch 10. Warm water 11. Iodine solution 12. Food containing vitamin C

[Choose any fresh food rich in Vitamin C from your locality. You can learn about food items rich in vitamin C from the chart provided in this guidebook. Keep the food in the refrigerator to test as frozen food for three days. Collect the same food sample fresh from locality in the morning to test as fresh food.]

Procedure:

1. Take 10 g of the fresh food sample that you want to test for vitamin C content. Use electrical balance to measure the food properly.
2. Grind the food sample with mortar and pestle, make a smooth paste.
3. Take the food content into a beaker and add 50 cm3 of water into it.
4. Stir the content thoroughly.
4. Filter the content with filter paper, collect liquid in another beaker. [Please see the procedure of filtering using filter paper at page 9]
5. Now take 10 cm3 of food content into a syringe.
6. Take 1 g of corn starch into a beaker. Add 100 ml warm water into it. Stir the content continuously until it mixes with water completely.
7. Add 1 cm3 of iodine solution. This will turn the starch solution blue black.
8. Add liquid food content onto the blue-black solution drop by drop using the syringe and shake the beaker. Keep adding until the blue-black color of the solution turn colorless.
9. Check the volume of liquid food content that is used make the blue-black solution colorless.
10. Repeat the procedure three times and record the data on the given table.
11. Repeat no. 1 to 10 with the frozen food.

Recording of the observations:

Sample number	Food sample	Initial reading	Final reading	Volume of liquid food sample used	Average volume of liquid food sample
Trial 1					
Trial 2					
Trial 3					

Table 5: The volume of the food sample (fresh) containing vitamin C required to make 10 cm3 of starch- iodine solution colorless.

Sample number	Food sample	Initial reading	Final reading	Volume of liquid food sample used	Average volume of liquid food sample
Trial 1					
Trial 2					
Trial 3					

Table 6: The volume of the food sample (frozen) containing vitamin C required to make 1 cm3 of starch- iodine solution colorless.

[Students will analyze the findings from the table and write the results on the spaces provided. The food contains more vitamin C content will be required in less amount to ma the blue-black solution colorless]

Result:

Instruction for using filter paper

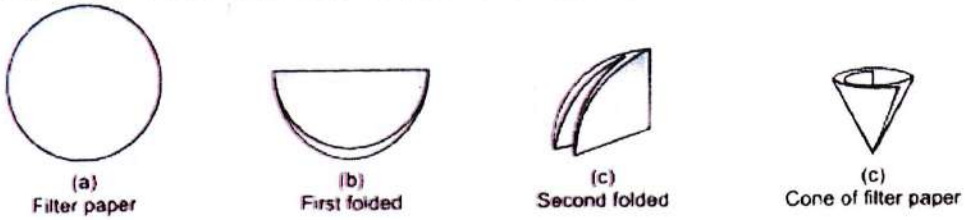


Fig : How to fold the filter paper.

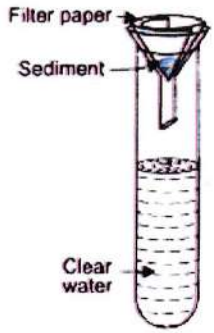


Fig: How to place filter paper inside the funnel and place onto the beaker of test tube.

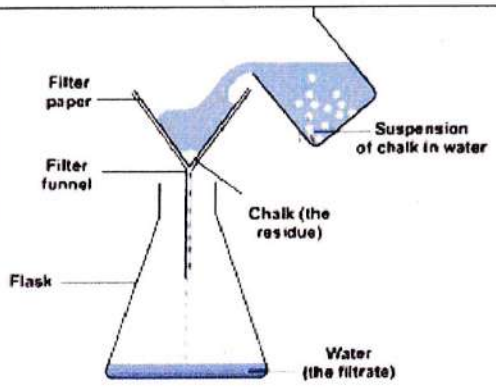


Fig: Sample filtration process with chalk and water

Safety note:

1. Iodine can stain skin and clothing, it must be handled carefully.
2. Be careful with handling warm water. It can burn your hands. Do not handle warm water to make starch solution without the supervision of the teacher.
3. Sharp and cutting tools like knife can cause cuts and puncture wounds, if they're not handled properly. Always cut away from the body and face.
4. Use hand gloves, and safety googles.
5. In the event of a chemical splashing into your eye(s) or on your skin, immediately flush the affected area(s) with running water for at least 20 minutes.
6. Always work in properly-ventilated areas.
7. Do not chew gum, drink, or eat while working in the lab.

Conclusion:

1). Compare the Vitamin C content of natural foods to processed foods. Support your answer using data collected in the experiment.

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2). Compare the Vitamin C content of raw foods to cooked foods. Support your answer using data collected in the experiment.

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3). Compare the Vitamin C content of fresh foods vs. frozen foods. Support your answer using data collected in the experiment.

4). Discuss three things you learned or that surprised you by performing the experiment.

5). What food(s) would you choose to provide your daily requirements of Vitamin C? Explain why.

