With thanks to

The Julia and Hans Rausing Trust

University of Southampton

Catalyst

Resource 3: Maritime archaeology - challenges

Teacher / leader notes

Age: 10-14 years old

Summary

This resource provides ideas and background information for teachers / leaders wishing to task their students to solve some of the challenges the Black Sea Maritime Archaeology Project team faced on the expedition.

Aims of the activities

To develop:

- an understanding of how an expedition team have to employ all their skills, experience and creativity, and the available equipment to respond to challenges
- curriculum areas: changes over time, climate change, scientific enquiry, working scientifically
- skills: problem solving, innovation, investigation, measuring.

Key terms:

Innovation, problem solving, investigation

Background information

The Black Sea Maritime Archaeology Project (BSMAP) was a three-year expedition researching ancient coastlines and the seafaring history of the Bulgarian Black Sea. The expedition team faced a series of challenges at sea.

Black Sea MAP linked to learning

The conditions could be very tricky. The depths of shipwrecks of up to 2000m were too deep for divers to work on the sea bed. The pressure changes of gases in the body during descent and ascent can cause serious injury at greater depths.

The Black Sea contains a mixture of salty sea water and freshwater from rivers. Sea water is more dense than the fresh water that flows in from rivers. The sea water sinks, forming a layer of water with little oxygen in it, described as 'anoxic'. Life can rarely survive in this deeper layer, so there is little decay of any wooden structures such as shipwrecks.

Objects found on the shipwrecks may have been under the sea for over 2000 years. They absorb salt water whilst submerged. Once brought to the surface, objects will begin to decay and disintegrate quickly. Water fills cells in the wood and when they dry out rapidly they shrink, crack and distort. Salt is worse as it forms crystals. The salt water must be removed gradually by reducing the salt concentration by mixing with greater concentrations of fresh water so the objects don't crack. Preservation is a long and expensive process.

Ideas for student activities

Film 3 explores challenges the team faced whilst out on their research expedition. Pauses in the film can be used to discuss how the problem could be solved or to investigate a similar problem.

Running the activities

a) Measuring accurately

The team find an ancient transport vessel, an amphora. It is partly buried, making it hard to estimate how large or heavy it is. The team want to bring the amphora up to the surface. To do this safely they need to know the exact dimensions of the object.

1. Watch Film 3. Pause the film at the problem of recording the amphora accurately (prompt at 01.29 minutes)

   i. Host a discussion about measuring accurately:
   - Why do the team need to know the exact measurements of the amphora?
     - Knowing the exact size, the team can make calculations of how best to lift the amphora from the sea bed.
   - What measurements do they need to calculate the size of the amphora?
     - The team need to know the length and width of the amphora.
   - How do you suggest the team try measuring the amphora?
     - The ROV's laser scanner provided accurate measurements.
   - What could the amphora have been used for in the past?
     - Amphoras were used to transport dry foods and liquids, commonly olive oil, wine or fish paste.

   ii. Students can practice measuring skills using one of these resources (please note Black Sea MAP is not responsible for the content of the following sites):
   - NRICH collection of STEM resources based around the topics of length, area and volume (bit.ly/nrichSTEM)
   - TES measurement activities (bit.ly/TESmeasure)
   - BBC KS3 Bitesize (bit.ly/BBCmeasure)
   - STEM Learning hosts resources on a wide variety of STEM subjects (Free registration is required for this site) (bit.ly/STEMresource)
   - NRICH resources for a younger (KS1) audience (bit.ly/nrichKS1).

2. Continue the film to see how the team solved their problem.

b) Design a grabber

The team are unable to lift the heavy amphora. The ROV grabber shape is not fit for the task. How could the grabber be improved?

1. Watch Film 3. Pause the film at the problem of lifting the amphora (prompt at 02.26 minutes). You can:
   i. Host a discussion about the grabber.
   - Why is the existing design not suitable?
     - The amphora is too heavy for the ROV grabber to lift it without damaging it.
   - How could it be improved?
     - Opportunity for open discussion about improvements.
   - What do you think the team did next?
     - Opportunity for open discussion.

ii. Use 'Design a grabber' from the STEM Learning Polar Explorer Resources page 19 (bit.ly/STEMPolar) All materials are listed in the resource.

2. Continue the film to see how the team solved their problem.

c) Preservation

The team bring the amphora up onto the boat. The conditions at the bottom of the sea are very different to those onboard. The team need to preserve and protect the amphora.

