

Freshwater Indicator Species: Teacher Notes

Overview/Introduction

This activity will place students in the position of a biologist who has been contracted by the Environment Protection Agency (EPA) to report on the quality of water samples. Students will have to identify different freshwater aquatic organisms from water samples, assign them SIGNAL scores, then draw conclusions on the quality of the different water samples.

Curriculum Outcomes: Victorian Curriculum F-10

Levels 9 and 10

Biological Sciences

- Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems (VCSU121).

Recording and processing

- Construct and use a range of representations, including graphs, keys, models and formulas, to record and summarise data from students' own investigations and secondary sources, to represent qualitative and quantitative patterns or relationships, and distinguish between discrete and continuous data (VCSIS137).

Analysing and evaluating

- Analyse patterns and trends in data, including describing relationships between variables, identifying inconsistencies in data and sources of uncertainty, and drawing conclusions that are consistent with evidence (VCSIS138).

Communicating

- Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (VCSIS140).

Target Audience

This activity is suitable for students in years 9 and 10.

Duration of Activity

This activity takes 1.5 – 2 hours to complete.

Learning Objectives

Upon completion of this activity, students should be familiar with the concept of indicator species, and the SIGNAL score system. Students should also be able to interpret SIGNAL scores and draw conclusions about water quality from them.

Background Information

Freshwater aquatic organisms can be used to assess the health of a waterway. Different organisms can tolerate different levels of pollution, thus the presence of certain species can be an indicator of the health of the waterway. Such species are called indicator species.

The 'Stream Invertebrate Grade Number – Average Level' (SIGNAL), or SIGNAL score for short, is a simple scoring system to determine how healthy a waterway is (Chessman 2003, p. 3). High SIGNAL scores indicate a healthy waterway that is likely to be high in dissolved oxygen while having low levels of salinity, turbidity, nitrogen and phosphorus (Chessman 2003, p. 3).

Aquatic organisms are given a SIGNAL number between 1 and 10, with the low number being tolerant of pollution and the high number being intolerant (Chessman 2003, p. 12). The SIGNAL score of the waterway is determined by adding up the total of all the numbers, then dividing this by how many different organisms were found.

Example for hypothetical water sample A:

Organism 1 = Number 3

Organism 2 = Number 4

Organism 3 = Number 2

Organism 4 = Number 4

Total = 13

$13 \text{ (total)} / 4 \text{ (organisms)} = 3.3$

This score shows the water is severely polluted.

SIGNAL Score Ratings for Freshwater Streams (Waterwatch Victoria n.d.):

Higher than 6	Healthy
Between 5 and 6	Mild Pollution
Between 4 and 5	Moderate Pollution
Less than 4	Severe Pollution

Materials

This activity requires:

- Microscope – compound and stereo
- Petri dishes, 1 per water sample
- Cavity slides
- Flat glass slides
- Cover slips
- Droppers
- Water samples with aquatic organisms. Be mindful that water samples may contain polluted, dirty water. Wash hands after handling.

Activity

1. Students will be required to identify the organisms with the help of a microscope.
2. Then they will note the organism's appearance, abundance, assign a SIGNAL number and comment on what this shows.
3. Students will then calculate the SIGNAL score for the water sample.
4. Once a SIGNAL score has been calculated for each water sample, the students will then write a conclusion in the format of a report to the EPA, stating whether they believe the water samples are polluted or not and why.
5. Students will also answer the 'Further Questions'.

Instructions/directions (from the student notes)

1. Collect samples to be analysed.
 2. Look carefully at each sample of water. Note its appearance. Make sure you look very carefully at each sample and describe it as accurately as you can.
 3. Put the sample into a petri dish. Use a magnifying glass and/or a stereo microscope look for small organisms. If the organisms are very small place a drop of water containing them on a flat slide. If the organism is large place it with some water on a cavity slide.
 4. To observe organisms more closely, use a plastic Pasteur pipette (dropper) to suck the organism up and transfer it to a microscope slide with water. Observe at low power and if necessary at high power. In each case cover with a coverslip trying to exclude air bubbles.
 5. Bring the specimen/s into focus. Use the information provided in the table below and any other resources available to identify the organism. Some things you see might be debris, that is, just bits of dead and decaying plant matter.
 6. Try to estimate the abundance of the organism. That is, the number of this type of organism in your sample. If you can count them that would be best, but you may have to make a rough guess. In your sample is there 1, 10s, 100s, 1000s of the organism?
 7. If the organism has a **Signal Number** record it. This scoring system allows us to use the organisms in your samples to very roughly measure the pollution level of the water.
- Organisms that need **unpolluted water** are given a high Signal Number;

- Organisms that can live in **polluted waters** get a low Signal Number.
8. Calculate the **Signal Score** from each sample, by adding up all the signal numbers of the organisms you have found and then dividing the total by the number of types of organisms in the sample. A Signal Score that is higher than six, indicates healthy water. A Signal Score that is lower than four, indicates pollution.

Resources

Further resources include:

- A short YouTube video that illustrates the concept of indicator species, <https://www.youtube.com/watch?v=Vfo8skcxKVg&frags=pl%2Cwn>
- A guide to collecting suitable samples: <https://www.epa.vic.gov.au/our-work/publications/publication/2003/october/604-1>
- A good reference for identifying different organisms is *A Beginners Guide to Waterbugs* produced by Melbourne Water: <https://www.melbournewater.com.au/media/117>.

Extension

1. Students could be supplied with water samples from different locations and asked to compare them.
 - a. For example, from two different streams.
2. Students could be involved in the collection of the water samples during a field trip.
3. Students could be supplied with water samples from various parts of the same stream and asked to identify changes in the water quality, then suggest possible causes.

References

Chessman, B 2003, *SIGNAL 2.iv – A Scoring System for Macro-invertebrates ('Water Bugs') in Australian Rivers*, Monitoring River Health Initiative Technical Report no 31, Commonwealth of Australia, Canberra.

Waterwatch Victoria n.d., *Waterway and catchment health resources*, Waterwatch Victoria, retrieved 15 August 2018,

http://www.vic.waterwatch.org.au/cb_pages/waterway_and_catchment_health_resources.php.

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