LESSON PLANS WITH 'RAY'ZOR SHARP FACTS!

INSPIRE YOUR PUPILS & DIVE INTO THE WORLD OF RAYS

WITH THE RAY-PRODUCTION UNIT LESSON PLANS

IN ASSOCIATION WITH

SEA LIFE

SHARK TRUST

Ray-Production Lesson Plan. Introduction

SEA LIFE in association with the Shark Trust have created a series of lesson plans with one goal in mind — making life easier for teachers. This is the second in the series, all based around Rays, and has been created by teachers, proven in the classroom, and is absolutely, positively, completely… free!

This is a great way to introduce the creatures of the sea to your classes, we hope you find the information here useful and your pupils enjoy learning about Rays.

Once you've introduced the creatures to your class, why not meet them in real life with a school trip? You can continue the learning outside of the classroom after all the more they see, the more they'll learn!

To book your school trip today visit www.sealife.co.uk/lessonplan

Join the Shark Trust today!

Pup's Club members get a great shark pack and magazine as well as helping the Trust in their conservation work – www.sharktrust.org/join

Become a citizen scientist by collecting an eggcase from the beach and report your findings at www.sharktrust.org/eggcase

To learn even more visit www.sharktrust.org/juniors to start your voyage of discovery. Although there's nothing like visiting an Aquarium, talking to the staff and finding more out more about sharks.

Unit Planning Overview. Ray-Production Year 5

Download your **Teacher Notes or Activity Pack** Using the orange links below

The Ray-Production unit provides a set of ideas to support teaching of the statutory requirements in Animals, including humans for Year 5 (and some extension into Year 6) of the English National Curriculum. The ideas and lesson plans can be adapted to suit your own curriculum plan and can easily be adapted to support teaching and learning under other curricula. Sharks and Rays are inherently engaging for young people, as our experience of providing educational experiences for thousands of classes each year tells us.

We hope that you and your pupils will try out the Ray-Production unit and enjoy learning more about these amazing animals.

The lesson plans give suggestions for creating your own teaching resources such as powerpoint presentations and activity cards.
For a supporting resources pack, please contact sharkbites@sharktrust.org.

Ray-Production 1 – Rays don't grow on trees, but... Teacher Notes Activity Pack

What is a fish? How do fish differ and why? Can we put fish in a tree?

Key Words	Supporting Curriculum Attainment Targets
Taxonomy, Classification, Elasmobranch, Cartilaginous, Teleost,	• Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals (Year 6) • Give reasons for classifying plants and animals based on specific characteristics (Year 6) • Identify how animals and plants are adapted to suit their environment in different ways and that adaptation leads to evolution (Year 5)

Introduction	Activity	Extension	Plenary	Assessment
Powerpoint presentation/ interactive teaching introducing fish classification and adaptation to different marine habitats	Creative writing to create habitat description and classification tree construction exercise with species cards.	Provision for additional research and expansion of classification tree.	Discuss family trees/ classification and opportunity to extend to adaptations and convergent evolution.	Creative writing and results of classification exercise.

Unit Planning Overview. Ray-Production Year 5

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Ray-Production 2 – What's in a Mermaids Purse? Teacher Notes Activity Pack

Are there eggs in the sea? How do rays create rays?

Key Words	Supporting Curriculum Attainment Targets
Reproduction, Oviparity, Viviparity, Ovoviviparity, Life-Cycle, Lateral Keel, Lateral, Citizen Science.	• Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate • Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs • Describe the differences in the life cycle of a mammal, an amphibian, an insect and a bird (and a ray!) • Describe the life process of reproduction in some plants and animals

Introduction	Activity	Extension	Plenary	Assessment
Powerpoint introduction and interactive discussion to introduce fish reproduction and the Great Eggcase Hunt.	Eggs-ploration: measurement, recording and identification of eggcases using ID key. Production of table and graph of results.	Research Great Eggcase Hunt and write article on aims of the project.	Compare lifecycles of sharks and rays with other fish and land animals. Possibility to discuss citizen science in terms of "fair tests" and experimental protocol.	Results tables and graphs from activity plus written article from extension activity.

