Freshwater Indicator Species – Teacher Notes

By: Louise Lopes

Introduction:

In this investigation, students will play the role of a biologist in a water pollution consultancy business. It is their job to examine samples and make determinations about water quality. Students will use their scientific skills to make predictions, identify and classify organisms, record and analyse data, and present and justify their findings. This investigation can be extended to an excursion, where students collect their own samples, or adapted as a classroom activity by having samples prepared beforehand.

This investigation is at a prescribed level of scientific inquiry and covers content in the Biological and Environmental sciences from grades 7 to 10, such as using a key to identify organisms in a local habitat and using a microscope. Furthermore, suggestions are given on how to incorporate issues within water management, sustainability, threats to biodiversity and climate change.

Biological analysis is an important part of land management and conservation work. By providing context to this activity in the form of a case study, students will benefit from understanding the value of this type of research. Students will understand how scientists collaborate with conservation groups, industries, governmental agencies, and Indigenous and local communities in order to research, plan and implement environmental protection strategies. These points are covered when students examine a real-life strategic plan being conducted in Tasmania.

Question:

Students are provided with an objective, which is to examine samples and apply the concept of an Indicator Species in order to make determinations on the health of the ecosystem they are researching.

The water system that is chosen will provide additional details that students can incorporate into their Aim and Hypothesis. Pertinent details that can be included is the history of the land, its current council zoning, nearby uses of the land (i.e. residential, industrial, agricultural, etc.) and what large fauna and flora currently rely on this water system for sustenance.

After teachers have selected a site, they may also give students a wider context about the aim of this report. Consider real-world applications for doing this biological analysis, such as determining the site for heritage preservation value, deciding whether a recent protection plan has been successful, or confirming whether industrial processes occurring in the vicinity are polluting the waterway.

Plan:

Teachers can set their students up for success by being strategic with their site selection. Knowing before-hand what types of organisms are likely to show up, will allow teachers to refine the ‘organism guides’ that are provided to students.

The general guides provided to students in their worksheets can be supplemented with more localised information; check State government websites for additional resources. An example is *A Beginners Guide to Waterbugs* produced by Melbourne Water: https://www.melbournewater.com.au/getinvolved/protecttheenvironment/Documents/Waterbug%20Guide_Online.pdf

Another example is *Water Bug Detective Guide* by Wagga Wagga NSW council: http://www.wagga.nsw.gov.au/__data/assets/pdf_file/0020/44183/Water-Bug-Identification-Sheet.pdf

Another example is *Critter Catalogue – A guide to the aquatic invertebrates of South Australian inland waters* by the South Australian EPA: www.epa.sa.gov.au/files/8543_critters.pdf

If students are collecting the samples themselves, you will need to have droppers and canisters to contain the samples. Ensure that you have permission to collect samples in the area. Tell students to wear protective gear like gloves, closed sole shoes with long socks, long sleeved shirts and long pants to minimise any exposure to insects that bite. Leeches is a consideration, if there are leeches or ticks in the area, ensure correct removal procedures are observed.

Once in the lab, students are given a materials list. Year 7 students can use a magnifying glass in place of a microscope. Alternatively, guidance can be given on how to use a stereo microscope. The investigation can be further adapted by having the microscopes already set up, having pre-made petri-dishes and slides, or only including petri-dish samples in the analysis. For Year 8 students, consider completing the microscope syllabus points in conjunction with this investigation. If this option is chosen, then teachers may wish to include the use of a compound microscope by allocating an entire lesson on its correct use. This will open up the ability for students to examine single-celled organisms. For students at higher grades, the written instructions which have been provided should be sufficient.

Conduct:

Collecting Samples: If students are collecting their own samples, motivate them to take as many notes as possible about what they observe in their surrounding environment. Examples that students can focus on is: animal track paths to the water's edge (students can try to guess what large creatures use this site for their drinking water), fauna and flora surrounding the water ways and the overall colour and transparency of the water. This information can lead to a valuable discussion, as two of the main causes of the extinction of fresh water fish are the clearing of riparian vegetation and siltation.

