

Science

Junior Cycle

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1.0 Learning Intentions

After this week's lesson you will be able to:

- Examine the role of Science in society.
- Practice basic research techniques in preparation for your CBA 2
- Identify laboratory equipment and safety symbols
- Follow the scientific method in order to design your own investigation
- Identify Variables- Dependent, Independent and control
- Understand how to complete your CBA 1

1.1 Specification

The specification for junior cycle science focuses on the development of students' knowledge of and about science through the unifying strand, Nature of science, and the four contextual strands: Physical world, Chemical world, Biological world, and Earth and space. It has been designed for a minimum of 200 hours of timetable student engagement across the three years of junior cycle.

1.2 Chief Examiner's Report

One of the new characteristics of this specification is the development of the unifying Nature of Science strand. While some aspects of this strand are assessed directly in a classroom-based context, question 11 of the paper largely focussed on this part of the specification; almost all parts of question 11 assessed candidates' ability to work and think scientifically. Central to question 11 was the assessment of candidates' understanding of the concept of a scientific hypothesis, assessed in parts (a) and (g); the evidence from the answering of these parts of the question is that while some candidates demonstrated a full understanding of this concept, many other candidates demonstrated moderate-to-poor levels of understanding. Other parts of question 11 – parts (c), (d) and (f) – assessed candidates' ability to engage with the design of a scientific experiment; the evidence from the answering of these parts of the question is that candidates have good understanding of experimental design and the use of standard laboratory equipment and techniques.

1.3 Revision Notes

1.4 What is Science

- Science is both a body of knowledge and a process. In school, science may sometimes seem like a collection of isolated and static facts listed in a textbook, but that's only a small part of the story. Just as importantly, science is also a process of discovery that allows us to link isolated facts into coherent and comprehensive understandings of the natural world.

- Science is exciting. Science is a way of discovering what's in the universe and how those things work today, how they worked in the past, and how they are likely to work in the future. Scientists are motivated by the thrill of seeing or figuring out something that no one has before.
- Science is useful. The knowledge generated by science is powerful and reliable. It can be used to develop new technologies, treat diseases, and deal with many other sorts of problems.
- Science is ongoing. Science is continually refining and expanding our knowledge of the universe, and as it does, it leads to new questions for future investigation. Science will never be "finished."
- Science is a global human endeavour. People all over the world participate in the process of science. And you can too!

1.5 The Role of Science in Society

It is impossible to overestimate the role of science in modern society, because today it has a huge impact on many areas of life and people's activities. With the help of scientific knowledge, a person comprehends the world. The great role of science in modern society is also in the fact that it is impossible to manage it without having certain knowledge.

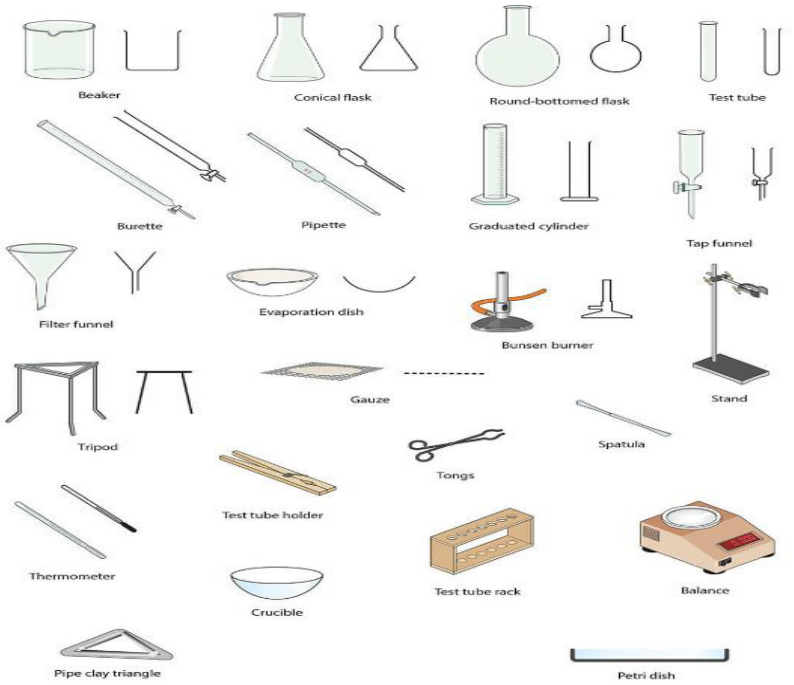
1.6 Contribution and impact of Scientists on Society

- It is important to be aware of the role scientists have played in making the world a better place. Through their discoveries and inventions, they have expanded our knowledge and understanding of how the world works.