Top 20 Foods High in Vitamin C in Bangladesh

LEMONS 	CAPSICUM 	PAPAYAS 	CORIANDER LEAVES 	GUAVAS 
PEAS 	AMLA 	SPINACH 	CAULIFLOWER 	GREEN CHILLIES 
BROCCOLI 	LYCHEES 	PINEAPPLE 	CABBAGE 	GREEN/ UNRIPE MANGO 
ORANGES 	TOMATO 	POINTED GOURD 	POMELO/ GRAPE FRUIT 	CUCUMBER 

Does Heat Affect Voltage Flow in a Circuit?

Asif Iqbal Hossain
Maple Leaf International School

Hypothesis

Voltage is directly proportional to the temperature of a circuit.

Apparatus

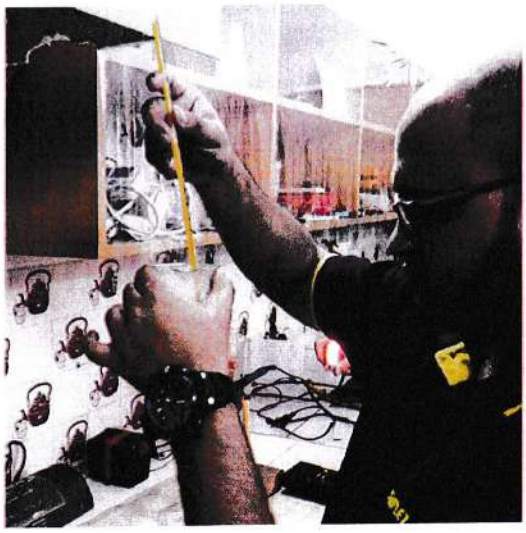
Nichrome Wire (About 7 inches)
Crocodile Clips
Bunsen Burner/Candle
Constantan Wire (About 7 inches)
Multimeter

Method

A thermocouple is when two different types of metal wires are joined together (the junction). When they joined in a complete circuit and the junction is heated over a flame and the other parts are at room temperature, the atoms in the metals gain kinetic energy and the electrons start to flow. This generates current and voltage. This is called the Thermocouple Effect.

The experiment was conducted as follows:

1. Take the two wires (Nichrome and Constantan were used here. You can use any other two metals as you like) and twist them together. If soldered, then it will be the best. This part is called the junction or the thermocouple.
2. Attach a crocodile clip to the ends of the wires. Attach one end to the COM of the multimeter and the other one to "VmAuA'. (It really does not matter which end connects to what part of the multimeter). Set the multimeter to milli Volts.
3. Safely hover the junction over a flame (Bunsen Burner would be the best). Leave the wires over the flame for a couple of seconds. Patience here is very important.
4. We will observe that a voltage will be recorded in the multimeter. It is best to record the data from the lowest temperature and then raise it to the highest temperature.

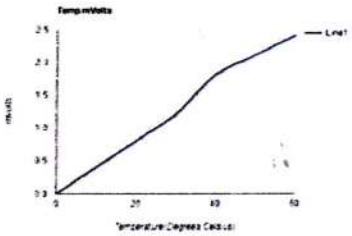


5. NOTE: if the temperature becomes too high, the junction may become burnt. Then its is necessary to make another junction or thermocouple.

Result

From the results and graph, it is easily perceived that when the temperature increases, the voltage also increases. So, we can create the formula, voltage equals to constant multiplied by temperature. Side by side, we can declare that voltage is directly proportional to the temperature across a circuit.

Temperature (Degrees Celsius)	Milli Volts
0	0
10	0.4
20	0.8
30	1.2
40	1.8
50	2.1
60	2.4



Conclusion

Thus, it is safe to say that our hypothesis: "Voltage is directly proportional to the temperature of a circuit" is correct. If the temperature increases, then the voltage will also increase and vice versa. The data declares that the hypothesis is correct. Thus this experiment was successful.