Examining Samples: Students are provided with instructions on how to prepare their samples, and are given result tables to fill out. Students are invited to record details on the overall appearance of the sample. Encourage students to justify their classifications by pointing out the defining features which lead them to make their decision. If students find that their vocabulary for describing these features is too limited, then they can draw them instead.

Students may also choose one organism that they find interesting and record as many characteristics that they can. They can then challenge themselves to find the scientific name for this species and its geographical distribution.

Students will have to record the estimated population sizes of organisms found in their samples. This is referred to as the *abundance* of the organism. You may choose to further refine these estimations based on the type of samples students are examining. If most samples are being observed in petri-dishes with low magnification, then the *abundance* can include the entire surface of the petri-dish. However, if students are using compound microscopes to examine very small and single-celled organisms, then the *abundance* will have to be calculated from the viewfinder. Multiply the *abundance* found in the viewfinder with the magnification setting to calculate for a uniform area (i.e. a cm square). By doing this, the *abundance* numbers for each sample can be compared between each other.

<u>Analyse:</u>

In this section, students will collate all the data they have recorded to make general calculations. Students can choose to calculate the signal number for each sample, and then find the average signal number between samples, or they may wish to find the average signal score for each identified organism, regardless of what sample they came from.

Eventually students will have a final number for their entire data set. The scale indicates that any number above six indicates healthy water, while a signal score any lower than four indicates pollution.

Collate a data set for the entire class by instructing each lab group to report back their overall number. It is recommended that a medium and range be calculated. These numbers can provide important insight later when students assess the reliability of their investigation.

<u>Problem-Solve:</u>

In this section students are asked to use their analysed data to make conclusive statements, justify these findings and tie this all back to the wider context of the report. Those students who made careful observations throughout this investigation will be at an advantage as they have more evidence to build their case.

If the water is found to be clean and abundant in biodiversity, then students can address why it is important to preserve this site. If the water is found to be polluted then allow students the opportunity to research ways that human activities may have impacted this environment, and what some of the consequences have been, such as loss of a native population. Advanced students may challenge themselves with researching what practises could be implemented in the future to stop or even reverse this pollution.

Students can include the role that Indigenous and local communities have in stewardship of this site. There is now more recognition of the sustainable land management practises of Indigenous communities. Practises such as traditional burning, fishing traps, and sowing and storing plants are

Figure 1 - Image by: B.Hanna, Image copyright owner: Heritage Division

used to work with the environment. An example of this is the Brewarrina Aboriginal Fish Traps situated in the Barwon River which feeds into the Darling River. They are some of the oldest man-made structures in the world. They are listed on the National Heritage List, and images of them can be shown at the Heritage Council of New South Wales website: http://www.environment.nsw.gov.au/heritageapp/visit/viewattractiondetail.aspx?id=5051305

The assessment that students provide in their report will have to include an evaluation on how robust their findings are. If all lab groups had similar signal numbers, then this could be used for validation. Students are encouraged to disclose any forms of human error or limitations in their investigation. Students may find that samples were collected too close together, samples weren't properly preserved or that additional materials were needed. Students can consider how taking photos of their samples under magnification would have made the task of identification and classification much easier.

For an extension to this investigation, students can perform a case study of a recent Plan being implemented by the Australian Government: *Recovery Plan for the Giant Freshwater Crayfish (Astacopsis gouldi)* ***2017*****.** This plan has been published on the Australian Department of the Environment and Energy website and can be found here:
http://www.environment.gov.au/biodiversity/threatened/publications/recovery/astacopsis-gouldi-recovery-plan-2017

From downloading and examining this report, students can see the depth of work that is required to put these initiatives into practise. This report includes a detailed analysis on the threats to this habitat, such as sedimentation, illegal fishing and climate change.

Conclusion:

In this section, students are asked to bring it all together by summing up their report in just a few statements. This would be a great time to see if any of the students' predictions were correct and if they feel as though the aim of their report has been achieved.

References

Figure 1 - Image by: B.Hanna, Image copyright owner: Heritage Division
http://www.environment.nsw.gov.au/heritageapp/visit/VisitItemImages.aspx?isAttraction=1&ID=5051305#ad-image-1