

## CHAPTER 1: SCIENTIFIC INQUIRY 2

### Formulating questions about a studied phenomenon YouTube

A question about a phenomenon should ask something that can be measured and observed through experimentation. It can only be answered by gathering evidence. This is achieved by collecting data through qualitative and quantitative observations.

It is believed that “salt water causes metals to rust faster”. This phenomenon can be studied by formulating the following questions:

1. What previous investigation has been carried out on rusting?
2. Which metals rust and which ones do not?
3. Will the metal rust if it is alloyed?
4. What conditions are needed for rusting to occur?
5. How can we conduct a scientific inquiry to investigate on the effect of salt water on rusting?

### Planning and conducting a simple laboratory investigation

We can thus plan and conduct a simple laboratory investigation on rusting in the presence of salt water.

#### Planning

In planning the investigation on rusting, we should consider the apparatus and chemicals. The apparatus and chemicals need not necessarily be obtained from a laboratory. It costs less to use containers and chemicals commonly available. Instead of using a test-tube, a piece of iron and sodium chloride from the laboratory, we can take a glass, iron nails and sea water.

#### Conducting

We have to use exactly the same apparatus and the same amount and type of water if we want to make a good investigation. We can also prepare a sample, which is not exposed to either tap water or salt water.

Thus, we can clean three identical iron nails and immerse them in three identical transparent glasses. One glass is left exposed to air as sample. The second one is to be filled with tap water so that only half the nail is immersed. The third one is to be filled to the same height as the second one, but with sea water.

The date and time is noted. The three apparatus are observed at the same time every day.

#### Safety

Safety is the state of being protected from danger or harm. A laboratory coat and safety goggles should be worn during most chemistry experiments. It is also a good practice to wash hands after leaving the laboratory.

During the investigation of rusting in the presence of sea water, it is important that we do not get hurt with the sharp nails. Also, we should wash our hands after setting up the apparatus.

## Recording data

Data, which can be qualitative or quantitative, must be recorded in a way that makes interpretation or comparison easy.

## Tables

A table consists of a list of facts or numbers arranged in a special order, usually in rows and columns.

The following table can be used to write down the observations made on the different apparatus used to investigate on rusting:

	Nail in empty glass	Nail in half-filled glass with tap water	Nail in glass half-filled with sea water
Amount of rust observed after one week	<i>Little</i>	<i>Much</i>	<i>Very much</i>

## Diagrams

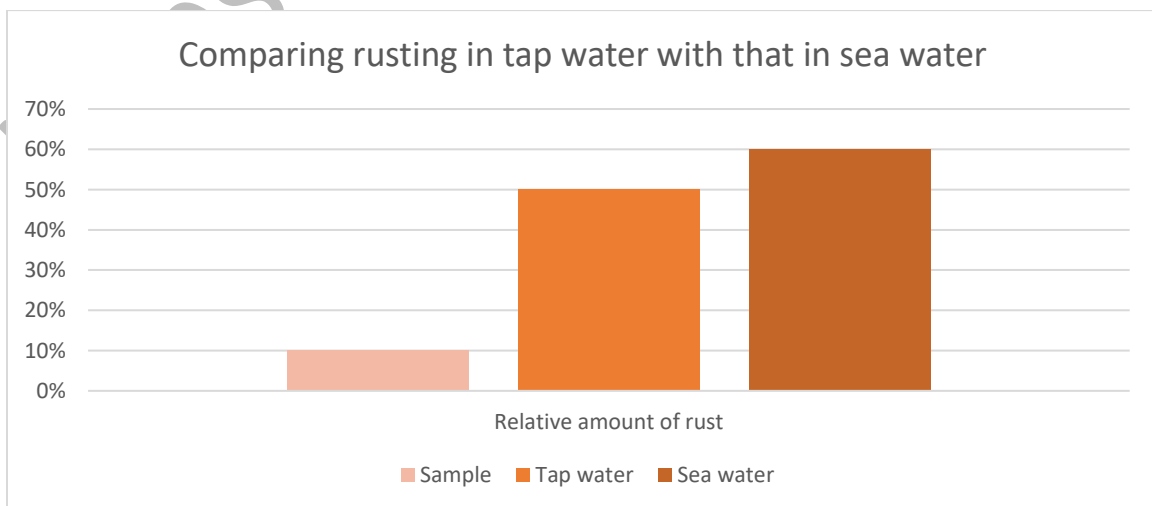
A diagram is a simple drawing using lines to explain how something works or how to set up an apparatus. In science, we use a pencil to draw and label a diagram.