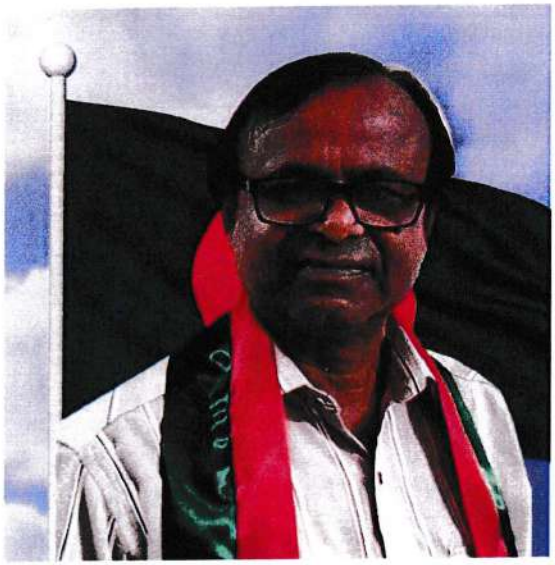
Further Information

We all know that voltage is directly potential to the current flowing in a circuit (V=IR). So, if current increases, the voltage also increases. On the other hand, the current is the flow of electrons in a circuit. They move as a result of chemical reactions that are triggered in the cells of batteries, and electrons move from the negative part of the cell to the positive end. They move because they have some kinetic energy inside them. So, if we can increase the amount of kinetic energy, there will be more current. This leads us to our hypothesis - the thermal energy from heat is direcly proportional to the current flowing through a circuit, thus also directly proportional to the voltage across the circuit. We think that the thermal energy is converted into kinetic energy, thus increasing the kinetic energy of the electrons, which move faster, increasing the current, increasing voltage. To determine our hypothesis, we will use the thermocouple effect. In this laboratory experiment, the intensity of thermal energy affecting the electromotive force in a series circuit was tested. This knowledge is very necessary as it will help is in making suitable circuits in different parts of the world. In some regions of the planet, it is very warm and elsewhere cold. So, it will be very beneficial for us if we knew at which regions of the planet the maximum voltage can be generated at a required rate due to a natural source-the climate.

Acknowledgement

We are grateful for choosing us for participating in the AEIF 2019 Project on Inquiry Based Learning to Promote Science Education funded by U.S. Department of State. We are also thankful to Maple Leaf International School for all the facilities.

THOUGHTS
shared



Khurshiduzzaman Ahmed
Headteacher of Kaliganj Karim Uddin Public Pilot High School

Lalmonirhat, Bangladesh

"IBL method is a unique method in science education. We came up with this idea by participating in AFIF IBL project. So I am thankful to GEIST International Foundation. To fund these educational institutions in the remote areas of Bangladesh. In the future we want to work more intensively, we want to enrich our students and educational institutions. Thank you. "

Vaping Vs Smoking: Choosing the Lesser Evil of Two

Zakia Sultana
Maple Leaf International School

Hypothesis

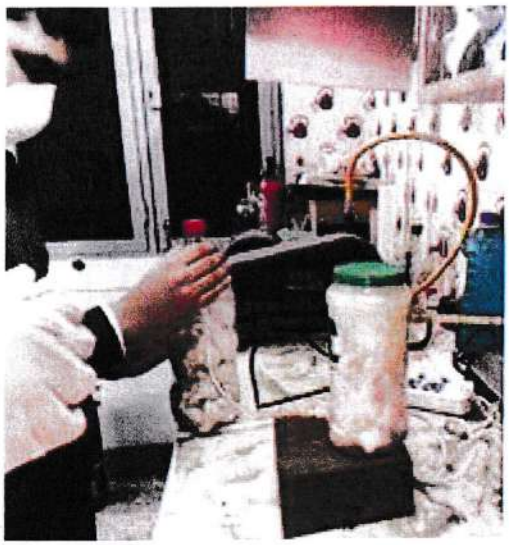
Vaping is less harmful on lungs and airways compared to both active and passive smoking.

Apparatus

3 Plastic Bottles
0.5 m plastic tube
Cotton wool
Air Suction Pump
30 Cigarettes
E-Cigarette
6ml Juice for Vaping
containing nicotine 8. Soldering Iron
Glue gun
Match Stick

Method

1. Make holes in the 3 bottles using soldering iron. 1st bottle will be used to demonstrate Active Smoking, 2nd bottle to demonstrate passive smoking and the 3rd to demonstrate the effects of vaping.
2. Fill the bottles with cotton balls.
3. Connect the 1st and 2nd bottle with the plastic tube through the holes and fix them using glue gun.
4. Connect the 2nd bottle with air suction pump and the 1st bottle with a tube for holding cigarettes.
5. Next put one cigarette at a time in the cigarette holder and burn it while the air suction pump is on. In this way burn 30 cigarettes.
6. Next connect the sir suction pump to the 3rd bottle and this time insert the mouth piece of e-cigarette instead of cigarettes. Continuevaping with short puffs until 6 ml of juice is consumed.



The plastic bottles used in the experiment represented our lungs and the cotton balls represented the alveoli. It was seen that when smoked using traditional smoking both active and passive smoking caused huge deposition of tar both in airways and lungs.

On the other hand with vaping the tar deposition was reduced as much as to the extent of control. This was because the vaping juice did not contain tobacco but depending on the ingredients it may contain other carcinogens and toxic materials which can be harmful in the long run.

How Much Light Do Indoor Plants Need?

Shahana Sultana
BAF Shaheen English Medium College

Hypothesis

Hypothesis: indoor plants photosynthesize faster in front of lamp

Background

We worked with the plant Epipremnum aureum, common name is money plant, which is one of the most common indoor plant of Bangladesh.

Apparatus

1. sodium bicarbonate
2. liquid soap
3. lamp
4. test tube
5. beaker
6. syringe
7. punch hole
8. stop watch

Method

Prepare a 0.1% bicarbonate solution by mixing 0.5 gram of baking soda with 2 cups (500 ml) of water in a beaker. Add a few drops of liquid dish soap to this solution and mix gently. Use the punch hole to cut out 10 discs from the leaf.

Remove the cover from the tip of the syringe. Draw about 6-8 mL of the bicarbonate solution into the syringe. With your finger at the tip, take out the plunger and carefully put the leaf discs into the syringe. The discs will be seen floating on the solution. Re-insert the plunger.

