Coordinator Notes: Module 2.3 Water – Ocean Properties

This Module explores some of the interesting science within our oceans!

- Students will learn there are 5 major ocean areas in the world, and the difference between oceans and seas.
- Students will build on knowledge of water properties and fluid dynamics from previous modules. Experiments in Module 2.3 explore the science of water currents, water density, water temperature and floating (buoyancy forces).
- Students will explore why ships float, and how submarines sink.
- Students will use knowledge gained to build and test their own submarine!

Session Length:

This Module can be presented in different session durations per your needs.

Lesson plans are provided for:

- A 120 minute session, or, 2 x 60 minute sessions
- 45 minute, 75 minute, and 90 minute sessions

Technology:

PowerPoint: If you do not have access to a data projector and cannot display the PowerPoint presentation, we recommend that you print the most important slides before the session, and either enlarge them onto cardboard to use in place of slides, or create a booklet that students can share in small groups. The most important slides have been included as a 'Reduced Slides' PowerPoint file, and an easily printable pdf version of these slides is also provided. If you choose this option, we recommend that you still read and use the slide notes included in the full PowerPoint for the session.

The session can be conducted without slides all together, but they offer visual aid in explanation of scientific concepts. We recommend at the very least that instructions for each experiment are printed for the students.

Videos links: The suggested links to online videos within the session can be helpful with explanation. Notes have been included in the slides if there is an essential component to a video which the facilitator should discuss or demonstrate, if the video cannot be played.

Video files: A video file for each Module has been provided to aid explanation and instruction for some experiments and challenges. It is recommended coordinators view video files prior to delivering sessions, if the experiments and challenge activities are unfamiliar.

Please read the Module 2 Risk Assessment before proceeding with the session

Contents	Page

Module 2.3 Water – Ocean Properties: Overview

Begin the session by exploring what students already know about oceans. Have students visited a beach, have they swum in an ocean?

Encourage students to share what they know. Encourage students to use the scientific method (introduced in Module 1) to form hypotheses for their experiments in Module 2.

Content overview:

Concept / Activity	Session Duration (minutes)			
	120	90	75	45
Oceans of the World Explore with students how vast the world's oceans are, introduce the difference between oceans and seas.	*	*	*	*
Experiment E2.3.4 Float or Sink – Salt Content A quick experiment to explore which objects float and sink, and, to discover differences between fresh water and salt water.	*	-	-	-
Ocean Movements Introduce the ways oceans move. We see waves at the surface, below the surface there are currents, and along the coast, tides.	*	*	*	-
Ocean Currents Discuss the important role currents play in our oceans. Introduce the concept of surface and underwater currents.	*	*	*	-
Experiment E2.3.1 Water Density – Temperature An exciting hands on experiment, exploring how warm and cold water interact and mix. Relate back to ocean currents.	*	*	*	-
Water Density – Temperature Introduce the concept of 'density' and explore how cold and warm water densities are different. Revisit matter/molecules.	*	*	*	-
Experiment E2.3.2 Water Density – Salt Content An exciting hands on experiment, exploring how fresh and salty water interact and mix.	*	*	*	-
Water Density – Salt Content Reinforce the concept of 'density' and explore how fresh and salty water densities are different. Relate back to ocean currents.	*	*	*	-
Ocean Transport Discuss how the ocean is an important mode of transport and also a major source of food for the planet.	*	*	-	-
The Science of Floating Explore ideas for how heavy ships can float. Introduce the concept of buoyancy force, and Archimedes' Principle.	*	*	*	*
Experiment E2.3.3 – Buoyancy An exciting hands on experiment, exploring buoyancy and Archimedes Principle.	*	*	-	-

Submarines Explore ideas for how submarines can both float and sink. Introduce the concept of ballast material for density and stability.	*	*	*	*
Submarine Challenge Explores water density and buoyancy, providing free exploration time to explore floating and sinking.	*	*	*	*

Slides:

PowerPoint Slides are available to support the delivery of this module. Slides explain concepts visually, and include short, engaging videos relevant to the topic. A full list of slides and recommended inclusions for each session duration are provided in the table below. Appropriate slides are also noted in lesson plans for each duration.

