TUNNELWORKS
KS3 SCIENCE LESSON 5 (ESSENTIALS)
TEACHERS' NOTES

About this lesson

In this lesson pupils consider habitats in the tidal Thames and organise species into food webs or chains to explore the idea of interdependence. They identify natural changes to habitats over time and contrast these with man-made changes, identifying how these changes may impair how a species is adapted to its habitat. Students consider how changes may affect entire food chains or webs. They identify some benefits from the Thames Tideway Tunnel, before considering how they can play their own part in preserving habitats along the River Thames.

Learning outcomes

Students can:

- Organise plants and animals into a food chain or web including producer, consumer, secondary consumer and predator
- Identify how marine species are adapted to their habitat and how these adaptations may be unable to cope with rapid, man-made changes
- Identify how humans may alter natural habitats, with positive and negative consequences
- List some positive impacts the Thames Tideway Tunnel is predicted to have on habitats

Curriculum links

KS3 Science

- Biology Relationships in ecosystems – food webs, accumulation of toxic materials
  Adaptation – effects of changes in the environment

What you will need

- KS3 environmental science lesson presentation
- KS3 worksheet
- You will need class ICT access if you would like students to work in pairs or small groups to complete the drag and drop activity.

Preparation

Review the lesson plan below and the KS3 environmental science lesson presentation. Adapt the content to suit your students' ability.

Time (60mins)	Teaching activity	Learning activity	Assessment for learning
5 mins	**Starter:** Ask students to think about the tidal Thames – the part of the river that is subject to daily tides and which begins at Teddington Lock, Twickenham, and extends down into the Thames Estuary. Ask students to work in pairs or small groups and identify and describe at least one type of habitat they might find along the river, and some species that might inhabit this habitat. Share ideas, which you might like to gather on your board.	Students discuss and identify types of habitat along the tidal Thames.	Verbal suggestions, questioning, discussion.
5 mins	**Whole-class:** Show slide 1a to 1c, which shows three main habitats along the Thames. Explain that students are going to explore species that inhabit all three habitats and then think about how two – the tidal Thames flowing in the City and downstream near the sea – can be protected from negative (unhelpful) human impacts.	Students suggest species that may be found in these habitats.	Verbal suggestions, questioning, discussion.
5 mins	**Whole class:** Briefly review the concept of food chains and webs using a non-river example (e.g. plants, worms, birds and foxes).	Students share prior knowledge and understanding of food chains and webs and could give non-river examples to illustrate their ideas.	Verbal suggestions, questioning, discussion.
10 mins	**Whole class or small groups:** Show slide 2. Students drag species to create a food chain or web.	Students create a food chain or web. They position species on the board and then draw connecting lines to create food webs. Share ideas.	Verbal suggestions, on-screen work.

	Ask students to suggest which species may inhabit the lower and estuary reaches of the Thames (these include reeds, tubificid worms, grey mullet, shellfish and diver sole, European otter, seal and harbour porpoise). Ask students to create a food chain using these species, writing down their idea. (NB porpoises and otters eat shellfish as well as fish.) Share ideas.	Students create food chain or web using tidal Thames species and record their ideas on the worksheet.	On-screen and written work, discussion.
5 mins	**Small groups:** Ask students to think about how this habitat changes naturally over time, and share suggestions (e.g. tides, day/night, seasons, slow changes to shape over many years).	Students discuss in small groups then share suggestions.	Verbal suggestions, discussion, questioning.
10 mins	**Whole class:** Briefly review the idea of adaptation. Show slide 3 and discuss how each species may be adapted for its habitat. Click to reveal suggestions. **Whole class:** Invite students to suggest, using examples, whether patterns of human activity along the River Thames might have negative (unhelpful) impacts on habitats and species, positive (helpful) impacts, or a mixture. Ask students to write down their ideas on the worksheet, outlining how this may impair or improve how the species is adapted for the habitat. Show examples on slide 4.	Students suggest examples of adaptation for each species. Students identify examples of human activities and suggest any positive or negative impacts on habitats and the species they contain, recording them on the worksheet and linking their ideas to how well the species can remain adapted in this changed environment (e.g. one that's polluted, noisier or lacks shellfish, for example).	Verbal suggestions, discussion, questioning. Written work, discussion, questioning.

