TUNNELWORKS
KS3 SCIENCE LESSON 4 (ESSENTIALS)
TEACHERS' NOTES

About this lesson

In this lesson students review their learning from lesson 1 and plan a survey to detect harbour porpoises in an Estuary. They review how the research team will use a hydrophone to listen for harbour porpoises before considering features of a 'good' survey that would return representative data for the area covered. Using safety and site information students review three survey options and identify some pros and cons of each approach, before selecting the best plan to suggest to the research team. Students see a map of where harbour porpoises were detected in March 2015 and suggest how to add to this data to give a better understanding of whether harbour porpoises live in the Thames Estuary throughout the year.

Learning outcomes

Students can:

- List some features of a good survey investigation
- Identify an appropriate survey plan, justifying their choice
- Suggest how to improve an initial survey to gather more data and give a more detailed understanding.

Curriculum links

KS3 Science

- Plan and design investigations and experiments to make observations and to test predictions
- Apply sampling techniques
- Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions.

What you will need

- KS3 Science porpoises lesson 4 presentation
- Lesson 4 worksheets

Preparation

It is helpful if students understand that 'sampling' is a way to survey populations of species in a small, representative area and use this data to suggest populations of these species over a wider, similar area. In the case of these vessel surveys, the 'sample' area is along the survey track. Review the lesson plan below and the KS3 Science porpoises lesson two presentation. Adapt the content to suit your students' ability, including whether you will ask students to design their own survey using the blank chart.

Time (60 mins)	Teaching activity	Learning activity	Assessment for learning
10 mins	**Starter:** Invite students to work in pairs and recall key facts about harbour porpoises. Show **slide 1**. Ask students to recall how sampling can help determine populations of a species (how many there are) in a large area, by looking carefully at how many there are in a small area. Ask students to imagine they need to sample the worms and other invertebrates in your school field. How might they do this? **Whole class:** Review students' ideas about sampling.	Students discuss key facts in pairs and share. Students agree a definition of sampling and examples of how sampling might be used. Students outline an investigation to sample invertebrates in your school field, thinking about how to find and count, how many sites to sample, how to make sites representative of the whole field.	Recall, discussion, questioning. Discussion, questioning. Suggestions, questioning, discussion.
10 mins	**Individuals or pairs:** Ask students to consider some limitations to sampling and come up with a quick list of good practice ideas. Discuss their ideas. Using the invertebrates sample idea from above, consider what limitations there might be to sampling and how to ensure a sample is properly representative. For example, consider how a sample is a snapshot in time. How might invertebrate populations change over the year? Would a survey in a school flowerbed reflect the number and type of invertebrates in the field? Discuss how the chosen sample areas must be representative.		

Time (60 mins)	Teaching activity	Learning activity	Assessment for learning
10 mins	**Whole class:** Show **slide 2**. Explain that the survey of harbour porpoises will seek to be representative of the Thames Estuary area. Show **slides 3 and 4** and watch the video and animation. Ask if it's feasible to fully record all the porpoises in the Thames Estuary. Guide students to recall that the hydrophone has a 300m range – could a boat easily patrol the whole area? Elicit that this is a good candidate for sampling. Help students identify that the boat could travel in lines 600m apart and have a good chance of detecting all harbour porpoises nearby.	Students review estuary map. Students watch video, paying attention to key facts in the animation. Students could sketch a diagram to show why boat tracks could be 600m apart but still detect all harbour porpoises.	Interpretation of map. Recall, questioning, discussion. Written work.
20 mins	**Individuals or pairs:** Show **slide 5** and briefly review the survey area. Hand out the lesson two worksheet. Students complete Task 1. Ask pairs to discuss each plan and identify some pros and cons about each one, before choosing what they think is the best plan. **Whole class:** Share ideas, pros and cons. Ask students to suggest the best plan. Show **slide 6** and discuss why plan C may be the best plan to suggest to the research team.	Students identify some pros and cons of each plan and choose the best. Students give reasons for why one plan may be better than the others.	Written work, discussion, questioning. Questioning, discussion.
10 mins	**Plenary:** Show **slide 7**. Ask students to think back to your earlier discussion about sampling. What could the research team do to improve their understanding of harbour porpoises in the Thames Estuary?	Students suggest ideas: more coverage; detailed surveys in some areas; returning at different times of year etc.	Questioning, discussion.