PowerPoint Presentation: 'M 2.3 - Master Slides 120 minute Session Duration'		**Session Duration (minutes)**			
Slide	**Content**	**120**	**90**	**75**	**45**
1	Introductory title page for Module 2.3	*	*	*	*
2	Prompt slide – discussion on what we already know about oceans?	*	*	*	-
3	Ocean Fact or Fiction (3 facts to explore as true or false)	*	*	*	-
4	Prompt slide – discuss the difference between oceans and seas. Explain different oceans surround Australia.	*	-	-	-
5	Map of the Pacific and Atlantic Oceans	*	-	-	-
6	Map of the Indian and Arctic Oceans	*	-	-	-
7	Map of the Southern Ocean, image of frozen sea-ice	*	-	-	-
8	Experiment 2.3.4 outline, Float or Sink (salt water)	*	-	-	-
9	Prompt slide – discuss ocean movements: waves, currents, tides	*	*	*	-
10	Prompt slide – explains ocean currents in more detail	*	*	*	-
11	Experiment 2.3.1 outline, Water Density (temperature)	*	*	*	-
12	Prompt slide – explains temperature and water density	*	*	*	-
13	Experiment 2.3.2 outline, Water Density (salt content)	*	*	*	-
14	Prompt slide – explains salt content and water density	*	*	*	-
15	Prompt slide – discuss the ocean as a transport mode	*	*	-	-
16	Prompt slide – discuss ideas for how heavy ships float	*	*	-	*
17	Prompt slide – outlines buoyancy force, displacement	*	*	*	*
18	Experiment 2.3.3 outline, Float or Sink (buoyancy)	*	*	-	-

19	Prompt slide – outlines Archimedes Principle, reinforces buoyancy and displacement	*	*	-	-
20	Prompt slide – discuss how submarines both float/sink	*	*	*	*
21	Prompt slide – outlines submarine design, introduces ballast	*	*	*	*
22	Introductory slide for C2.3 Submarine Challenge	*	*	*	*
23	Overview of Challenge aims and scoring	*	*	*	*
24	Outline of Challenge Rules	*	*	*	*
25	Outline of Challenge Design Tips	*	*	*	*
26	Video – Air Powered Submarine Demonstration	*	*	*	*
27	Air Submarine Design Idea	*	*	*	*
28	Air/Balloon Submarine Design Idea	*	*	*	*
29	Baking Powder Submarine Design Idea	*	*	*	*
30	References	*	*	*	*

Module 2.3 Water – Ocean Properties
Lesson Plan
120 minute session or 2 x 60 minute sessions

High Tech: Use PowerPoint Presentation 'M2.3 - Master Slides'
Low Tech: Print PowerPoint 'M2.3 - Reduced Slides for Printing'. Use slide notes from the ENTIRE 120 minute presentation, adapting discussion to cover omitted slides.

Key Learning Area			**Topic**
Physics, Chemistry, Physical World			Ocean Properties, Water Density, Fluid Dynamics
Timing	**Running Time (hh:mm)**	**Procedure**	**Materials**
5 min	00:05	**Lesson Introduction** Welcome. Brainstorm: What do we know about Oceans? Ocean Fact or Fiction?	PowerPoint M2.3 (slides 1-3)
		Body of Lesson **(Lesson 1, 2 x 60 minute sessions)**	
5 min	00:10	Explore how vast the world's oceans area, note the difference between an ocean and a sea. Highlight the 5 ocean regions.	PowerPoint M2.3 (slides 4-7)
10 min	00:20	Discuss hypothesis, conduct Experiment 2.3.4 Float or Sink (salt content) and discuss results	PowerPoint M2.3 (slide 8) Cups, trays, paper towel, soap, water, salt, food colouring, spoons, small objects
5 min	00:25	Explore ocean movements: waves, currents tides. Discuss importance of currents, introduce types and causes of currents.	PowerPoint M2.3 (slides 9-10)
13 min	00:38	Discuss hypothesis, conduct Experiment 2.3.1 Water Density (temperature) and discuss results	PowerPoint M2.3 (slide 11) Cups/jars, plastic cards, trays, food colouring, spoons, warm water and cold water
2 min	00:40	Discussion about water density and temperature. Recap matter and molecules (Module 2.1)	PowerPoint M2.3 (slide 12)