10 mins	**Small groups:** Ask students to briefly discuss their ideas and identify common ideas or themes, linked to patterns of human activity in the Thames. Share ideas. Help students identify that changes affect species at any level of a food web or chain (such as how porpoises may be directly impacted by commercial fishing or underwater noise pollution), but can spread from the bottom of the chain (e.g. loss of reed beds due to construction along riverbanks). Show slide 5 and click to reveal answers. (You may wish to also point out that squeezing the river into a smaller space by building along the banks and into the river makes the habitats and species in it more vulnerable to change. (e.g. the Strand is named as such because it used to be the strandline of the river).	Students identify shared ideas.	Verbal suggestions, discussion.
10 mins	**Plenary:** Show the video on slide 6. Identify as a class how the Thames Tideway Tunnel will help improve habitats downriver in the tidal Thames. Fish are particularly vulnerable to pollution – how will they be helped? Discuss other ideas for managing habitats and patterns of human activity (such as commercial fishing and shellfish dredging). Ask students to suggest how the changes can improve how fish can thrive, increasing food sources for harbour porpoise and other predators. Show slide 7. Ask students to suggest what they can do personally to make sure they don't have a negative (unhelpful) impact on habitats along the River Thames.	Students can identify that changes can happen at any level in the food chain, and can affect other levels. Students identify positive impacts to habitats in the tidal Thames from the Thames Tideway Tunnel. Students identify ideas for personal actions to improve and protect Thames habitats, including personal habits, volunteering, advocating for wildlife etc.	Verbal suggestions, discussion. Verbal suggestions, questioning, discussion. Verbal suggestions, questioning, discussion.

Differentiation

Easier	Harder
Students make a food chain. Show the adaptations and ask students to match to a species (slide 4). Print the impacts on slide 6 and ask students to sort into 'good' and 'bad'.	Students make a food web. Students could try to sort the species into three groups, one for each 'reach' of the Thames and its habitat. Challenge students to work in more depth when considering patterns of human activity, changes and impacts, and when considering personal ideas for action.

TUNNELWORKS
KS3 SCIENCE
DIG DEEPER

Soil and bird survey

Pupils can complete a simple soil and bird survey in your school grounds to identify the animals present and consider local food chains for wildlife.

Soil

Pupils can search for: worms, slugs, snails, woodlice, centipedes and millipedes, spiders, beetles, ants, earwigs, maggots and grubs (invertebrate larvae) and caterpillars.

Pupils will need a ruler, string, pencils, spade, small trowel (or metal cutlery is fine – sterilise after use) plastic tubs and a plastic tray, magnifying glasses and a guide to soil invertebrates. Working in groups, pupils should:

- Measure a 50cm x 50cm square and mark using pencils and string.
- Dig out the top 5cm and turf, and lay to one side.
- Use their unaided eyes and the magnifying glasses to find any invertebrates in the turf and top layer. Pupils can put soil in the plastic tray to help break it up and see what they find.
- Sort any finds into plastic tubs.
- Repeat for the 5cm layer of soil revealed, using the trowel or cutlery to gently explore the soil and place in the tray, remove invertebrates and sort into plastic tubs.
- Count the numbers of each type of invertebrate they find.

Birds

Pupils can spot pigeons, blackbirds, crows and other corvids, robins, blue tits and other tit family members, finches, sparrows, starlings, magpies, gulls and other birds.

Pupils will need binoculars and a guide to birds. Working in groups, pupils should:

- Set a time to monitor birds on your school fields or another location with grass, trees and shrubs.
- Using their unaided eyes and the binoculars, spot how many of each bird they can see in 15 or 30 minutes, making sure not to double-count birds that move around.

Data

Pupils can present their data as tally charts and bar charts. They can repeat their survey at other times of year to see how species vary across the seasons. Pupils can think of other visitors to their school grounds, such as small mammals like mice, squirrels, foxes and badgers, and starting with the plants in your grounds, think of the food chains that might exist.

Food chains and webs

tudents can research other food chains or webs along the River Thames, or create new chains and webs using the following species in three habitats:

Upstream near the source:	In the City:	Downstream towards the sea:
Water mint	Micro-organisms	Reeds
Freshwater snail	Tubificid worm	Tentacled lagoon worm
Dace	Dunlin	Mullet
Kingfisher	Black-tailed Godwit	Harbour porpoise
Water vole	Wigeon	Dover sole
Lamprey	Atlantic salmon	Shellfish
Bat	European eel	European otter
Heron		Seal

Students can research these three habitats in more detail and describe their key features:

Are they freshwater, saline or does this change with the tides?
Is the river level constant or does it vary with the tides?
What is the riverbank like?
What is the riverbed like?
How fast does the water flow?