We can thus draw a diagram to show the apparatus to investigate on rusting in sea water.



## Chart

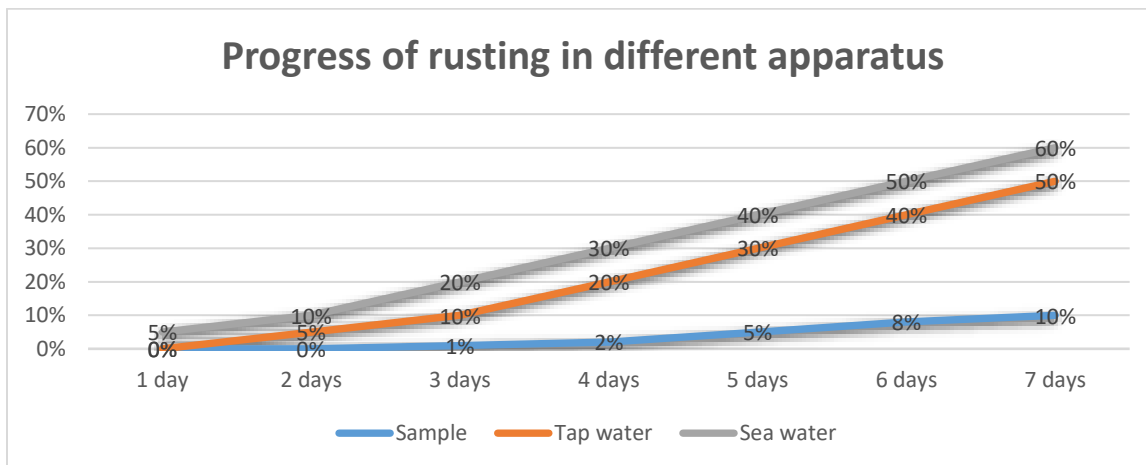
A chart is a graphical representation of data, in which the data is represented by symbols, such as bars in a bar chart or slices in a pie chart. We can represent the relative amount of rust that appears, after one week, on each nail on a chart as shown below.



## Graphs

A graph is a planned drawing, consisting of a line or lines showing how two sets of numbers are related to each other.

By plotting a graph, we can view the progress of rust that appears with time, in each apparatus.



## Drawing and writing conclusions

Now that we have reached the conclusion of the investigation, it is time to summarize and explain what happened in our experiment. Our conclusion should answer the question that initiated the investigation.

Our conclusion should be based solely on our results.

Think about the following questions:

1. Was your hypothesis correct? Did rusting occur faster in sea water than in tap water?
2. If your hypothesis was not correct, what can you conclude from that?
3. Do you need to run your experiment again, changing a variable (like an apparatus or condition)?
4. Is your data clearly defined so that everyone can understand the results and follow your reasoning?

Remember, even a failed experiment can yield a valuable lesson, for example, it can enable us to formulate a new hypothesis.

Thus, our experiment showed that the iron nail rusted slightly faster in sea water than in tap water.

## Acquiring and presenting results using ICT

The application Microsoft Word 2021 was used to draw the diagrams. Microsoft Excel 2021 was used to generate the charts and graphs shown above.

This chapter itself, with the investigation has been printed and also shared using the website address <http://dushan.intnet.mu/chemistry/Lower%20Secondary/Chemistry%20Lower%20Secondary%20Notes.html>

## Writing a short report

### Steps involved

Since our hypothesis proved correct, we should start writing a report, stating the steps in which the investigation was carried out to find out whether the iron nail rusted faster in sea water compared to tap water.

Step 1: In three identical, transparent glasses, a separate but identical iron nail was placed vertically.

Step 2: The first glass was used as a sample.

Step 3: The second glass was half-filled with tap water.

Step 4: The third glass was half-filled with sea water.

Step 5: Every morning the appearance and the mass of each iron nail was recorded.

Step 6: The apparatus was left to stand for one week before making a conclusion.

### Results of the experiment

1. Traces of rusting were observed in the glasses containing the tap water and the sea water after one day.
2. Traces of rust did not appear in the sample apparatus until after three days.
3. After one week, the iron nails were all coated with a reddish-brown layer of rust.
4. The layer of rust was thinnest in the apparatus containing only air.
5. The layer of rust was thickest in the apparatus containing sea water.
6. The apparatus was not discarded until after one month, to confirm the observations and to measure the masses of each rusted iron nail. The apparatus with the highest mass will indicate more rusting.

### Conclusion

The results confirm that rusting occurs faster in the presence of sea water. Thus, the hypothesis that rusting occurs faster in sea water than in tap water is confirmed.