13 min	00:53	Discuss hypothesis, conduct Experiment 2.3.2 Water Density (salt content) and discuss results	PowerPoint M2.3 (slide 13) Cups, straws, food colouring, salt, spoons, markers, paper towel, water
2 min	00:55 / 1 HOUR	Discussion about water density and salt content. **(Break for 2 x 60 minute sessions)**	PowerPoint M2.3 (slide 14)
		Body of Lesson **(Lesson 2, 2 x 60 minute sessions)**	
3 min	00:03 / 01:03	Brainstorm: What do we transport across our oceans? How do heavy ships stay afloat?	PowerPoint M2.3 (slides 15-16)
2 min	00:05 / 01:05	Discuss the science of floating, introduce concepts of buoyancy force, displacement.	PowerPoint M2.3 (slide 17)
10 min	00:15 / 01:15	Discuss hypothesis, conduct Experiment 2.3.3 Float or Sink (Buoyancy) and discuss results	PowerPoint M2.3 (slide 18) Tubs, water, aluminium foil, marbles, paper towel
3 min	00:18 / 01:18	Recap buoyancy / displacement, explain Archimedes' Principle	PowerPoint M2.3 (slide 19)
2 min	00:20 / 01:20	Brainstorm: How do submarines sink and float? Explain how submarines submerge and rise.	PowerPoint M2.3 (slides 20-21)
5 min	00:25 / 01:25	Introduce challenge activity and explain materials and rules. Watch Air Submarine video. (If video unable to be played, coordinator should watch prior to the session).	PowerPoint M2.3 (slides 22-29)
10 min	00:35 / 01:35	Form groups and encourage students to design submarines.	Design Planning Sheet M2.3

10 min **10 min**	00:45 / 01:45 00:55 / 01:55	Support students to build and test submarines. Support groups to undertake testing and scoring	Plastic bottles, rubber bands, paper clips, marbles, straws, plastic tubing, paddle pop sticks, balloons, baking powder, scissors, water proof tape, Styrofoam / polystyrene, bubble wrap, modelling clay, butter knives (ballast), cotton balls. Water tubs, water. Scoresheet M2.3
5 min	01:00 / 02:00 END.	**Lesson Conclusion** Clean up. Discussion about the session, submarine designs were effective.	

Module 2.3 Water – Ocean Properties: Experiments

E2.3.1: Water Density (Temperature)

Aim: To observe what happens when warm water meets cold water.

Materials (per group):

- 4 clear jars (or cups) with the same sized openings
- 1 plastic card (or 2 pieces cardboard) larger than the cup/jar
- 1 shallow tray
- Red and blue food colouring
- 2 spoons
- Warm and cold water (enough to fill all 4 jars/cups)

Procedure:

1. Break into groups and collect materials.
2. Fill 2 jars with warm water, and 2 with cold. Make sure each jar is filled right to the brim.
3. Add blue colouring to the cold jars, and red colouring to the warm jars. Stir the colours in with the spoons.
4. Part A: Place a red (warm water) jar onto the tray. Make sure it is full right to the brim.
5. Place the plastic card on top of a blue (cold water) jar. Holding the card in place, slowly turn the jar upside down - the card should stop any water from escaping.
6. Now place the upside down blue jar and card carefully on top of the red jar in the tray.
7. Make sure that the jar brims line up exactly, and then, gently pull the card out from between the jars.
8. Observe what happens and record your results.
9. Part B: Repeat the experiment, but this time, start with a blue (cold water) jar on the tray, and place a red (warm water) jar and card on the top.
10. Observe what happens!

Expected Result:

Part A: The cold (blue) water sunk and mixed into the warm (red) water, because the cold water has a higher density than the warm water.

Part B: The warm water (red) stayed above the cold (blue) water, because it has a lower density.

Explanation:
Warm water has a lower density than cold water. When the warm water is on top, it floats above the more dense cold water. When the cold water is on top, it flows downward and the warm water moves upward causing the water molecules to mix. The addition of food dye helps us to visualise this phenomenon.

Note: This experiment is included in the Module 2 Video

E2.3.2: Water Density (Salt Content)

Aim: To observe what happens when fresh & salt water meet.