TUNNELWORKS
KS3 SCIENCE
CREST ACTIVITY

How can people help harbour porpoises thrive in the Thames Estuary?
CREST Bronze Research Project – Student Brief

What's the background?
The harbour porpoise is the smallest species of cetacean found in European waters. (Cetaceans are a type of marine mammal that also includes whales and dolphins.) It is commonly seen in coastal areas, although its range in Europe includes much of the North Sea. It is the commonest cetacean species in northern Europe and prefers shallow, cold waters.

In many places around Europe, harbor porpoise populations have declined or disappeared altogether. It is unclear exactly why this is happening but pollution, disturbance to its environment through activity and noise, reduced numbers of key fish species on which harbour porpoises feed, and entanglement in fishing nets all appear to play a role.

Your research challenge:
What conditions do harbour porpoises need in order to thrive in the Thames Estuary? What changes may have contributed to their decline, and what steps can be taken to manage this environment so their numbers will increase once more?

Some things to think about…
What do harbour porpoises feed on?
What food chains and webs are harbour porpoises members of?
Which of their food species are most at risk?
What conditions do their food species need in order to thrive?
How is human activity affecting populations of these food species?
What human activities might affect harbour porpoises?
How can we help each food species to thrive?
How can we reduce the impact of human activities?

Health and Safety
Before you carry out any experiment:
(a) find out if any of the substances, equipment or procedures are hazardous
(b) assess the risks (think about what could go wrong and how serious it might be)
(c) decide what you need to do to reduce any risks (such as wearing personal protective equipment, knowing how to deal with emergencies and so on)
(d) make sure your teacher agrees with your plan and risk assessment
NOTE: Your teacher will check your risk assessment against that of your school. If no risk assessment exists for the activity, your teacher may need to obtain special advice. This may take some time.
(e) if special tools or machines are needed, arrange to use them in a properly supervised D&T workshop.

How can people help harbour porpoises thrive in the Thames Estuary?
CREST Bronze Research Project – Teachers

The Tunnelworks CREST Introduction for Teachers provides important information you will need alongside this document.

Research question
What conditions do harbour porpoises need in order to thrive in the Thames Estuary? What changes may have contributed to their decline, and what steps can be taken to manage this environment so their numbers will increase once more?

Possible equipment, materials and resources
These will depend on the presentation format(s) chosen by the students. They might include:
- Internet and public library access for research
- Desktop publishing and slide presentation software
- A suitable audience, if students are to present their research.

Prompts
The student brief gives ideas to start students' thinking. Each one implies several items to research and students should identify these themselves. If necessary, use the prompts below to point students in suitable directions.

- What species of fish and shellfish live in the Thames Estuary?
- What do harbour porpoises eat?
- What do these fish and shellfish eat?
- How might commercial fishing affect fish numbers?
- How might commercial shellfish gathering affect their numbers?
- How does dredging for scallops affect the seabed?
- How might shipping and pleasure boating affect harbour porpoises?
- How can we manage commercial fishing?
- How can we manage shipping or pleasure boating?
- How might pollution enter the Thames Estuary?
- How does this pollution enter and rise up the food chain?
- How can we reduce this pollution?

Suggestions for supporting students
Students must research and select information for themselves and demonstrate their understanding and application of the information they have identified as relevant. However, they may need some direction from you to identify suitable sources of relevant information at an appropriate level.

Although Bronze Award students are not expected to have an official Mentor for their project, access to expert advice makes students feel their work is important. Also, if the topic is not in your area of expertise, you may find a Mentor valuable. Your CREST Local Coordinator may be able to suggest suitable contacts.

Depending upon the nature of the project, someone with knowledge and/or experience of meteorology or water management could be ideal.

If you live in Southwark, Wandsworth, Hammersmith or Newham, you may be able to access a Thames Water STEM ambassador who can help. Please contact education@tideway.london for further information.

Discuss with students how they will manage their time (after school clubs, working during lunch hours, homework). Agree a completion date with them.

Internet search

Harbour porpoise, Thames Estuary, Thames harbour porpoise survey, harbour porpoise threats, harbour porpoise protection, harbour porpoises fishing.