Next, hold the syringe upright with the tip up, and expel the air inside by gently pushing the plunger. While plugging the tip of the syringe tightly with your finger, gently pull the plunger. This will create a slight vacuum and tiny bubbles will start to come out from the leaf discs. Hold this for a few seconds and the release the plunger, letting it snap back.

Some of the discs will begin to sink since the oxygen has been removed from them. Repeat the previous step until all the discs have sink to the bottom of the solution. After the completion of this step, carefully remove the plunger and pour the solution with the discs into a test tube.

Place the test tube just under the light source (the lamp) or closer, if possible. Finally, record the time taken for the leaf discs to float back on the solution.

Repeat these steps another 2 times by placing the test tubes 10 and 20 inches away from the light source.

Test tube	Distance from light source	Time taken to float back
A	0 inch	37 minutes
B	10 inches	53 minutes
C	30 inches	122 minutes

Conclusion

Indoor plants are able to photosynthesize under artificial light source. But if the light intensity is not adequate, plants cannot photosynthesize properly: the rate of photosynthesis gets very low.

Determine the Energy Changes of a Toy Car as it Moves Down a Ramp

Rejaul Karim
BAF Shaheen College Dhaka

Hypothesis

Vaping is less harmful on lungs and airways compared to both active and passive smoking.

Apparatus

1. a toy car
2. a piece of wood to create slop
3. scale
4. stopwatch

Method

1. Two lines on the ramp are a distance s of 0.90m apart. Place the front of the car level with the line at the top of the ramp.
Release the car and determine an average value for the time t taken for the car to travel to the lower line. Record your measurements and calculations.
2. Calculate the final speed v of the car as it reaches the lower line on the ramp given that
V=2s/t
3. Measure the vertical height h through which the car descends
as it moves a distance of 0.90m along the ramp. Draw a diagram to
explain how you did this.
4. Record the mass m of the car, which is given on the card.

Iron Rust Creation

Jotish Chondro
Taluk Shakhati High School, Kaligonj Lalmonirhat

Apparatus

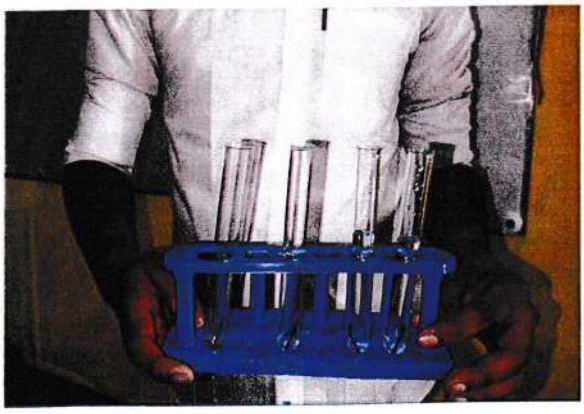
CaCl2
Oxygen
Test tube
Boiling water
Cooking oil
Iron rod and
Cold water

Method

1. Take four test tubes and mark them 1 to 4.
2. Label the test tubes 1–4.
3. About 1/4 fill tube 1 with deionized water and add a nail.
4. About 1/4 fill tube 2 with boiled deionized water and add a nail. Carefully pour a little oil over the surface to prevent air from reaching the water.
5. Mix some salt with some deionized water to make a solution. About 1/4 fill tube 3 with this mixture and add a nail.
6. Put a nail into tube 4 and add about 2 cm depth of anhydrous calcium chloride granules (these absorb water). Put a bung in this tube to prevent any further water from getting in.
7. Leave for at least three days and then note any changes in appearance of the nails.

Result

4th test tube turns out brownish in colour.