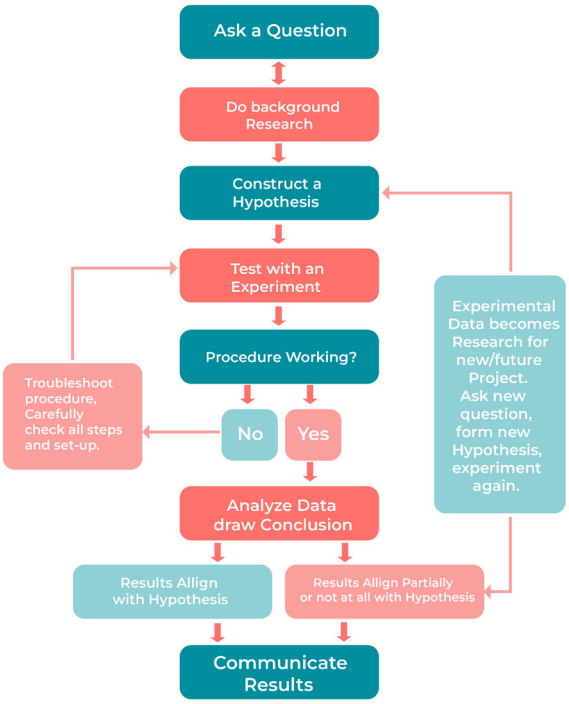
- New materials have been designed, disease has been controlled and treated, new technologies have been developed and we now have a greater understanding of the Universe. Most of the effects of scientific discoveries have been for the better but sometimes they can be used for negative reasons or have damaging results eg, invention of engines has confounded global warming and climate change by releasing excess Carbon Dioxide into the atmosphere.

- Science and society are interlinked.
  Society often guides scientific research in different areas. Currently there is a global Pandemic meaning there is an increased need for research in the biological sciences in order to find a vaccine. Climate change is also a global concern and society is looking to science for answers.

1.7 Lab Equipment



1.8 The Scientific Method



1.9 Steps of the Scientific Method

1. Ask a Question-The scientific method starts when you ask a question about something that you observe: How, What, When, Who, Which, Why, or Where?

2. Do Background Research-Rather than starting from scratch in putting together a plan for answering your question, you want to be a savvy scientist using library and Internet research to help you find the best way to do things and ensure that you don't repeat mistakes from the past.

3. Construct a Hypothesis-A hypothesis is an educated guess about how things work. It is an attempt to answer your question with an explanation that can be tested. A good hypothesis allows you to then make a prediction:

"If _____[I do this] _____, then _____[this]_____ will happen."

4. State both your hypothesis and the resulting prediction you will be testing. Predictions must be easy to measure.

5. Test Your Hypothesis by Doing an Experiment-Your experiment tests whether your prediction is accurate and thus your hypothesis is supported or not. It is important for your experiment to be a fair test. You conduct a fair test by making sure that you change only one factor at a time while keeping all other conditions the same.

6. You should also repeat your experiments several times to make sure that the first results weren't just an accident.

7. Analyse Your Data and Draw a Conclusion-Once your experiment is complete, you collect your measurements and analyse them to see if they support your hypothesis or not.

8. Scientists often find that their predictions were not accurate, and their hypothesis was not supported, and in such cases, they will communicate the results of their experiment and then go back and construct a new hypothesis and prediction based on the information they learned during their experiment. This starts much of the process of the scientific method over again. Even if they find that their hypothesis was supported, they may want to test it again in a new way.

9. Communicate Your Results-To complete your investigation you will communicate your results to others in a final report and/or a display board. Professional scientists do almost exactly the same thing by publishing their final report in a scientific journal or by presenting their results on a poster or report booklet

1.10 Posing a Hypothesis

What is a Hypothesis?

A hypothesis is a tentative, testable answer to a scientific question. Once a scientist has a scientific question she is interested in, the scientist reads up to find out what is already known on the topic. Then she uses that information to form a tentative answer to her scientific question. Sometimes people refer to the tentative answer as "an educated guess." Keep in mind, though, that the hypothesis also must be testable since the next step is to do an experiment to determine whether or not the hypothesis is right!

A hypothesis leads to one or more predictions that can be tested by experimenting. Predictions often take the shape of "If ____then ____" statements, but do not have to. Predictions should include both an independent variable (the factor you change in an experiment) and a dependent variable (the factor you observe or measure in an experiment). A single hypothesis can lead to multiple predictions, but generally, one or two predictions is enough to tackle for a science investigation.

Example:

Question	Hypothesis	Prediction
How does the size of the dog affect how much food it eats?	Larger animals of the same species expend more energy than smaller animals of the same type. To get the energy their bodies require, larger animals eat more food.	If I let a 70-pound dog and a 30-pound dog eat as much food as they want, then the 70-pound dog will eat more than the 30-pound dog.
Does fertilizer make a plant grow bigger?	Plants need many types of nutrients to grow. Fertilizer adds those nutrients to the soil, thus allowing the plants to grow bigger.	If I add fertilizer to the soil of some tomato seedlings but not the other, then the seedlings that got fertilizer will grow taller and have more leaves than the non-fertilized plants.

What if My Hypothesis is Wrong?

