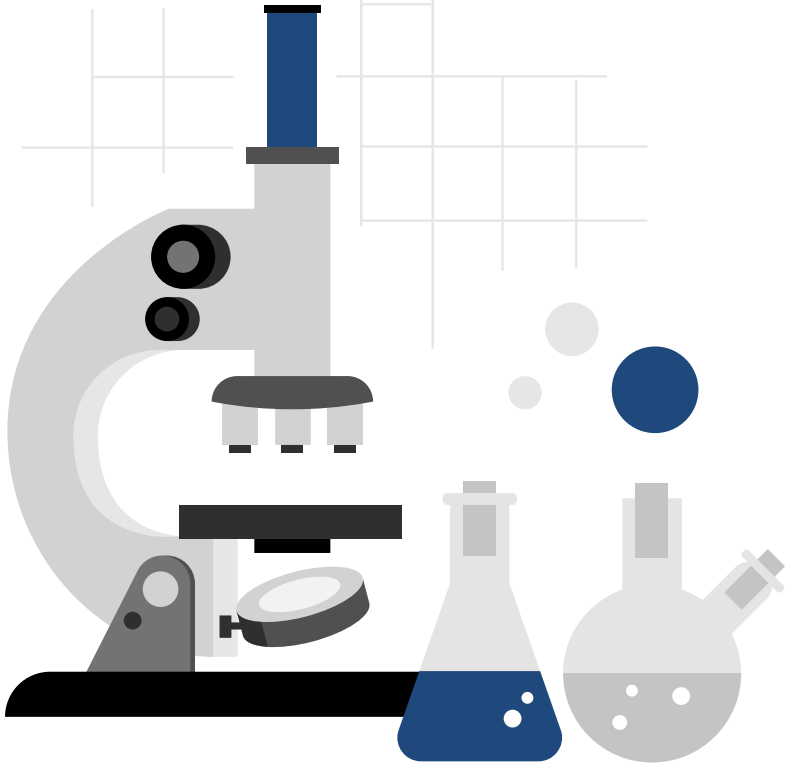

# SCIENCE LITERACY

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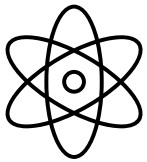
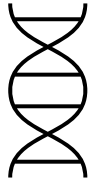
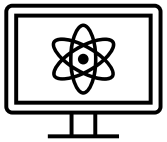
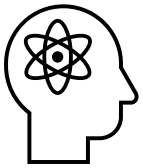
# What is Science Literacy?

- A skill to be developed and practiced
- Something to be applied to both journal articles and research papers; and to blog, social media, news, and magazine articles
- The ability to decipher scientific texts
- The ability to determine the credibility of science writing in many forms

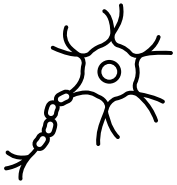
# Why is Science Literacy Important?

- Help you make important decisions around health, technology, climate and energy, and more
- Help you recognize dis- and misinformation

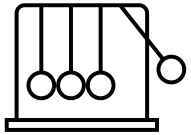





# To tell if scientific research is credible, we need to know what good research looks like!





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# Experiment Design

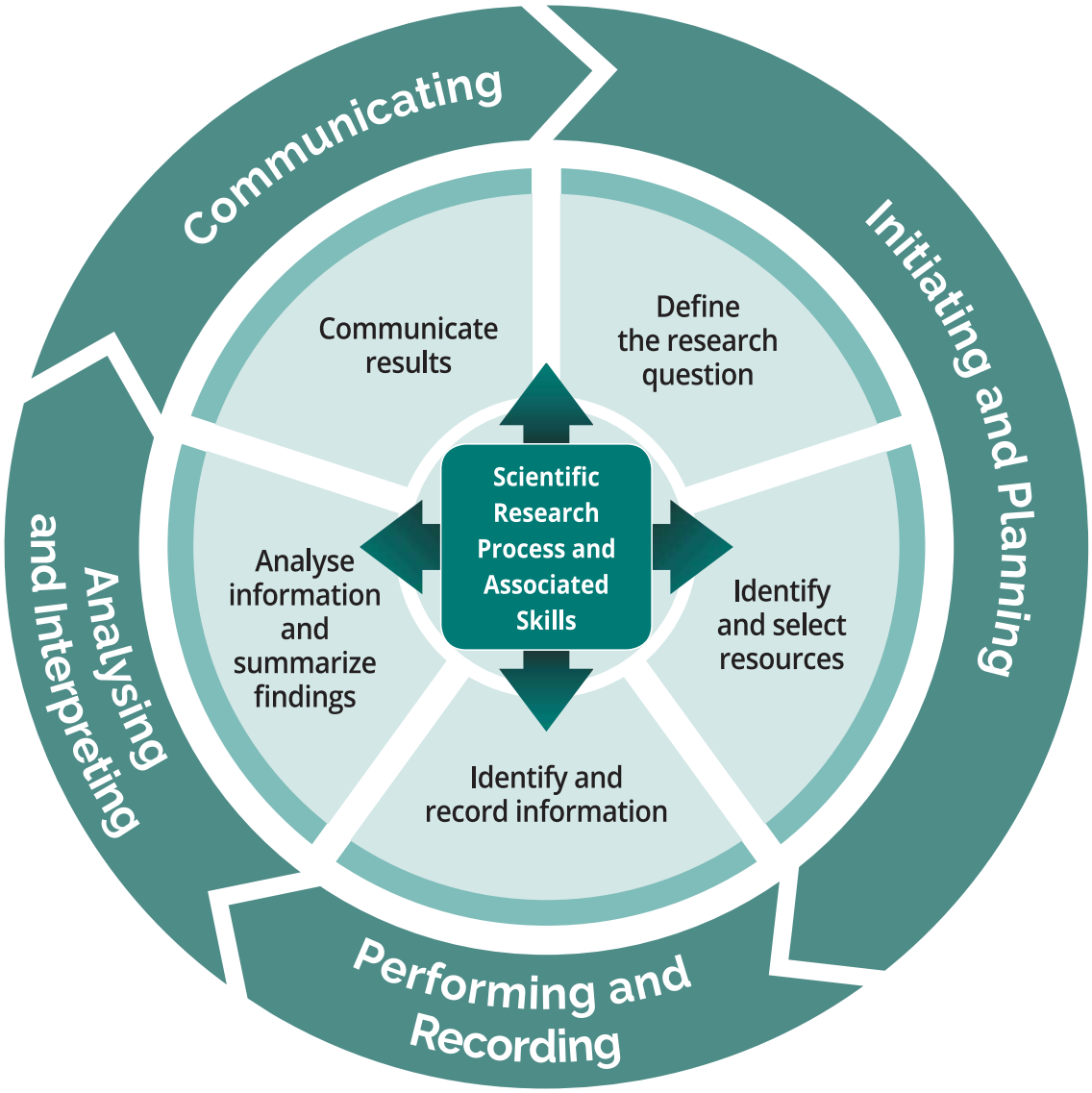
Can you put these in order?