Ray-Production 3 – Ray Predator or Ray Prey Teacher Notes Activity Pack

What makes a ray bad prey? Rays under pressure

Key Words	Supporting Curriculum Attainment Targets
Growth curve, overfishing, maturity	• Describe the differences in the life cycle of a mammal, an amphibian, an insect and a bird (and a ray) • Research and compare growth of different animals • Compare life histories of bony fish and sharks and explore the advantages and disadvantages of different adaptations (in light of human fishing pressure)

Introduction	Activity	Extension	Plenary	Assessment
Introduction to fisheries & impact of different life histories on ability to be fished sustainably.	Overfishing game. Plot sizes of different species and identify age at maturity and quantity of eggs produced in life-time.	Write about sustainable fishing and why it is important.	Review how rays' life history strategy makes them vulnerable, and what we can all do to support sustainable fishing.	Plot growth points and answer accompanying questions.

Unit Planning Overview. Ray-Production Year 5

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Ray-Production 4 – Ray-Vision Session Teacher Notes

Introduction	Assessment
This is a test of learning outcomes/ revision in the form of a fun quiz – pub quiz style. Set up small teams and distribute lined paper for answers.	The quiz includes opportunities for individuals to demonstrate learning on their own and as part of a team.

Ray-Production 1. Rays don't grow on trees, but... Teachers' Notes

Focus Questions

What is a fish? How do fish differ and why? Can we put fish in a tree?

Curriculum Attainment Targets

- Describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences including micro-organisms, plants and animals (Year 6)
- Give reasons for classifying plants and animals based on specific characteristics (Year 6)
- Identify how animals and plants are adapted to suit their environment in different ways and that adaptation leads to evolution (Year 5)

Introduction 20-25 mins

Teacher Introduction: Using Powerpoint slides or images introduce the topic of classification with an interactive Q&A to establish pupils' prior knowledge and understanding.

Suggested Initial Game: Give students a selection of beads, coins, sweets, etc. and ask them to sort them into groups. Then get them to think about relationships and start to build a tree of relationships. Ask them to discuss their choices and decisions about how they grouped the items.

Interaction: What is a fish? Ask students to call out characteristics of a fish (where do they live, what do they look like, how do they breathe, etc.)

NB: Almost every rule has an exception – there are air-breathing fish, smooth-skinned fish, fish with no fins, and so on.

Ray-Production 1. Rays don't grow on trees, but... Teachers' Notes

Key points for introduction:

- How could we sort fish into groups?
- It's about relationships - like a family tree
- For fish there is a division between two major groups - teleosts (teleios **complete** + osteon **bone**) and chondrichthyans (chondr- '**cartilage**', ichthys '**fish**')
- What are the differences? Differences that you can see (skin, gills, fins, teeth, etc.) differences that you can't see (skeleton, reproduction, internal organs, genes, etc)
- The names tell us what is the most important difference...the skeleton. Sharks and rays have cartilage - like human nose and ears (to demonstrate difference get everyone to wiggle the top of their nose (bone) and the bottom (cartilage).
- But the easiest way to tell is by the gills. Sharks and rays are collectively called 'Elasmobranchs' (Elasmos **Metal Plate** + Branchia **Gills**) - fish have a cover, sharks have slits (normally 5)
- Further down the tree, there is a split between sharks and rays - what's the difference?
- Most sharks have long rounded bodies (ask children to describe the shape of a shark)
- Most skates and rays have flattened body shapes
- Many - but not all - sharks spend most of their time swimming in open water.
- Many - but not all - skates and rays spent their time on the sea bed.
- So why all the different shapes. Can you sort the sharks and rays?

Ray-Production 1. Activity Pack

Activity 1 Adaptation Station 25 mins

Challenge: Can you sort the sharks from the rays (and fish).