Differentiation

Easier	Harder
Sketch a diagram to show clearly how the boat could make sweeps 600m apart and detect any harbour porpoises in the area. Ask students to generate a list of criteria for a good plan (coverage, ease of navigation, no shallow water, no obstructions etc.) Discuss and list on your board. Ask students to compare the three existing plans against these criteria.	Ask students to consider cost and time implications of each plan (salaries, boat fuel etc.). Ask students to plan and draw their own survey route instead of comparing the three suggestions. Share ideas and choose the best suggestion from the class.

Answers

Plan C may be the best survey plan.

- It stays well clear from obstructions or hazards.
- It covers the area well so would be representative, even if the tracks may be a little over 600m apart.
- It does not go into shallow areas.
- It is easier to steer and navigate than other plans.
- It may be quicker to complete due to its simplicity.

Plan A delivers good coverage of the area but heads into shallow water – the hydrophone may be damaged here. The route may be more complex to navigate accurately, and near the wreck the tracks almost overlap. The research team would need to discard data here so they don't 'double count' any porpoises.

Plan B doesn't cover all of the area so could miss porpoises in areas not covered. The route passes by or could even hit one of the obstructions. The tracks are closer together than 300m so create lots of overlaps. This isn't efficient and could also 'double count' porpoises if the research vessel passes by them twice.

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SURVEY PLANNING

Students could play the role of planner for the survey and:
- Use the scale to estimate the distance travelled for each plan
- Estimate the cost of the survey at £100 per hour for the boat plus £50 per hour for the skipper and £25 per hour for three researchers.

Students could apply their ideas and complete a simple sampling survey in your school grounds. They can plan their survey so it includes a number of representative sampling sites, a survey to map and find the area coverage of the whole site, use fieldwork techniques to gather and organise data and then use a spreadsheet to estimate species populations for the site.

Ideas could include:
- Worms and other invertebrates in your fields or flowerbeds
- Plant species (dandelions or daisies)
- Bird visitors
- Butterflies and other flying insects.

What you will need:
- KS3 Science porpoises lesson 4 presentation
- Lesson 4 worksheets

Song of the Whale

Encourage your students to consider the survey vessel Song of the Whale as a scientific instrument.

A fact sheet with information about the vessel is attached.

Questions the students could consider include:
- What is a scientific instrument?
- What makes the Song of the Whale different from a leisure vessel?
- How important are the skills and expertise of the crew in operating the vessel?
- What might affect how efficient the vessel is as a research tool?
- Choose another scientific instrument e.g. a microscope or Bunsen burner and compare it to the Song of the Whale.
  - What do they have in common?
  - What is different?
  - How do each support scientific research and experimentation?

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R/V Song of the Whale

R/V Song of the Whale is a purpose built 21 m steel hulled research vessel, suited to work in both coastal and offshore environments and able to work in any ocean around the world. As one of the quietest marine research vessels in the world, SOTW operates with minimal disturbance to marine life, due to numerous design features, such as a five-bladed propeller and vibration-dampening mounts on the engine. SOTW is an environmentally conscious survey platform, the vessel sails when possible (low carbon, as well as acoustically quiet), can comfortably remain offshore overnight and for extended periods during surveys, and generates electricity from wind turbines, remaining self-sufficient for over a month, if necessary. As the vessel was designed with our research in mind it has a number of unusual features including two outriggers for towing hydrophone (microphone) arrays, an 11 metre high crow's nest and an elevated A-frame which provides a 5 metre eye-height for visual surveying, and a dedicated computer/communications room for acoustic detection and data logging.

Facts about the vessel:

- Length: 21.53m
- Beam (width): 5.6m
- Draft (how deep the bottom of the boat is): 3m
- Registered Tonnage (how heavy the boat is): 51.58
- Sleeps 10-12 people
- Has 2 'heads', or toilets aboard
- Has its own workshop for repairs out at sea, called the Lazarette
- Carries two small inflatable boats, or zodiacs, for deploying equipment and to allow trips ashore
- Operating speed under power: 6.5 kts, maximum speed 9.5 kt