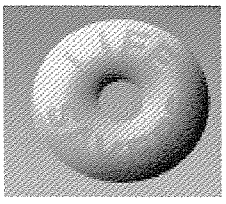
Activity 1a
Defining Topic for Investigative Study

Scientific investigations all begin with a question. There is no single set and sequence of steps to be followed, and the investigation procedures are guided by the question asked. Moreover, investigation procedures can influence the results. Therefore it is important to be able to define a good question before starting a scientific investigation. Below shows an activity that helps students define a good question for scientific investigation.

"Life Saver" Investigation



How long does it take for a "Life Saver" to dissolve in the mouth?

Each student is provided with a piece of "Life Saver". They are asked to put it into their mouths and see how long it takes to completely dissolve it in the mouth. A statistics of the time recorded for each student is made and analyzed.

Guided questions for students:

1. Is the time needed by all students the same? What information does the statistics provide us with?

2. What are the factors that affect the time taken for the "Life Saver" to dissolve in the mouth?

3. Is this question "How long does it take for a "Life Saver" to dissolve in the mouth?" a good question for a scientific investigation?

4. What are the criteria for a good question for a scientific investigation?

5. How would you modify the question above so that it becomes a good question for a science investigation?

Activity 1b
Defining Topic for Investigative Study

Some considerations:

A. General Guidelines

The chosen topic

1. should stimulate curiosity of or provoke wonder in students;
2. should allow students to find out, e.g. experimental details, data to be recorded, etc.;
3. should involve practical task;
4. should allow reasonable variability of investigations among different groups;
5. can be done using simple equipment available in school chemistry laboratories; and
6. can be conducted safely.

B. Topic selected by the students or the teacher?

Topics selected by students	⟷	Topics prescribed by teachers

C. Different types of topics

1. Quantitative analysis
2. Preparative and testing
3. Design and make
4. Others

Tasks (30 minutes):

1. You are required to work as a group to define a topic for investigation for your students. If you wish, you can make reference to the three investigation outlines provided, or put forward other topics.

2. Discuss why you selected the topic, and list out the anticipated difficulties & possible ways to resolve them.

Group Number: _____ Date: _____

Topic

Notes

Possible Investigations

C

1. **How fast do chlorine bleaches deteriorate?**
   Chlorine bleaches slowly lose their power when standing in air. As a chemist of a bleach manufacturing company, investigate whether chlorine bleaches significantly deteriorate under different conditions. You need to think about:
   - Why the strength of a bleach solution changes upon storage?
   - What method could be used to monitor the change in concentration of the active ingredient in chlorine bleach?
   - How you would investigate the effect of e.g. sunlight and temperature on the strength of chlorine bleaches?

   Do your answers suggest that the deterioration of chlorine bleach is likely to be a significant problem for the manufacturers and users of chlorine bleaches?

2. **Extraction of limonene from citrus fruit peels**
   Limonene is a naturally occurring substance found in the essential oils of spearmint, caraway, lemon and orange oil. Orange peel zest (the orange part) contains about 0.5 – 1% of limonene by weight. Limonene can be used to replace toxic, hazardous, and dangerous petroleum-derived chemicals. Two most commonly used methods for isolating limonene are solvent extraction and steam distillation.

   Using one of the above methods, extract limonene from several fruit samples and compare their limonene contents.

3. **Indoor carbon dioxide filter**
   On average, we spend more than 80% of our time at home, in offices and other indoor environment. Carbon dioxide level is a key indicator for indoor air pollution. Living things breathe out carbon dioxide. A high level of carbon dioxide in the indoor means there is inadequate supply of fresh air. It makes you feel sleepy, and provides a warning of possible building up of other indoor air pollutants. Carbon dioxide in the air can be absorbed by chemicals e.g. calcium oxide. The concentration of carbon dioxide can be measured by a hand held carbon dioxide meter.

   Design an environmental friendly and economical indoor carbon dioxide filter to reduce the concentration of indoor carbon dioxide to an acceptable level.

D

Possible Investigations

1. **Too much phosphate in washing powder and detergents?**
   Phosphates are added to most domestic laundry powders and detergents to enhance the cleaning action. However, if too much phosphates are discharged into sea or rivers, eutrophication will occur. As phosphates in detergents cause much harm to the environment, we are going to analyze different brands of washing powders in the market, aiming to compare their phosphate contents. You might
   - determine phosphate ions in water by a colorimetric method
   - compare the phosphate contents in different brands of washing powder

2. **Determining a better formula for a soap bubble solution**
   Many children like playing with soap bubbles. As a scientist in the product development team of the biggest chain toy stores, one of the recent development is to determine a better formula of soap bubble solution. You need to think about:

   - How soaps bubble form?
   - What the criteria for a better formula, e.g. staying in air for a longer period of time or making soap bubbles as large as possible?
   - What constituents in the solution can affect the properties of the soap bubbles formed?

   Do your answers suggest the soap bubbles you make is better than the ones available in market?

3. **Water purification system**
   Supply of clean drinking water can be a big problem, particularly in some developing countries. People often have to acquire untreated water from wells or rivers. Such water is often contaminated with germs and toxic metal ions. Design a low-cost and portable system that removes toxic substances from drinking water.