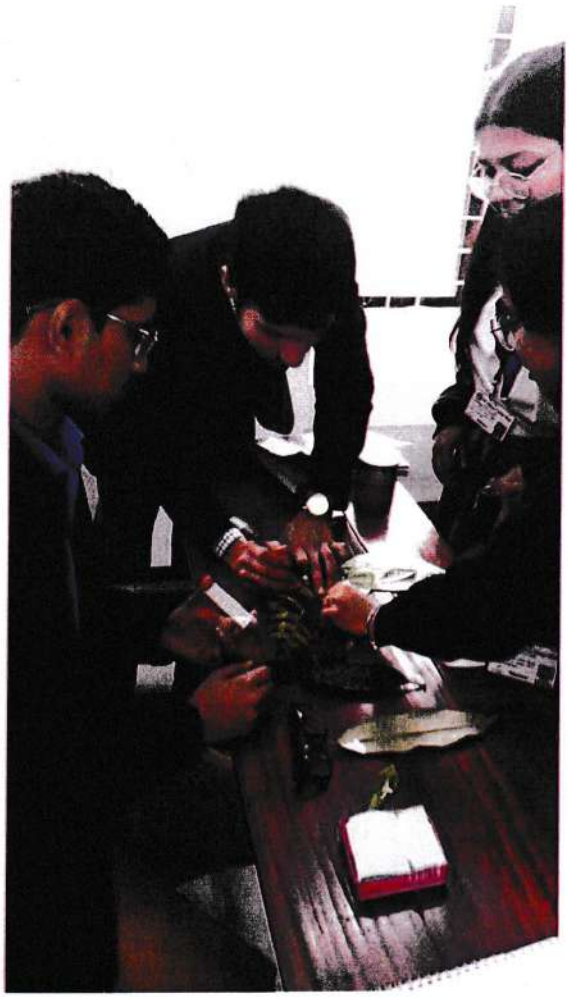


The Most Friendly Plant of the Campus

Muhbubul Alam
BAF Shaheen College Dhaka

Apparatus

.1. Nail Varnish
2. Leaf
3. Microscope
4. Microscope Slide
5. Scissors

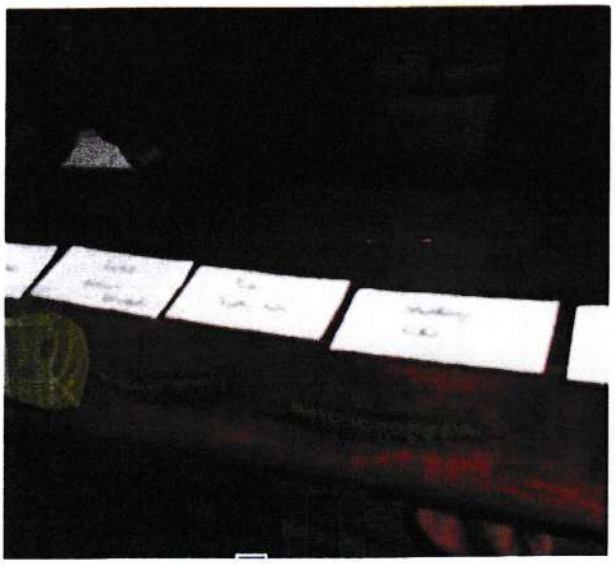


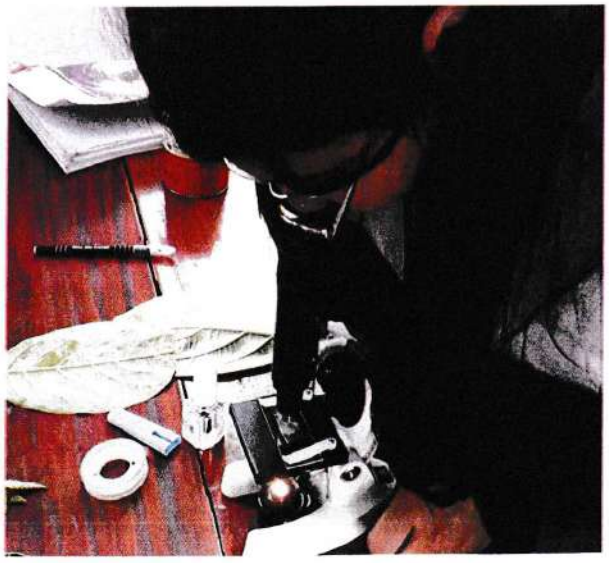
Method

Prepare an epidermal impression by coating the leaf surface with nail varnish. Peel off the dried layer of nail varnish by using sellotape and stick this onto a slide. And place it under the microscope.
Data analysis:
Count the number of stomata of each leaf collected from the surrounding area of the campus.

Conclusion

The plant leaf with most of the stomata can do maximum photosynthesis. Therefore, it could be considered the most friendly plant on the campus as more photosynthesis means more carbon dioxide is removed from





Smart Trash Bin to Reward People for Recycling Plastic

Rifath Ara
BAF Shaheen English Medium College

Apparatus

Cork sheet
Rubber band
Glue
Some chocolates
Hard paper
Adhesive tape
Colors

Method

This project aims to observe the change in people's habit of using trash bins if they are rewarded. The smart trash bin is made using cheap and local materials and throws chocolates as a reward if someone puts a plastic bottle in it. To observe if this can encourage people to use trash bins, a trash bin was set on the school campus near the school canteen without a reward system, and another was set with the reward system on two different days. The trash bin area was recorded for both days, and data was taken by counting the number of people who have used the trash bin.

Observation

It was observed that smart trash bin increases the peoples habit of throwing trash.

Impact

If this project can be continued for some time, then it will make it a habit for people to throw plastic bottles in the trash bin instead of throwing them anywhere else. This will also make the next generation do the same.

THOUGHTS
shared

Zakir Hossain, Principal at Robertsonganj High School & College

Rangpur, Bangladesh

"The inquiry-Based Learning [IBL] project under the banner of the Global Educators Initiative Sustainable Transformation [GEIST] International Foundation is a very unique and effective measure to promote science education. Science education demands interaction and engagemer in the classroom which is to learn more practically rather than only going through books.

Science education becomes fun to learn when there is an urgency or necessity to inquire about various aspects. Inquiry-based learning [IBL] develops curiosity, creativity, critical thinking, an problem solving skills among students which led them to opt for pursuing science education. I helps the learners to go for small-scale research and unique experiments on different educatio projects. Furthermore, it facilitates them to understand the significance of learning and acquire the 21st-century skills which will help them to compete in the global economy.