Materials (per group):

- 4 clear cups
- 1 clear straw per student
- Red, yellow, and green food colouring
- Salt (3 tablespoons)
- 1 spoon, 1 marker, paper towel.
- Water (approx. 450ml)

Procedure:

1. Break into groups and collect materials.
2. Label 3 jars: "0", "1" and "2", and fill them evenly with water. Leave the 4th cup empty.
3. Add red colouring into jar ''0'" and stir to mix.
4. Add yellow colouring and 1 tablespoon of salt into jar "1". Stir to mix.
5. Add green colouring and 2 tablespoons of salt into jar "2". Stir to mix.
6. Place one end of the clear straw approx. 1cm into the red water in jar "0". Place your thumb over the top of the straw, then lift the straw out of the jar. Red water should stay in the straw.
7. Next, sink the water filled end of the straw approx. 2cm into jar "1". Quickly lift your thumb up, then place it back over the top of the straw. Lift the straw out of the jar. Observe.
8. Next, sink the water filled end of the straw approx. 3cm into jar "2". Quickly lift your thumb up, then place it back over the top of the straw. Lift the straw out of the jar.
9. What do you see?
10. What happens if you vary the cup order, or, the change the depths you sink the straw?

Drain the water filled straws into the empty 4th cup.

Expected Result:

The coloured water will remain separated into layers in the straw. The red water will be at the top, the yellow in the centre and the green at the bottom.

Explanation:

Density is a measure of how tightly packed together matter is inside a substance. Salt water and fresh water have different densities.

Fresh water only contains water molecules! Salt water contains a mixture of both water molecules and salt. The salt adds more matter to the water, increasing its density, and making it heavier than fresh water.

Note:

- ***Be aware of potential allergies to salt.***

E2.3.3: Float or Sink (Buoyancy)

Aim: To observe Archimedes' Principle

Materials (per group)

- 1 tub or large bowl (at least 6L capacity)
- Aluminium foil (approx. 30cm x 30cm) per student
- 10 - 20 marbles
- Paper towel
- Water (approx. 3L per tub)

Procedure:

1. Pour the into the tub bowl, filling over half way.
2. Gently place one marble onto the surface of the water. Let go.
3. Observe.
4. Remove the marble from the water.
5. Fold the aluminium foil into a boat like shapes. Gently place the 'boats' onto the surface of the water. Let go.
6. Observe. Which shapes float?
7. Place one marble onto a floating aluminium foil boat.
8. Observe.
9. Continue adding marbles onto the boat. How many can you add?

Expected Result:

The marble will sink. The aluminium foil will float, when folded into a boat shape. The aluminium foil boat will be able to support the weight of one marble, and will remain floating as more marbles are added. The boat will sink if and when the weight of the marbles exceeds the buoyancy of the boat.

Explanation:

Archimedes is an Ancient Greek scientist, who observed that when an object is placed in water, it pushes enough water out of the way to make room for itself. This is called 'displacement'.

Archimedes Principle: Tells us that when an object enters the water, two forces act on it, a downward force (gravity) that is determined by the objects weight, and the upward force called buoyancy, determined by the weight of the water displaced (or pushed aside) by the object. Whichever force is greater, determines whether an object sinks or floats!

This is why a marble will sink. The marble is heavy, but it is also very dense and small in size. It only displaces a little bit of water. It sinks because its weight is greater than the weight of the small amount of water it displaces.

However, a big ship can float, even though it weighs a lot, because it displaces a huge amount of water (that weighs even more than the ship!). Ship shapes are carefully designed so that they will displace enough water to float easily. By having a hull, or base, that has a large surface area, a big amount of water can be easily displaced. Curved hulls create even more area, and greater buoyancy.

E2.3.4: Float or Sink (Salt Content)

Aim: To observe how objects float in fresh and salt water

Materials (per group):

- 2 cups
- 1 tray / paper towel
- 1 small piece of soap (able fit into the cups, without touching the sides)
- 300ml water
- ¼ cup salt
- Food colouring, a spoon
- Other objects for testing (e.g. Lego, marbles, paper clips, cork, lids, toothpicks)

Procedure:

1. Place both cups onto the tray / paper towel.
2. Fill both cups evenly with water.
3. Add a drop of food colouring and the salt to one cup, stir to mix well.
4. Place the soap carefully into the cup without the colouring (fresh water).
5. Observe.
6. Remove the soap.
7. Next, place the soap into the cup with the colouring (and the salt).
8. Observe. Document your results!
9. What other objects could you test?

Expected Result:

The soap piece will sink in fresh water, and float in salt water.