Step 1 Ask students to imagine they are fish, there are many different habitats for animals that live in the sea. Ask students to write a descriptive paragraph about each of the following (Rocky Seabed, Sandy Seabed, Open Ocean, Seaweed Forest)

The paragraph should describe your life in each habitat – what you might encounter, what you might eat, how you might hide from predators, how you search for prey. Can you imagine being an animal in that habitat?

Step 2 Give students a set of animal cards (suggestions below). Draw a basic (simplified) fish family tree on the whiteboard. Ask them to create a family tree for these animals. Are they bony fish or elasmobranchs? Can they be divided into smaller groups. Ask students to write on each card which habitat you think they might live in.

FLAT FISH | SHARKS | RAYS

FISH | ELASMOBRANCHS | BONY FISH | ROUND FISH

FISH	MAJOR GROUP	MINOR GROUP	HABITAT
Blue Shark	Elasmobranch	Shark	Open Ocean
Angelshark	Elasmobranch	Shark	Sandy Seabed
Manta Ray	Elasmobranch	Ray	Open Ocean
Thornback Ray	Elasmobranch	Ray	Sandy or Rocky Seabed
Bass	Bony Fish	Round Fish	Open Ocean
Mackerel	Bony Fish	Round Fish	Open Ocean
Turbot	Bony Fish	Flat Fish	Sandy Seabed
Plaice	Bony Fish	Flat Fish	Sandy Seabed

Extension Search for other types of fish and add them to your tree. Add another level of grouping based on other features. Students can explore and expand almost indefinitely. Try to avoid right and wrong "classifications" but ask them to explain their reasoning.

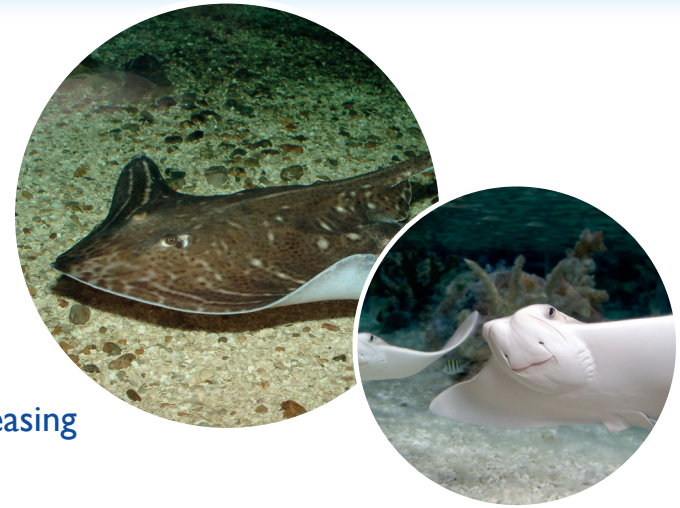
Activity 1 Plenary Session 10 mins

Discuss their family trees and the role of adaptation to environment in shaping evolution.

Note that there is a shark (Angelshark) which is flattened and lives on the seabed and there is a ray (Manta Ray) that has evolved back into an open water habitat.

You could also discuss convergent evolution – the flat fish and the rays both adapted to the seabed environment but in very different ways. The rays flattened top to bottom (you can demonstrate this with a plasticine shark and roll it flat!). The flatfish laid on their side and flattened side to side (also eyes have to move across head in one direction and mouth in the other).

Ray-Production 2. What's in a Mermaid's Purse Teachers' Notes



Focus Questions

Are there eggs in the sea?
How do rays create rays?

Curriculum Attainment Targets

- Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
- Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
- Describe the differences in the life cycle of a mammal, an amphibian, an insect and a bird (and a ray!)
- Describe the life process of reproduction in some plants and animals

Ray-Production 2. What's in a Mermaid's Purse Teachers' Notes

Introduction 10-20 mins

Teacher Introduction: Use Powerpoint slides and/or Shark Trust Great Eggcase Hunt materials to introduce the topic of animal reproduction and ray reproduction.