Science education develops competence and skills that need to be imparted among young learners with a view to creating a sense of internationalism and coping with the demands of globalization. If the method [inquiry-based learning] is prioritized in the curriculum, students will be more enthusiastic and interested in science learning "

Chemistry in Our Dailylife

Niharika Podder
BAF Shaheen College Dhaka

Hypothesis

Determination of the rate of diffusion in liquid at different

Apparatus

1. Two Beakers
2.Burner
3. Stand
4.Thermomete
5. .Potassium permanganate (KMn04)

Method

.At first, we take two beakers. In the first beaker, we take hot water, and in the second beaker, we take cold water. After that, we put the same amount of solid potassium permanganate (KMn04) in both beakers.

Observation

After some time, we will see that potassium permanganate is dissolving in both beakers. It will create a pink solution. In the first beaker water will turn pink solution faster than second beaker. Because, in first beaker KMn04 particles will get added motion due to heat and scatter faster
Result: We can see that rate of diffusion is faster where heat is more. So, we can say the presence of heat increases the rate of diffusion.

Where Do We Breathe the Cleanest Air?

Md. Ruhul Kadir
BAF Shaheen English Medium College

Apparatus

Plastic plates
Marker
Threads
Magnifyling glass

Method

Coat the top of the white or clear plastic plates (take six plates) with petroleum jelly. Hang the plastic plate from an object using thread. Stick the face mask on the top of three plates using glue. Mark plates as "School", "Home" and Car." Let the plastic plates sit for at least seven days (weather permitting). At the end of the experimental time, collect the plastic plates and observe them using a hand lens. Observe the difference between the plates covered with and without face masks. Compare the condition of the plates and record the observation.

Result

1. The plate which was on the back of the car was the dirtiest.
2. The plates with face masks were cleaner than the ones with masks.

Video Games Increase Pulse Rate

Nazrul Islam
BAF Shaheen English Medium College

Hypothesis

Vaping is less harmful on lungs and airways compared to both active and passive smoking.

Apparatus

Mobile /Laptop

Pen /Pencil

Paper

Method

1. Let the student to be seated in a comfortable position
2. Measure resting pulse rate
3. Let the student to play an exciting video game
4. Measure the pulse rate after 10 minutes

Name	Detail	Pulse Rate General	Pulse Rate Playing Video Games
Zayed	Age-14, Male	88	132
Dhruba	Age-14, Male	87	149
Tahsin	Age-14, Male	94	138
Zasia	Age-15,Female	96	148
Saffi	Age-14, Male	84	140
Fabiha	Age-12,Female	88	150
Alvira	Age-12,Female	95	144

Result: While some video games get your heart racing, a new study has warned that video games can actually trigger heart problems in some children.

Investigate the Current Flow Through a Nichrome Wire

Sultan Mahmud
BAF Shaheen English Medium College

Hypothesis

Vaping is less harmful on lungs and airways
compared to both active and passive smoking.

Apparatus

a length of resistance wire attache
•an ammeter,
•a voltmeter,
•a jockey or sliding contact to conne
• a resistor,
• a switch,
• connecting wires,
• crocodile clips.

Assumption

1. Temperature constant
2. Type of material (i.e. copper) is unchanged.

Method

1. Close the switch and place the pointed end of the sliding contact onto the wire at the 10.0 cm rule. Exert a sufficient force on the sliding so that a good connection is made between it and the wire.
2. Record
(i) the length L of wire across which the voltage is measured,
(ii) the voltage V across the length of wire,
(iii) the current I in the circuit.
3. Open the switch. Calculate the resistance R of the length L of wire using the relationship
4. By placing the sliding contact at different positions on the wire, repeat (a) and (b) for a wide range of values of L. Record your results for L, V, I and R in Fig. 1.2. Include the results from (a) and (b) in your table
(Using the grid, plot a graph of R / Ω against L / cm. Draw the straight line of best fit through your points.
5. Determine the gradient of the line of best fit.



Melting Wax

Md.Abdul Moktadir
Kaligonj Kup Pilot High School

Hypothesis

White wax candles burn the longest

Apparatus

1. Candles of different colors
2. Matches
3. Stopwatch

Method

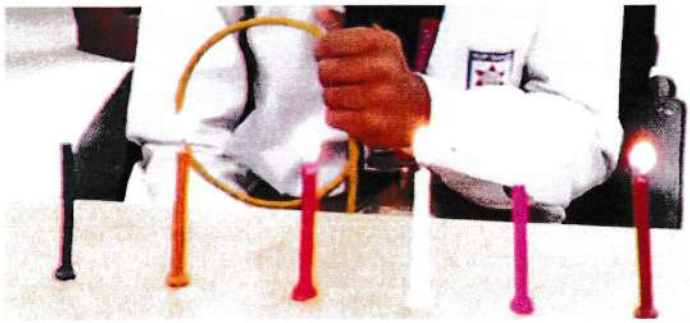
1. Provide students with candles of different colors (eg white, yellow, pink). 2. Divide students into groups and observe the burning of colored wax.

2. Experiments by different groups will review and analyze which color burns first from the burning time of different colored waxes.

3. After analyzing the data, students will gain a detailed understanding of the melting point, boiling point, and inter-particle attraction and bonding between particles and will know which color wax is cost-effective to use.

