Uncovering the identity of crab larvae using DNA barcoding

Suggested follow-up Activities

This document outlines some ideas for follow-up activities to support learning of the themes from the talk 'Uncovering the identity of crab larvae using DNA barcoding' with museum curator Dr Andrew Hosie. These activities can be applied to many different year levels and implemented in a way that suits your class, however this talk and associated activities are best suited to older students. We have also provided a detailed outline for one activity; 'Strawberry DNA extraction', linking to the science curriculum area, and strongly linking to the first part of the DNA barcoding process outlined by Dr Hosie in his talk. These activities are intended to be engaging, hands-on ways to support our talk.

Some suggested themes and activities to link to this talk:

1. Taxonomy and Classification

This talk outlined the museum's role in identifying new species and classifying them, in this case based on both physical features and DNA barcodes. Students can practice classification based on physical features by classifying a group of objects into groups based solely on their features (eg- a large selection of different cutlery). How did they group their items? Can they make smaller groups from this? How can we break down these groups? Discuss how this related to classification and taxonomic levels, breaking down all life until it reaches species level.

Can students make a dichotomous key to help others in classifying a 'mystery specimen?'

You can support this learning by visiting Boola Bardip for our facilitated programs *Classified Information* and *Thinking Taxonomically.*

2. Life Cycles- growth, change and population management

The Blue Swimer Crab, *Portunus armatus* has a life cycle from egg to larval stages and then into adult crab, and they change significantly through this time, as seen through the talk.

- *Do you think this style of life cycle presents a challenge for those who manage species? Why or why not?*

- *How does knowing about the species life cycle help in ensuring that there are enough Portunus armatus adults in years to come?*

Investigate other species that have a similar life cycle, including the Western Rock Lobster, mentioned in the video. Learn more about these life cycles, what each of the stages are and how long each stage lasts to help answer the questions above.

Some helpful fact sheets from Department of Fisheries

- https://www.fish.wa.gov.au/Documents/recreational_fishing/fact_sheets/fact_sheet_blue_swimmer.pdf
- https://www.fish.wa.gov.au/Documents/recreational_fishing/fact_sheets/fact_sheet_western_rock_lobster.pdf

3. DNA Barcoding

DNA Barcoding is one way that researchers can identify species of crab larvae, or any animal, by using a genetic sequence that will differentiate that species from others.

How might this be helpful in species identification, particularly of species that have larval stages?

Follow the Australian Museum's DNA Barcoding Learning Journey to gain further insight into how DNA barcoding works. (best suited for upper secondary students) https://australian.museum/learn/teachers/classroom-activities/dna-barcoding-modules/

Activity Outline: Strawberry DNA Extraction

Overview	Tying into Dr Hosie's work using genetic barcoding, participants will conduct a science experiment to extract the DNA from a strawberry
Year Level	Yr. 4-10
Learning Outcomes	Students will conduct an experiment that is an approximation of how scientists extract DNA, this is a key part of the study of DNA and genetics. Students will gain experience in the practical aspects of conducting lab work.

CURRICULUM

Curriculum Links
Transmission of heritable characteristics from one generation to the next involves DNA and genes (ACSSU184) Solids, liquids and gases have different observable properties and behave in different ways (ACSSU077) Mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques (ACSSU113) Chemical change involves substances reacting to form new substances (ACSSU225)

EQUIPMENT AND MATERIALS

DNA extraction solution: mix 1 tablespoon of dish detergent and 1 teaspoon of salt into 1 cup of water

Denatured alcohol: Methylated spirits or rubbing alcohol. Put it in the freezer for the best results

Item	**Notes**
Strawberries	Ziplock sandwich bag
Rubber gloves	Test tube or a smaller cup
DNA extraction solution	Dropper or a small spoon
Large plastic cup	Denatured alcohol
Gauze, cheesecloth, or coffee filter	Paper towels
Rubber band	

INSTRUCTIONS

1. Place a strawberry in a zip-lock bag. Squeeze out as much air as possible before sealing the bag.

2. Use your hand to gently mash up the strawberry inside the bag. Don't hit the bag to break the strawberry, as this could damage the DNA.

3. Open the zip lock bag add two tablespoons of DNA extraction solution. Reseal the bag and continue to mash and mix the strawberry and solution.

4. Place a sheet of gauze over your large cup and use a rubber band around the edge to secure it in place.

5. Carefully pour the mixture from the zip lock bag into the cup using the gauze to filter out any solids.

6. Use the dropper or spoon to take some of the solution from the large cup and place it in the test tube/smaller cup.

7. Add a dropper or spoon of the alcohol to the solution in the smaller cup.

8. Observe the solution in the smaller cup. The alcohol will float on top of the solution. Watch closely and you'll see a threadlike cloud appear in the alcohol. This is the DNA, It will over time clump together and float to the top of the alcohol layer.

QUESTIONS

It's important to understand how each part of the DNA extraction solution works and how each step in the experiment helps to isolate the DNA.

You can follow an activity such as the one on the next page with students to match the experimental step to the function within the experiment.

EXPERIMENTAL STEP	FUNCTION WITHIN EXPERIMENT
A. Mashing up the Strawberry by hand while in the bag	__ Separates the DNA from other proteins in the mixture
B. Mixing the strawberry with dishwashing detergent in the DNA extraction solution	__ extracts and clumps the DNA from the mixture, allowing it to be seen
C. Mixing the strawberry with Salt from the DNA extraction solution	__ Breaks open the cells
D. Pouring the strawberry mix through gauze	__ filters out material too big to possibly be DNA
E. Adding Alcohol to the solution	__ Burst the cell membranes to release more DNA

Answer Key (top to bottom): C,E,A,D,B

Discussion Question for students: It's impossible to see a single strand of DNA, how are we able to see the DNA in this instance?

A. The DNA in this experiment was clumped together, not in a single strand, which we wouldn't be able to see. Because it was clumped it made it visible to us. This DNA is also from hundreds of thousands of cells, rather than just one cell, so there is a lot more genetic material here than would be found in one cell. Strawberries are also octoploid meaning they have eight sets of chromosomes per cell, while we are diploid, we have 2 sets per cell.

CONCLUSIONS

Scientists study DNA for many different reasons, from understanding how it works within our bodies and development of medicines, to genetically modifying food, or for identification purposes. They can also use it to study the evolutionary history of living things or correctly identify them the way Dr Andrew Hosie does.

Today you followed the process scientists go through to extract DNA from cell samples. You could further this experiment by trying it with different things like oatmeal or kiwi fruit. Beyond this you could experiment with ways to weigh the DNA extracted and calculate the percentage of the sample that's made of DNA.