Key points for introduction:

- In the last lesson we learned that sharks and rays are collectively called 'elasmobranchs'
- Skates and rays have flattened body shapes and have adapted to live on the seabed (with exceptions – can you remember the name of a ray that lives in open ocean?)
- We are going to look now at reproduction – how sharks and rays produce young

Interaction: Discuss with the children the different methods of reproduction

- How do mammals reproduce? What happens to eggs? What happens in gestation? What role do parents play? This is **viviparity**
- How do birds reproduce? What happens to eggs? What happens in gestation? What role do parents play? This is **oviparity**
- Draw up a list of pro's and con's for ovoparity and viviparity – e.g. Dangers to eggs – can be eaten, squashed but can survive without parents.

Ray-Production 2. What's in a Mermaid's Purse Teachers' Notes

Continue introduction:

- Think about reproduction in the sea. Fish have "choices":
    - Viviparity or oviparity
    - If oviparity:
        - spawning (like plants on land) or fixed eggs.
        - guard eggs or leave
        - lots of small eggs or fewer large eggs
- Evolution shapes these choices, depends on where the live, their migration behaviour, what they eat, the danger of predators, etc.
- Sharks and rays reproduce in three different ways, depending on species
    - Viviparity – live bearing, like mammals
    - Oviparity – egglaying, like chickens
    - Ovoviviparity – an in-between process where eggs are produced but carried internally, they hatch before being born as if live young.
    - Why might species use different methods (e.g. if you live in open ocean best to keep young with you, if vulnerable to predation better to leave, eggs can be tied to seaweed or laid on seabed)
- Empty eggcases can wash ashore and are often found on the beach
- We can find and record these eggcases: this is the basis of the Shark Trust's Great Eggcase Hunt citizen science project.

NB: The Shark Trust website has information and downloadable materials on ray lifecycles, mermaids purse biology and the citizen science project. If possible you could visit a local beach to look at the strandline and search for eggcase. www.eggcase.org

Ray-Production 2. Activity Pack

Activity 1 Eggs-ploration 25-35 mins

Scientists will take measurements and look at different features of an organism in order to understand what species it is and where it fits into a family tree. A step-by-step ID key is a useful tool in this process.

Challenge: Identify different eggcases to species using the key www.eggcase.org

Activity: Students should look carefully at ten pictures of eggcases. Take measurements (repeat 3 times) of total length, capsule length and total width for each of the eggcases and take note of different sizes and features.

Students should create a table of their results and display as a bar chart.

Following the identification key step-by-step, students should identify each eggcase and record their results.

Extension: Research information from the Shark Trust website, students could be asked to write a short article on why the Shark Trust run the Great Eggcase Hunt: What information are they looking for? What do they need? How can they make sure they get information? How can they use the information? How can this help rays?

Plenary Session 5-10 mins

Review with students what they have learned about different reproduction strategies and how evolution shapes their "choices".

Discuss the Great Eggcase Hunt and citizen science in general – how does citizen science fit into what we know about fair tests in science? You could discuss that there is no control, no experimental protocol and relies on untrained scientists BUT there can be a huge number of records which scientists would never be able to collect.

A

B

C

D

E

F

G

H

Ray-Production 2. Activity Pack

A Small-eyed Ray (Raja microocellata)

B Undulate Ray (Raja undulata)

C Smallspotted Catshark (Scyliorhinus canicula)

D Blonde Ray (Raja brachyura)

E Thornback Ray (Raja clavata)

F Cuckoo Ray (Leucoraja naevus)