Conclusion

Students observed white wax to burn the longest. The possible reasons for this might be because white is the most tolerant to heat radiation, and there are usually no chemicals (e,g dyes) used in white wax. Students observed white wax to burn the longest. The possible reasons for this might be because white is the most tolerant to heat radiation, and there are usually no chemicals (e,g dyes) used in white wax.



Which locally Processed Drink Contains the Highest Amount of Vitamin C?

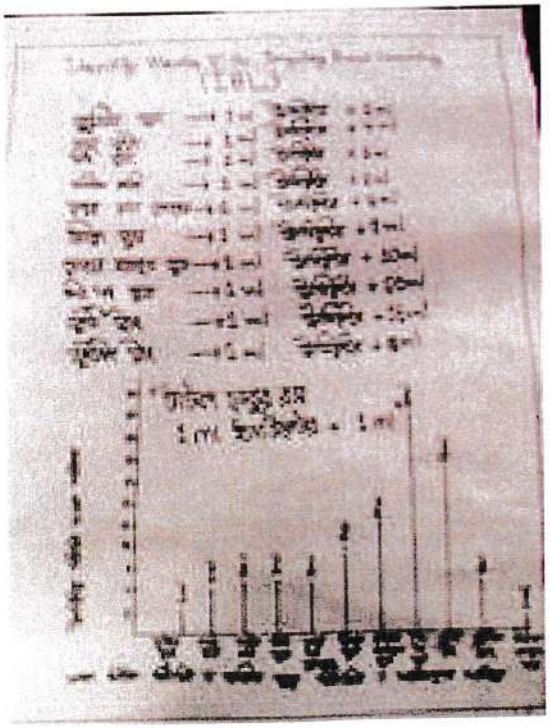
Firoza Zaman Suchona
Robertsonganj High School & College

Apparatus

1. Ten locally available processed drink most populer among young children
2. Syringe (20 ml syringe)
3. Beaker
4. Corn starch
5. Warm water
6. Iodine solution
7. Lemon juice

Method

1. Take 30 ml of the processed drink sample that you want to test for vitamin C content into a syringe.
2. Take 1 g of corn starch into a beaker. Add 100 ml warm water into it. Stir the content continuously until it mixes with water completely.
3. Add 1 cm3 of iodine solution. This will turn the starch solution blue black.
4. Add liquid food content onto the blue-black solution drop by drop using the syringe and shake the beaker. Keep adding until the blue-black color of the solution turn colorless.
5. Check the volume of liquid food content that is used make the blue-black solution colorless.
6. Repeat the procedure three times and record the data on the given table.
7. Repeat no. 1 to 10 with the provided other nine types of process drinks.



Result

The result revealed Junior Juice contains the highest amount of Vitamin C, which is almost as concentrated as lemon juice.

Necessary Elements for Plant Growth

Nilufar Yasmin
Dakhin Kolkond Masterpara Government Primary School

Apparatus

1. Guord seeds
2. Three pots
3. Scale to measure growth of the plants
4. Paper
5. Pen

Method

At first, we will take some gourd seeds.
Then we will plant them in three pots.
We will mark the pots as 1, 2, and 3.
We will place pot 1 in a sunny place and will water it regularly.
We will place pot 2 in a sunny place but will not water it.
We will place pot 3 in a dark place so that the plant cannot have sunlight. We will water pot 3 regularly.

Observation

At first, the growth of plants of all three tubs seem same. Hoever, after seven days the plant in the tub 2 and 3 showed sunted growth.Where as the plant of tub 1 showed the most growth of all.

Conclusion

Plants need sunlight and water both for optimum growth.

Find out the High Gluten Flour

Shahnaaz Sharfuddin
BAF Shaheen College Dhaka

Hypothesis

1: Atta (flour) contains more gluten than refined flour

2: Atta (flour) contains more gluten than rice flour

3: Refined flour contains more gluten than rice flour

Apparatus

1. Atta, Refined flour and rice flour
2. Beaker
3. Weight machine
4. spatula
5. tap water

Method

1. Measure 30 g of flour (all three types)
2. Take into a beaker
3. Make the dough by adding water
4. Let the dough settle for ten minutes
5. Wash the dough with running water from the tap. White starch will wash off from the dough. Keep washing until the white starch is coming out of the dough. Stop when no more white starch is coming out.
6. The sticky dough which is left is only gluten. Now measure the mass of gluten using an electric or manual weight machines.

THOUGHTS
shared

Al Harun Bappi, Teacher, Adarsha High School

Rangpur, Bangladesh

It's our pleasure and honor to join the AEIF project inquiry-based learning program implemented by GEIST International Foundation with the assistance of the US Department of State to promote Science education. The joining of the project has created ample opportunities for sustainable science teaching-learning for the young learners in school as well
as enhancing professional development for the teachers. Inquiry-based learning is fundamental for the development of higher-order thinking skills. We, the teachers along with our students, are so excited to explore the new vistas of knowledge by dint of inquiry-based learning. "To know the unknown" is grown in our student's soft minds. With the passage of time, students are so much interested in such a learning way that helps them to know science very well. We opt that our students are satisfied with the help of inquiry-based learning.