1. Watch Film 3. Pause the film at the problem of preserving the amphora (prompt at 04.19 minutes). You can:
   i. Host a discussion about the preservation.
      - What might happen to the amphora if it is left on the deck?
        - Ceramics removed from the sea are saturated with salt water. If the ceramic dries in air without treatment, the salt will crystallise, expanding and cracking the amphora.
      - What environmental factors will affect the amphora?
        - Light, oxygen in the air or temperature fluctuations.
      - Should objects found by archaeologists be taken to a museum?
        - Opportunity for open discussion.

   ii. Students can learn more about artefacts and why they are important using ones of these resources (please note Black Sea MAP is not responsible for the content of the following sites):
      - TES artefacts activities (bit.ly/TESartefacts)
      - Young Archaeologist's Club (YAC) activity on packaging artefacts (bit.ly/YACartefacts)
      - BBC 'Hands-on history' resources (bit.ly/STEMdig).

2. Continue the film to see how the team solved their problem.

Longer investigations

The team were faced with many other challenges. The following scenarios can stimulate discussion activities or longer investigations.

Your format could be e.g: week 1 computer research lesson; week 2-3 design / problem solve; week 4-5 plan and presenting work.

Why not invite a STEM Ambassador to see the student presentations and give feedback? (Request a STEM Ambassador through online at bit.ly/STEMamb

Why not enter projects for a CREST discovery award? (bit.ly/CRESTdisc)

Scenarios for longer investigations

a) Plastics at sea

The team were sad to note plastic pollution. Plastic bags could be seen in the water and on the seas bed, even attached to the deepest of shipwrecks. Plastic pollution is a huge problem in the sea and can be found around the globe. Different materials degrade at different rates depending on the environment. For example, a plastic bottle can take 450 years to break down; a newspaper may take six weeks.

- Investigate artefacts washed up on a beach or observe what sorts of material you have in your household waste that we use and discard. Group these by material and research how long these would take to biodegrade. Question what these items are or came from. Can you group them into categories such as 'tools' or 'containers'? How does this indicate about the way we live today?
- Which materials biodegrade and how could you test this? What items may be preserved from the past?

Useful resources

- Dissolving sea shells in vinegar: Polar Explorer Resources - page 42 of resource pack (bit.ly/STEMPolar)
- The Pacific Ocean and plastic pollution with Jo Royle hosted by STEM Learning (bit.ly/STEMplastics)

b) Sea-level change

When glacial ice melted after the last Ice Age sea levels around the world rose. The Black Sea was once a low-level freshwater lake but after the glacial melt, water broke through the Bosphorus Strait from the Mediterranean Sea. This raised the level of the lake. The denser salt water now sits at the bottom of the sea with an upper layer of fresher water continually replaced by rivers.

⟶ Investigate the effect of glacial melts by modelling the melt and layering of fresh and salt water.
⟶ Produce a short, narrated film (using phones / cameras) using your model to explain what might have happened around the Black Sea as the climate warmed. What effect might this have had on the sea and its wildlife?

Useful resources

- Current sea-level rise (How the arctic is changing): Polar Explorer Resources (page 102 of resource pack) for starter ideas. (bit.ly/STEMPolar)
- Salty seas: Polar Explorer Resources (page 99 of resource pack).
- Watching a glacier: Polar Explorer Resources (page 34 of resource pack).
- Catalyst article 'Water in the oceans' (bit.ly/STEMoceans)
- STEM Learning hosts resources on a wide variety of STEM subjects. (Free registration is required for this site). (bit.ly/STEMresource)

c) Organisms attracted by light

During the investigation of a shipwreck, the site was suddenly swarmed with fish. The ROV pilots had to switch off the lights and wait for the fish to leave the area. Eventually they could turn them back on to continue their study.

⟶ Investigate how light attracts organisms such as invertebrates.

Useful resources

- Nuffield Foundation Practical Biology (bit.ly/NuffieldBio)

d) Electrics at sea

Using technology under the water can be dangerous. Electrical current can be carried through salt water. If salt water gets into equipment it must be fixed on the ship before it can be used again.

→ Investigate how the resistance of water changes as salt is added.
→ Design and test a waterproof casing for an underwater camera.

Useful resources

- Salty science in Just add water, hosted by STEM Learning (bit.ly/STEMwater)
- Teach Engineering hands-on activity: Salt water circuit (bit.ly/TeachSalt)