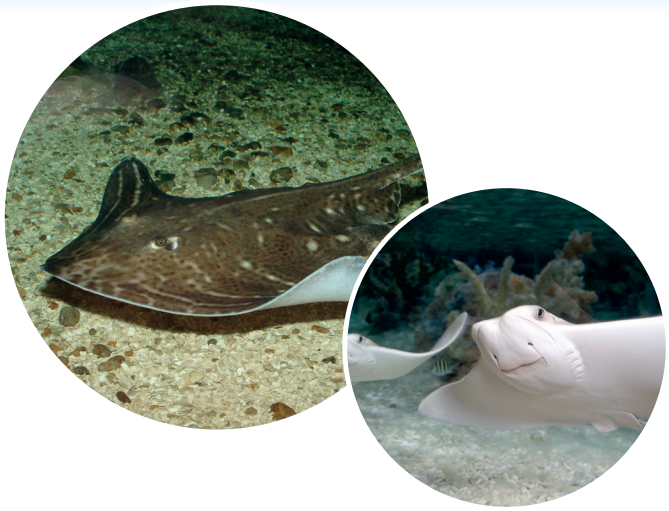
G Spotted Ray (Raja montagui)

H Nursehound (Scyliorhinus stellaris)

I Flapper Skate (Dipturus intermedia)

J White Skate (Rostroraja alba)

Ray-Production 3. Ray Predator or Ray Prey Teachers' Notes



Focus Questions

What makes a ray bad prey?
Rays under pressure.

Supporting Curriculum Attainment Target (and non-statutory guidance)

- Describe the differences in the life cycle of a mammal, an amphibian, an insect and a bird (and a ray)
- Research and compare growth of different animals
- Compare life histories of bony fish and sharks and explore the advantages and disadvantages of different adaptations (in light of human fishing pressure)

Ray-Production 3. Ray Predator or Ray Prey Teachers' Notes

Introduction 20 mins

Note: This is a complex topic and we have tried to simplify to an appropriate level. You may need to research the topic to feel comfortable with it – the MSC has some good information for teachers on their website www.fishandkids.msc.org

Teacher Introduction: Begin with an introduction to growth rates. Explain how we can chart growth against age and different animals have different shaped curves:

- Humans have two distinct rapid growth periods
- Commercial fish grow rapidly and stop growing after a few years
- Sharks and rays grow consistently and slowly

Compare life history of fish and rays (and compare to humans)

- Bony fish mature early (3-4 years) and reproduce quickly – many eggs every year
- Sharks/rays mature late, produce few young, have long gestation periods and long life spans (like humans)
- When we take animals in fisheries, we need to understand their life history
- Overfishing occurs when the number of fish being caught reaches a level where there are not enough adult fish left to replenish the population.
- If you take bony fish from the sea, the remaining stock can reproduce quickly to replace lost fish as long as enough mature fish are left.
- Taking sharks and rays needs to be done more carefully as they take longer to reach maturity and reproduce more slowly.

Ray-Production 3. Activity Pack

Activity 1 Overfishing game

15-20 mins

This is a fun game based on "stuck in the mud" which can help to demonstrate the issues around fishing and overfishing. It is best played in the playground but could be done in a clear classroom or school hall.

Preparation for game:

Mark out a large 'Sea' area marked with cones or other means.
Mark out a smaller area as a 'fishing net' for "caught fish"
Dress up "fishermen" (Bibs/T shirts)
Grey bands or hats (for rays)
Yellow bands or hats (for flatfish)

- Start with two fishermen who are given 90 seconds to catch fish
- Remaining students split into rays or flatfish
- The fishermen can only walk; in 90 seconds catch as many flatfish and rays as they can
- Stuck in the mud: if a fisherman touches a flatfish or ray they become "stuck in the mud" – other members of their team (flatfish or rays) can release a fellow team member who is stuck.
- Any ray that is stuck a second time must stand in the net. Their game is over.
- Flatfish can be stuck five times before going to the net.

Different number of fishermen affects number of sharks/fish caught and how quickly. Play again with 4, then 6, fishermen and note results.

Review: What have we learnt? Key points to note:

- Shark and ray populations take longer to recover.
- More fishermen means fish/shark and rays are caught more quickly.
- If too many are caught, size of population goes down as the fish can't reproduce fast enough to replace the ones that are caught.

Activity Growth Rates 15 mins

Challenge: Compare the growth rates of a Thornback Ray and a Haddock.