Some of the other objects may float in both fresh and salt water. However, more objects are likely to float in salt water, than in fresh water.

Explanation:

Density is a measure of how tightly packed together matter is inside a substance. Salt water and fresh water have different densities. Fresh water only contains water molecules! Salt water contains a mixture of both water molecules and salt. The salt adds more matter to the water, increasing its density, and making it heavier than fresh water.

The soap piece is denser than fresh water, but less dense than salt water, so it sinks in the fresh water and floats in the salt. Lower density objects will float on higher density liquids.

Note:

- ***Be aware of potential allergies to soap and salt.***

Challenge M2.3 - Submarine Challenge

Coordinator Notes

Scoring:

A scoring mechanism is included, so the element of 'competition' may challenge all students to participate to their fullest. You may remove the scoring system all together if it does not work with your group of students.

When scoring it is important to only announce the highest score - so there will be no 'losers' or last place. It is important to highlight the good teamwork and strategies of each group.

Consider asking students how they might approach the task differently if asked to do it again, or how they might teach the same things they learned during the club to a younger student.

**** If you choose not to use a scoring system modify the slides that reference a 'score'****

Activity Notes:

- If this challenge is completed inside, ensure a towel and / or newspaper are placed underneath and around the water tub(s).
- During the construction period, allow students to test their submarine in the water tub(s) as much as desired.
- Spilt water must be cleaned up straight away. Encourage students to keep the area safe and puddle free.
- Baking powder is to be used, NOT baking soda. Baking soda will not create the submarine effect. It is optional and does not need to be used as part of the design!
- This activity is intended for the students to be creative with their submarine design and to use the provided examples as guide. There are no right or wrong designs.
- If materials are available, students may prefer to work individually, or in pairs.
- The submarine's body will be made out of a plastic bottle. In order for the submarine to be submerged, it will require weights. Weights can be water, coins, paper clips or anything else suitable.

Suggested rules / guidelines:

- The submarine must be able to float.
- The submarine must be able to sink.
- A section inside of the submarine needs to stay dry! A cotton bud will be placed in this section, to test how dry it remains.
- Team members cannot use their hands to submerge the submarine! It must be able to sink by design, not force.
- Extra points for:
    - If the submarine can come back to the surface after submerging!
    - If the submarine can be moved forward and / or steered!

Planning Sheet M2.3: Submarine Challenge

To design your submarine, keep in mind:

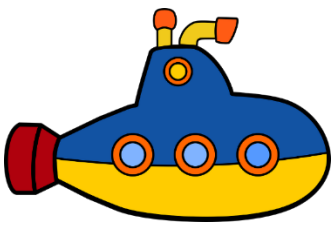
SIZE & SHAPE – Does the size and shape of the submarine change how it will float, or sink?

WEIGHT – How heavy will your submarine be? Will it float?

BALLAST – Will you add ballast to stabilise your submarine?

MOVEMENT – What could you add to make a propeller and make your submarine move underwater?

Thinking about these concepts, sketch ideas for your submarine design below!



Score Sheet: M2.3 - Submarine Challenge

- Note: Minimum score = 15 points. Maximum score = 40 points.

Team, Individual or Submarine Name					
Does the submarine float? Yes = 10 points No = 5 points **(A)**	**Does the submarine sink?** Yes = 10 points No = 5 points **(B)**	**Is there a dry area inside?** Yes = 10 points No = 5 points **(C)**	**Bonus Points: Can the submarine float after sinking?** Yes = 5 points **(D)**	**Bonus Points: Can the submarine be propelled or steered?** Yes = 5 points **(E)**	**Total Points** **(A+B+C+D+E)**

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Module 2.3 Water – Ocean Properties
Lesson Plan

90 minute session

High Tech: Adapt PowerPoint Presentation 'M2.3 - Master Slides', hide slides:.4, 5, 6, 7
Low Tech: Print PowerPoint 'M2.3 - Reduced Slides for Printing'. Use slide notes for the ENTIRE 90 minute presentation, adapting discussion to cover omitted slides.