- Assign Subjects to Treatment Groups
- Define Variables
- Design Experimental Treatment
- Formulate Question
- Measure Dependent Variable
- Make Hypothesis

# Experiment Design

Can you put these in order?

1. Formulate Question
2. Define Variables
3. Make Hypothesis
4. Design Experimental Treatment
5. Assign Subjects to Treatment Groups
6. Measure Dependent Variable


Communicating
Initiating and Planning
Performing and Recording
Analysing and Interpreting
Communicate results
Define the research question
Identify and select resources
Identify and record information
Analyse information and summarize findings
Scientific Research Process and Associated Skills

# Formulate Question

All research should be guided by a research question.

1. Identify a gap in existing research
2. The question you ask should be measurable in a way that could feasibly give you an answer
3. Is your question better answered quantitatively – using numbers and measurements – or qualitatively - using comparisons and groupings of information?

Your notetaking begins here – always keep diligent records of every action and decision during the experimental process.

# Define Variables

- Independent Variable: a variable in an experiment is something which is not changed by another variable in the experiment.
- Dependent Variable: the thing which changes based on changes to the Independent Variable.

For example: If you are asking if water volume impacts tree growth, the water volume is the independent variable, while the tree growth is the dependent variable.

# Make Hypothesis

- Your hypothesis should be based on your initial research and what is already known.
- You should be able to justify why you expect your hypothesis to come true.

# Design Experimental Treatment

- Your experimental treatment needs to be valid, it should account for variability, and it should be replicable.

# Validity, Variability, and Replicability

- Validity: Is your experiment measuring what you think or claim it is measuring?
- Variability: How great an impact does chance have on your results?
- Replicability: Could someone else recreate your methods and achieve the same results?

# Design Experimental Treatment

Experimental Treatment: The thing you are doing to or with your subjects which produces results.

- Your experimental treatment needs to be valid, it should account for variability, and it should be replicable.
- Are there variables you need to control to isolate your independent and dependent variables?
- Would it be helpful to have a control group, to make sure that a result is not due to chance or placebo?
- How many different groups do you need?
- Has someone else done a similar experiment, with a method you can adapt or reuse?

# Assign Subjects to Treatment Groups

- To test a hypothesis, you may need to do change the test slightly between multiple groups.
- Consider sample size - you want lots of subjects in a treatment group to make sure that chance isn't playing a big role in your results.

For example, using the tree example – you may need a group getting no water, a group getting water once per week, a group getting water on Mondays, Wednesdays, and Fridays, and a group getting water daily. You will need to keep track of which trees are in which treatment group.

# Measure Dependent Variable

- Record your results from each treatment group as precisely as possible
- Keep detailed notes on every action and decision

# Now What?

- An important part of science is sharing your findings. This is done via publishing.
- Journals are organizations which publish research, usually in a specific field.
- Many require peer review.

# Peer Review

The process by which multiple experts in your field review your work to make sure it stands up to scientific rigour, aligns with what is known in the field already, and that it is in fact valid, that is has accounted for variability adequately, and that it is replicable.

Peer review is a good sign of credibility, but it is not enough by itself! Peer review isn't a perfect process.

# Not All Journals Are Equal!

Which of these two journals do you think publishes more credible work? Why?

https://asrjetsjournal.org/index.php/American_Scientific_Journal/about

https://researcher-resources.acs.org/publish/pub_process/

# Parts of a Journal Article

- **Abstract** – a brief summary at the beginning
- **Methods** – a detailed description of exactly what the researcher did
- **Results** – a presentation of the results without analysis or discussion
- **Discussion** – the researcher analyzes the results to describe what they mean
- **Conclusion** – the researcher discusses why the results and discussion are important, and how they answer the research question.

# Questions to Ask

- Is the article peer reviewed?
- Who owns the journal? Who funded the research?
- What other kinds of research have been published by that journal?
- Have other scientists come to similar conclusions by replicating this study?
- How big is the sample size?
- Is the experimental treatment measuring what it claims to measure?
- Are the comments in the discussion and conclusion in line with the results, or does the author make conjectures?