Activity: Get students to plot the sizes of each species on a graph. Students can then use their graph to answer the following:

If a Haddock matures at 3 years, how large will they be at this time?

If a Thornback Ray matures at 68cm, what age is it when it can start reproducing?

If Haddock live approximately 10 years and Thornback Rays approximately 15 years, how many years will each species be able to reproduce for?

How many eggs will each produce in their lifetime?

Haddock:

Lifespan: 10 years

Mature: 3 years

Produce approximately 300,000 eggs, each taking 2 weeks to hatch

Thornback Ray:

Lifespan: 15 years

Mature: 60-85cm (female)

Produce 48 - 74 eggs a year, each taking 4-6 months to hatch

Ray-Production 3. Activity Pack

SP. & AGE	Born	1yr	3yr	5yr	7yr	9yr	11yr	13yr	15yr
Thornback	13cm	20cm	30cm	50cm	72cm	90cm	98cm	107cm	112cm
Haddock	4mm	16cm	30cm	45cm	55cm	65cm	-	-	-

Plenary Session 5-10 mins

Review with students what they have learned about the importance of considering life history when fishing for different types of fish.

Discuss the importance of sustainable fisheries and what we can all do to support sustainability – e.g. check labels/ ask about sustainability/ campaign for sustainable fisheries (such as Shark Trust No Limits? www.nolimitsnofuture.org)

Ray-Production 4. Teachers' Notes

Teacher Introduction: Set up class for quiz session. We have provided a set of questions, the format of the session is up to you.

You could divide the class into teams or have individual answer sheets.

1. **What is the main difference between the two major groups of fish?** (1)

2. **List three ways that you could sort fish into groups** (3)

3. **What habitat would a flat fish and a ray live in?** (1)

4. **Complete the following:**
   An animal which lays eggs is called _ _ _ parous (1)
   An animal which gives birth us called _ _ _ _ parous (1)

5. **How many species of skate and ray are there in the world?** (1)

6. **What is another name for a shark eggcase?** (1)

7. **Science that is carried out by the public is called _ _ _ _ _ _ _ Science** (1)

8. **Name three fish that you might eat** (3)

9. **When eating fish you should try to make sure it is _ _ _ _ _ _ _ able** (1)

10. **Draw the life cycle of a ray** (5)

11. **What would your growth curve look like – sketch out your growth curve** (3)

12. **Sharks and rays mature earlier/later* and reproduce faster/slower* than Cod. – circle the right words** (2)

ANSWERS
Click to show

Total 24 Points

Ray-Production 4. Teachers' Notes

Teacher Introduction: Set up class for quiz session. We have provided a set of questions, the format of the session is up to you.

You could divide the class into teams or have individual answer sheets.

1. **What is the main difference between the two major groups of fish?** (1) SKELETON - BONE OR CARTILAGE

2. **List three ways that you could sort fish into groups** (3)
   ANY OF: GILLS, BONES, FIN SHAPE, COLOUR, ETC

3. **What habitat would a flat fish and a ray live in?** (1)
   SANDY SEABED

4. **Complete the following:**
   An animal which lays eggs is called _ _ _ parous (1) OVI
   An animal which gives birth us called _ _ _ _ parous (1) VIVI

5. **How many species of skate and ray are there in the world?** (1) OVER 600

6. **What is another name for a shark eggcase?**
   (1) MERMAID'S PURSE

7. **Science that is carried out by the public is called _ _ _ _ _ _ _ Science** (1) CITIZEN

8. **Name three fish that you might eat** (3) FLUORIDE

9. **When eating fish you should try to make sure it is _ _ _ _ _ _ _ able** (1) SUSTAINABLE

10. **Draw the life cycle of a ray** (5)

11. **What would your growth curve look like - sketch out your growth curve** (3)

12. **Sharks and rays mature earlier/later* and reproduce faster/slower* than Cod. - circle the right words** (2) LATER AND SLOWER

Total 24 Points