Key Learning Area			**Topic**
Physics, Chemistry, Physical World			Ocean Properties, Water Density, Fluid Dynamics
Timing	**Running Time (hh:mm)**	**Procedure**	**Materials**
5 min	00:05	**Lesson Introduction** Welcome. Brainstorm: What do we know about Oceans? Ocean Fact or Fiction?	PowerPoint M2.3 (slides 1-3)
		Body of Lesson	
5 min	00:10	Explore ocean movements: waves, currents tides. Discuss importance of currents, introduce types and causes of currents.	PowerPoint M2.3 (slides 9-10)
10 min	00:20	Discuss hypothesis, conduct Experiment 2.3.1 Water Density (temperature) and discuss results	PowerPoint M2.3 (slide 11) Cups/jars, plastic cards, trays, food colouring, spoons, warm water and cold water
3 min	00:22	Discussion about water density and temperature. Recap matter and molecules (Module 2.1)	PowerPoint M2.3 (slide 12)
10 min	00:32	Discuss hypothesis, conduct Experiment 2.3.2 Water Density (salt content) and discuss results	PowerPoint M2.3 (slide 13) Cups, straws, food colouring, salt, spoons, markers, paper towel, water
2 min	00:35	Discussion about water density and salt content.	PowerPoint M2.3 (slide 14)

3 min	00:38	Brainstorm: What do we transport across our oceans? How do heavy ships stay afloat?	PowerPoint M2.3 (slides 15-16)
2 min	00:40	Discuss the science of floating, introduce concepts of buoyancy force, displacement.	PowerPoint M2.3 (slide 17)
10 min	00:50	Discuss hypothesis, conduct Experiment 2.3.3 Float or Sink (Buoyancy) and discuss results	PowerPoint M2.3 (slide 18) Tubs, water, aluminium foil, marbles, paper towel
3 min	00:53	Recap buoyancy / displacement, explain Archimedes' Principle	PowerPoint M2.3 (slide 19)
2 min	00:55	Brainstorm: How do submarines sink and float? Explain how submarines submerge and rise.	PowerPoint M2.3 (slides 20-21)
5 min	01:00	Introduce challenge activity and explain materials and rules. Watch Air Submarine video. (If video unable to be played, coordinator should watch prior to the session).	PowerPoint M2.3 (slides 22-29)
5 min	01:05	Form groups and encourage students to design submarines.	Design Planning Sheet M2.3
10 min	01:15	Support students to build and test submarines.	Plastic bottles, rubber bands, paper clips, marbles, straws, plastic tubing, paddle pop sticks, balloons, baking powder, scissors, water proof tape, Styrofoam / polystyrene, bubble wrap, modelling clay, butter knives (ballast), cotton balls. Water tubs, water. Scoresheet M2.3
10 min	01:25	Support groups to undertake testing and scoring	
		Lesson Conclusion	
5 min	01:30 END.	Clean up. Discussion about the session, submarine designs were effective.	

Module 2.3 Water – Ocean Properties
Lesson Plan

75 minute session

High Tech: Adapt PowerPoint Presentation 'M2.3 - Master Slides', hide slides:.4, 5, 6, 7, 15, 16, 18, 19
Low Tech: Print PowerPoint 'M2.3 - Reduced Slides for Printing'. Use slide notes for the ENTIRE 75 minute presentation, adapting discussion to cover omitted slides.

Key Learning Area			**Topic**
Physics, Chemistry, Physical World			Ocean Properties, Water Density, Fluid Dynamics
Timing	**Running Time (hh:mm)**	**Procedure**	**Materials**
		Lesson Introduction	
5 min	00:05	Welcome. Brainstorm: What do we know about Oceans? Ocean Fact or Fiction?	PowerPoint M2.3 (slides 1-3)
		Body of Lesson	
5 min	00:10	Explore ocean movements: waves, currents tides. Discuss importance of currents, introduce types and causes of currents.	PowerPoint M2.3 (slides 9-10)
10 min	00:20	Discuss hypothesis, conduct Experiment 2.3.1 Water Density (temperature) and discuss results	PowerPoint M2.3 (slide 11) Cups/jars, plastic cards, trays, food colouring, spoons, warm water and cold water
3 min	00:22	Discussion about water density and temperature. Recap matter and molecules (Module 2.1)	PowerPoint M2.3 (slide 12)
10 min	00:32	Discuss hypothesis, conduct Experiment 2.3.2 Water Density (salt content) and discuss results	PowerPoint M2.3 (slide 13) Cups, straws, food colouring, salt, spoons, markers, paper towel, water
2 min	00:35	Discussion about water density and salt content.	PowerPoint M2.3 (slide 14)