What happens if, at the end of your investigation, you look at the data you have collected, and you realise it does not support your hypothesis? First, do not panic! The point of an investigation is not to prove your hypothesis right. The point is to understand more about how the natural world works. Or, as it is sometimes put, to find out the scientific truth.

When scientists do an experiment, they very often have data that shows their starting hypothesis was wrong. Why? Well, the natural world is complex—it takes a lot of experimenting to figure out how it works—and the more explanations you test, the closer you get to figuring out the truth. For scientists, disproving a hypothesis still means they gained important information, and they can use that information to make their next hypothesis even better.

Forming a hypothesis- Link to video in lesson
-https://youtu.be/bp2fbzWZDmA

1.11 Identifying Variables

Variables are the factors in an experiment that change or potentially change. There are two types of variables independent and dependent, these variables can also be viewed as the cause and effect of an experiment.

- **Independent Variables**

An independent variable is the variable that the experimenter purposes changes or manipulates. The independent variable is the cause, input, or what is being done during the experiment.

- **Dependent Variables**

A dependent variable is the variable that changes in response to the changes in the independent variable. The dependent variable is the effect, output, or what happens during the experiment. This is usually a measurement or observation eg. Length, time colour change.

1.12 Control Variables

The more factors (other than the independent variable) you can keep the same in an investigation the more valid your results will be. In this way you will know that it is the CHANGE (independent) you made that is giving you your data (dependent) and not another factor.

1.13 Tips on completing CBA1 (Extended Experimental Investigation)

- When considering what experiment to design it is wise to choose a topic that interests you. You will be working on this for 3 weeks so you also want to give consideration to the time frame when considering what investigate
- Make sure that you have the materials needed to complete your investigation
- Give good consideration to your hypothesis and ensure that it is testable
- Only change ONE variable (independent)- It will over complicate your investigation if you are measuring too many independent variables.
- Make sure you justify your hypothesis. I think this will happen if I change X because..
- Make sure your investigation is safe to carry out in the lab
- Repeat, repeat! One of the main issues with CBA 1 is that students do not gather a sufficient amount of good quality data.
- Be as accurate as you can both in consideration of control variables and in how you collect and interpret data
- Always describe the relationship between variables eg. When I changes X it had Y effect.
- Graphs and charts are a great way of displaying results
- Consider an anomalous data that may be there and try to explain it
- Assess whether your hypothesis has or has not been supported eg. I thought that "X" would happen but instead my results showed "y". This could be because…..
- Describe the strengths and weaknesses of your investigation. There are always things that can be improved to make a better investigation. If there are none then explain why.

1.14- Advice form JCT on completing CBA 1

A. Questioning and Predicting

For this part of the investigation students may work individually or in small groups. Each student must contribute to the work of the group.

- Choose the topic
- Decide the research question
- Collect information on the background theory related to the research question
- Refine the question to help with the justification of their hypothesis/prediction
- Record the sources of information
- Write the hypothesis/prediction

B. Planning and Conducting

For this part the investigation students may work individually or in groups. Each student must contribute to the collection of data.

- Hands-on experience in the laboratory to plan and refine experimental design.
- Decide what equipment and materials will be necessary.
- Assess any possible risks
- Write *individual* Investigation Plan
- Submit *individual* for investigation approval
- Conduct the investigation

C. Processing and Analysing

For this of the investigation students must work individually.

- Analyse their own data
- Perform any necessary calculations
- Consider how to best represent and analyse their data
- Identify patterns and relationships in the data
- Explain any anomalous data
- Describe the relationship between the variables
- Draw conclusions
- Consider if their hypothesis or prediction has or not been supported

D. Reflecting and Reporting

Students may work individually or in groups to reflect on their work. They should be encouraged to critically discuss various aspects of their investigation, such as:

- The design of the experiment and possible improvements
- The limitations of their data
- Any possible theoretical or practical implications of their findings
- Further related Investigations that they might conduct, and why

Students must work *individually* to compile the report of their investigation, using the information/data they have recorded in their research throughout the investigation. Students will report their research and findings in a format of their choice. If a typed or hand-written report Is the format of their choice, the total length of the report would typically be in the 400 - 600 words range (excluding tables, graphs, reference list, and research records), but this should not be regarded as a rigid requirement.

1.15 Homework Task

A

Use any method available to you to do a quick search of an important scientific discovery made over the past century.

- Who made the discovery?
- What impact did it have on society?
- Is it still in use today?

- You should look at your source-website, book etc
- Think about whether this source is reliable?
- When was it written?
- Who wrote it?
- Can the information be verified anywhere else

B

- In an investigation what name is given to the type of variable that you change?
- When carrying out an investigation it is important to ensure that it is a fair test. Explain what this means
- Give two examples to illustrate the important role that science plays in society.
- Write down a hypothesis for the following scenario- You notice that there are birds outside your window in the morning that go to a species of tree. Can you hypotheses why?