**Modelling eDNA in a marine ecosystem – teacher notes**

**Ako: Learn about eDNA and how it can be used as a pest detector**

[Environmental DNA (eDNA)](https://www.sciencelearn.org.nz/resources/3209-environmental-dna) has revolutionised how scientists monitor ecosystems and identify the species that live in them. eDNA is genetic material found in hair, scales, skin and faeces that are naturally shed by living things into the environment.

This activity simulates scientists collecting eDNA sequences from marine ecosystems. It uses ‘water samples’ – ice cream containers that contain paper strips with short DNA sequences – that have been taken from different locations around Aotearoa.

Although real water samples may contain eDNA from thousands of different species, this activity only uses 11: Northern Pacific sea star, European green crab, killer algae, Mediterranean fanworm, wakame, cow, pleated sea squirt, blue cod, pine tree, common kelp and greenshell mussel. Some species are natives and others are introduced pests. Some species are aquatic and other are terrestrial. Some of the aquatic species are on biosecurity watch lists but are not yet in Aotearoa.

The Ministry for Primary Industries has information on some of the marine pests featured in this activity: [Ocean pests and disease threats to New Zealand](https://www.mpi.govt.nz/biosecurity/pest-and-disease-threats-to-new-zealand/ocean-pest-and-disease-threats-to-new-zealand/) and the [New Zealand Marine Pest ID Guide](https://www.mpi.govt.nz/dmsdocument/10478-New-Zealand-Marine-Pest-ID-Guide).

**What you need**

* [Species cards for modelling eDNA in a marine ecosystem](https://www.sciencelearn.org.nz/system/documents/files/000/001/364/original/Species_cards_for_modelling_eDNA_in_a_marine_ecosystem.pdf?1742598663)
* [Species tokens for modelling eDNA in a marine ecosystem](https://static.sciencelearn.org.nz/documents/files/000/001/365/original/Species_tokens_for_modelling_eDNA_in_a_marine_ecosystem.pdf?1742598712)
* [DNA sequences for modelling eDNA in a marine ecosystem](https://www.sciencelearn.org.nz/system/documents/files/000/001/366/original/DNA_sequences_for_modelling_eDNA_in_a_marine_ecosystem.pdf?1742599039)
* [Modelling eDNA in a marine ecosystem – student worksheet](https://www.sciencelearn.org.nz/system/documents/files/000/001/367/original/Modelling_eDNA_in_a_marine_ecosystem_%E2%80%93_student_worksheet_V1.docx?1742868884)
* 4–5 ice cream containers
* Large map(s) of Aotearoa New Zealand – for example, A1, A2, wall map or similar

**Activity set-up**

1. Cut up the DNA sequences for the 11 species. Note: The DNA sequences are the complementary strands so students will need to use the base pairing rules – for example, A pairs with T and G pairs with C – to find the correct species.
2. Cut up the species tokens.
3. Create ‘water samples’ by adding the DNA sequence paper strips to the ice cream containers. If you want to use water samples from different marine environments around Aotearoa, consider:

* land use – for example, plantation pine forests and agriculture
* marine protection areas
* aquaculture/marine farming locations
* areas where aquatic pests have been identified.

1. Check that the number of species DNA sequences you use in the water samples matches the numbers of species tokens available for student use.

**What to do**

1. Use the map of New Zealand to identify where the water samples have been collected.
2. Observe and discuss the species cards. Elicit students’ prior knowledge about the species.
3. Discuss the simulated DNA sequences that are featured on the cards. (The DNA sequences for introduced organisms feature an orange background while native organisms feature a green background. It’s your choice whether to point this out or allow students to come to this conclusion themselves.)
4. Use [Modelling eDNA in a marine ecosystem – student worksheet](https://www.sciencelearn.org.nz/system/documents/files/000/001/367/original/Modelling_eDNA_in_a_marine_ecosystem_%E2%80%93_student_worksheet_V1.docx?1742868884) to complete the activity.
5. Use the discussion questions below to deepen understanding and engagement.

**Discussion questions**

1. Is there anything that looks unusual? (For example, cow DNA and pine tree DNA in the water samples.)
2. How may it have got there?
3. How may the presence of cow poo and pine trees affect this coastal area and the species living in the sea?  (Cow poo adds extra nutrients to the water – there are more decomposers/less oxygen in the water, which affects filter feeders like mussels. Sediments and run-off from pine plantations may cause the water to become murky, which affects filter feeders.)
4. What could be done to reduce the amount of sediment run-off and cow poo in the coastal region?
5. Can you identify the species that are native and the ones that are introduced/pests?
6. Are you able to draw some simple food chains based on the plants and animals we have found in our eDNA samples? For example:

* Sun, algae, crab, cod
* Sun, algae/seaweed, crab, mussel, cod – mussels will eat crab larvae through filter feeding.

1. Can you see any correlations as to how the presence of some of the pests may affect the food chains and the abundance of some of our native species? For example:

* competition for similar resources such as light, and food/nutrients
* increased number of predators for some species.

1. How are some of these pests affecting the areas where they have been detected in Aotearoa?

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