3 min	00:38	Discuss the science of floating, introduce concepts of buoyancy force, displacement.	PowerPoint M2.3 (slide 17)
2 min	00:40	Brainstorm: How do submarines sink and float? Explain how submarines submerge and rise.	PowerPoint M2.3 (slides 20-21)
5 min	00:45	Introduce challenge activity and explain materials and rules. Watch Air Submarine video. (If video unable to be played, coordinator should watch prior to the session).	PowerPoint M2.3 (slides 22-29)
5 min	00:50	Form groups and encourage students to design submarines.	Design Planning Sheet M2.3
10 min	01:00	Support students to build and test submarines.	Plastic bottles, rubber bands, paper clips, marbles, straws, plastic tubing, paddle pop sticks, balloons, baking powder, scissors, water proof tape, Styrofoam / polystyrene, bubble wrap, modelling clay, butter knives (ballast), cotton balls. Water tubs, water. Scoresheet M2.3
10 min	01:10	Support groups to undertake testing and scoring	
		Lesson Conclusion	
5 min	01:15 END.	Clean up. Discussion about the session, submarine designs were effective.	

Module 2.3 Water – Ocean Properties
Lesson Plan

45 minute session

High Tech: Adapt PowerPoint Presentation 'M2.3 - Master Slides', hide slides: 2 to 15, 18 and 19.
Low Tech: Print PowerPoint 'M2.3 - Reduced Slides for Printing'. Use slide notes for the ENTIRE 45 minute presentation, adapting discussion to cover omitted slides.

Key Learning Area			**Topic**
Physics, Chemistry, Physical World			Ocean Properties, Water Density, Fluid Dynamics
Timing	**Running Time (hh:mm)**	**Procedure**	**Materials**
		Lesson Introduction	
5 min	00:05	Welcome. Brainstorm: How do heavy ships float on the ocean?	PowerPoint M2.3 (slide 1 & 16)
		Body of Lesson	
3 min	00:08	Discuss the science of floating, introduce concepts of buoyancy force, displacement.	PowerPoint M2.3 (slide 17)
2 min	00:10	Brainstorm: How do submarines sink and float? Explain how submarines submerge and rise.	PowerPoint M2.3 (slides 20-21)
5 min	00:15	Introduce challenge activity and explain materials and rules. Watch Air Submarine video. (If video unable to be played, coordinator should watch prior to the session).	PowerPoint M2.3 (slides 22-29)
5 min	00:20	Form groups and encourage students to design submarines.	Design Planning Sheet M2.3
10 min	00:30	Support students to build and test submarines.	Plastic bottles, rubber bands, paper clips, marbles, straws, plastic tubing, paddle pop sticks, balloons, baking

10 min	00:40	Support groups to undertake testing and scoring	powder, scissors, water proof tape, Styrofoam / polystyrene, bubble wrap, modelling clay, butter knives (ballast), cotton balls. Water tubs, water. Scoresheet M2.3
5 min	01:15 END.	**Lesson Conclusion** Clean up. Discussion about the session, submarine designs were effective.	

If time permits, conduct experiment E2.3.3 Float and Sink (Buoyancy). Refer to Slide 18.

Module 2.3 - References

Oceans and Currents

https://www.ausmarinescience.com/marine-science-basics/oceanography-of-australia/

https://www.csiro.au/en/Research/Environment/Oceans-and-coasts/Australasian-ocean-currents

http://www.abc.net.au/science/articles/2005/09/08/2043133.htm

https://www.nationalgeographic.org/media/ocean-currents-and-climate/

Water Density & Buoyancy

http://splash.abc.net.au/home#!/media/106652/?id=106652

https://www.exploratorium.edu/science_explorer/watertrick.html

https://www.britannica.com/biography/Archimedes

https://www.ck12.org/book/CK-12-Physical-Science-For-Middle-School/r1/section/14.2/

Submarine Challenge & Facts

https://youtu.be/aNF25kuYwaY

http://www.submarinesafaris.com/kids_build_your_own_submarine.php

http://www.informit.com/articles/article.aspx?p=413663&seqNum=2

http://www.sciencekids.co.nz/sciencefacts/vehicles/submarines.html

Module 2.3 - Required Materials

- Pens, pencils and writing paper are generally required every session.
- Students may like to bring a note pad to record their observations and ideas.
- A group usually refers to 2 - 4 students.