In our experience, children who are curious seem destined for success. A curious child is motivated to ask questions, seek answers and apply those answers to his or her personal experience. Teacher have discovered that this approach, along with rich content, can boost a student's receptive and productive scientific skills. Inquiry-based learning follows a process that we can incorporate into many curriculums. Essentially, inquiry-based learning is a natural way to learn the scientific method in various ways. It allows students much more control of their learning experience while teachers help and guide them along. It encourages our children's natural curiosity and sense of wonder about the world around them.

"We look forward to joining the more educational project in the days ahead.""

Introduction to Light and Reflection

Fahaad Hasan
Maple Leaf International School

Hypothesis

1. Light travels in a straight line
2. Light can be Reflected

Apparatus

Laser

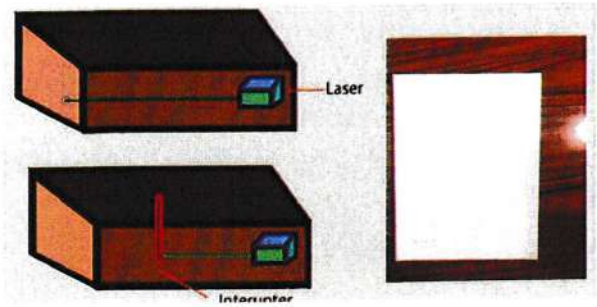
Mirror

Paper

Pen / Pencil

Method: Hypothesis 1

At first, in a paper we place a mirror and draw a normal line using a pencil in the middle of the mirror. After drawing that line, we point the laser at the mirror from the incidental side. Then the ray of the laser reflects to the opposite side. Next, we block the path of the rays from the laser and mark the points using a pencil one by one on the both of the side.The path
of the light is traced using a ruler and a pencil. Afterwards, we repeat the process again to ensure if the process is correct. If the method is carried out correctly, then the procedure is accomplished. Thus, the investigation to trace out a reflection of light can be carried out.



Method: Hypothesis 2

At the beginning of the experiment, we will place the laser pointer in a specified position or area and trace out a box beside it known as the Ray box. After setting the laser pointer at the correct position we have to turn on the laser. Remember to keep the laser in a specified position and do not move it. Then the rays of light hits the wall and rays of the laser can be seen thereafter we will use an interupter/Pencil to interrupt the rays of light and mark or point out the positions the rays are traveling in. We do this about four times, and the path of the light can be seen. Therefore using a ruler, we will trace the path in which the light travels. Thus the path of the light has been investigated, and the path has been found.

Introduction to Light and Reflection 2

Fahaad Hasan
Maple Leaf International School

Investigation

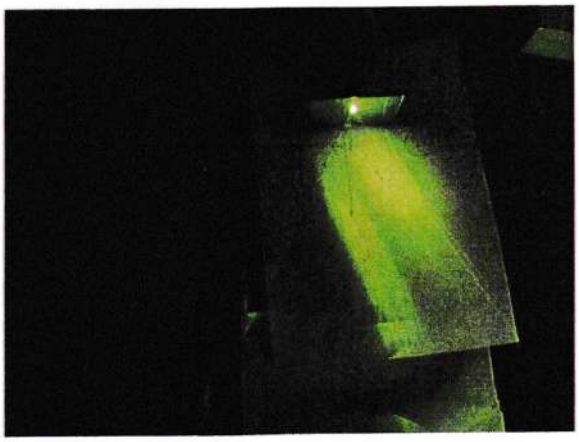
Investigating Double Mirror Periscope

Apparatus

Laser
Mirror
Paper
Pen / Pencil

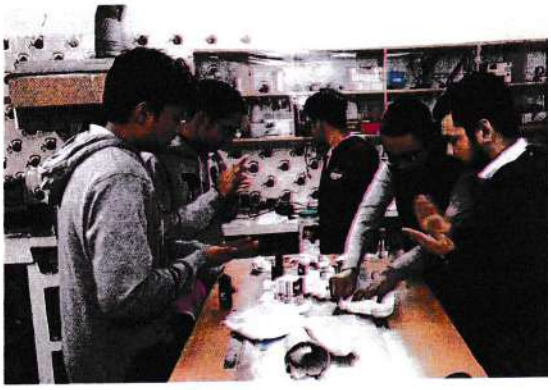
Method: Hypothesis 1

A periscope is a device that utilizes the reflection of light rays to give its a view from positions that are often unreachable or very difficult to reach. It usuallyoften consists of two mirrors that givegives us an elevated view than normal. At first, we have to place 2 mirrors inside a casing (e.g.table).The mirrors have to set parallel to each other at 45 Degree angle.Then we have to place a source of light (Ray) facing one of the mirrors. The light ray produced will be reflected by the 1st mirror at 45 degree which will be reflected by the 2nd mirror also at 45 degrees. Due to this, the destination of the light ray changes. It also increases the distance the light ray travelshas to travel to get to a certain plate.



PROJECT ACTIVITIES

Urban Phase



PROJECT ACTIVITIES

Rural Phase

THANK YOU