Activity	Material	Amount	Where can I find it?
All sessions	PowerPoint Slides* (digital, or printed)	1 per coordinator	Coordinator Package
All sessions	Printed PowerPoint* Slide Notes	1 per coordinator	Coordinator Package
All sessions	Printed Lesson Plan	1 per coordinator	Coordinator Package
All sessions	Printed Module 1 Risk Assessment	1	Coordinator Package
All sessions	Computer, Data Projector, Screen	1	Venue
Submarine Challenge (All Sessions)	Plastic PET drink bottles / dishwashing liquid bottles.	1-2 per student	Recycled or supermarket.
	Cutlery (spoons / butter knives)	2 per group (ballast)	Recycled or supermarket.
Note: Items are suggestions. Add and subtract materials to suit your group and location.	Rubber bands	3 per student	Supermarket / Stationary Shop
	Paper clips	5 per student	
	Paddle pop sticks	5 per student	
	Straws	3 per student	
	Balloons	2 per student	
	Baking Powder	1 tablespoon/ group	
	Cotton balls	3 per group	
	Paper Towel	3 rolls	
	Scissors	1 per group	
	Large tub (30L)	2 - 3	Variety store or hardware shop
	Water proof tape	2 - 3 rolls	Hardware shop
	Rubber / plastic tubing	1 to 5 metre, share between groups	Hardware shop
	Marbles	5 – 10 per group	Supermarket or toy shop
	Modelling clay	1 piece per student	Craft shop

Required materials list continues on next 2 pages

* PowerPoint Slides have been provided as a Master Slide Set for a 120 minute (or 2 x 60 minute) session duration. Hide/ omit slides as noted in lesson plans for delivery of shorter session durations.

Activity	Material	Amount	Where can I find it?
Experiment E2.3.4 'Float or Sink' (Salt Content) 120 minute, 2 x 60 minute session	Cups / jars	2 per group	Supermarket /recycled
	Paper towel	2 rolls	supermarket
	Shallow tray	1 per group	Supermarket/recycled
	soap	1 piece (20 cent size) per group	supermarket
	water	300ml per group	Venue or supermarket
	salt	¼ cup per group	
	Food colouring	A few drops per group	supermarket
	spoons	1 per group	Supermarket /recycled
	Small objects (e.g. Lego, marbles, paper clips, cork)	Shared across all groups	Recycled
Experiment E2.3.1 'Water Density' (Temperature) 120 minute, 2 x 60 minute, 90 minute, and 75 minute sessions	Red and blue food colouring	A few drops per group	supermarket
	Clear cups / jars	4 per group	Supermarket/ recycled
	Shallow tray	1 per group	Supermarket /recycled
	Plastic cards (or thick cardboard)	1 – 2 per group	Supermarket, recycled or stationary shop
	spoons	2 per group	Supermarket /recycled
	Warm water	Approx. 500ml per group	Venue, supermarket
	Cold water	Approx. 500ml per group	Venue, supermarket
	Kettle	1 per session	Venue, supermarket or recycled
Experiment E2.3.2 'Water Density' (Salt Content) 120 minute, 2 x 60 minute, 90 minute, and 75 minute sessions	Clear cups / jars	4 per group	Supermarket/ recycled
	Clear straws	1 per student	Supermarket
	Red, yellow and green food colouring	A few drops per group	supermarket
	Salt	3 tablespoons per group	supermarket
	spoons	1 per group	supermarket /recycled
	water	Approx. 450ml per group	Venue, supermarket
	Paper towel	1 roll	supermarket

Required materials list continues on next page

Experiment E2.3.3 'Float or Sink' (Buoyancy) 120 minute, 2 x 60 minute, and 90 minute sessions	Tub / large bowl	1 per group	supermarket
	Aluminium foil	1 x 10m roll	supermarket
	marbles	10 to 20 per group	Supermarket or toy shop
	Paper towel	1 roll	supermarket
	Water	Approx. 3L per tub	Venue or supermarket

Note:

Some listed materials, for example tubs, cups, jars, and spoons can be re-used for multiple experiments.

Review the experiments you plan to include, and the required materials for efficiencies, prior to sourcing materials for your session.