

Sort it Out



TEACHERS

This unit of work has been designed to support your class visit for the 'Sort it Out' programme at the National Aquarium of New Zealand. Students will participate in a range of level-specific interactive activities.

The primary focus of this programme is the Living World Strand of the Science Curriculum, however when planning your unit of work, links can be made to other essential learning areas. Similarly, different essential skills can be emphasised depending on the needs of your students.

PROGRAMME OVERVIEW

The Sort it Out programme teaches students about how scientists classify animals at the National Aquarium. They will learn how both vertebrates and invertebrates are organised into different phyla and classes by their common characteristics.

Students will develop their own classification systems based on careful observation and creative thinking.

ESSENTIAL LEARNING AREA: Science

STRAND: Living World

LEVELS: 2, 3, 4

Level	Essential Learning Area	Strand	Sub Strand	Achievement Objective
2	Science	Living World	Evolution	Recognise that there are lots of living things in the world and that they can be grouped in different ways.
3 & 4	Science	Living World	Evolution	Begin to group plants, animals and other living things into science –based classifications.

NATURE OF SCIENCE

- Understanding about Science
- Investigating in Science
- Communicating in Science
- Participating and contributing

The 'Sort it Out' programme at the National Aquarium of New Zealand lays the foundations for developing the above investigative skills and attitudes.

SPECIFIC LEARNING OUTCOMES

- To understand how scientists classify animals.
- To use and understand how dichotomous keys are a useful aid to classification.
- To understand, describe and identify how both vertebrates and invertebrates are organised into different phyla and classes by their common characteristics.
- Students will develop their own classification systems based on careful observation and creative thinking.

Major topics covered by this booklet:

- **Classification**
- **Scientific Naming**
- **Dichotomous Key**

Sort it Out

Pre and Post-Visit Activities

Pre visit activities

More than 10 million animal species live in the worlds marine environments. To most people, this huge diversity of life is unknown. The National Aquarium provides students with a rare opportunity to observe and learn more about the variety of marine life.

Fabulous Facts.....What do you know about classification?

What is Classification?

Classification is the arrangement of objects, ideas, or information into groups, the members of which have one or more characteristics in common. The science of classifying organisms is known as taxonomy.

Classification of Animals

Animals are put into two major groups: invertebrates and vertebrates.

Vertebrates are then grouped as fish, amphibians, reptiles, mammals or birds. Through this method of classification 95% of all animal species are invertebrates and around 40% of vertebrate species are fish.

There are other ways to group animals. Animals can be classified according to their habitats (marine animals), country of origin (Australian animals), diet (carnivores) or in any other way the taxonomist chooses.

Why Classify?

Classification makes it easier for scientists to study, find and identify organisms. It is also an important way to see how animals are related to each other.

Classification is all around us in everyday life

- *Non fiction books grouped in the school library according to subject. Why not by size?
How are your books grouped at home?*
- *How are groceries grouped in the supermarket? Why?*
- *How many groups do you belong to in a day?*

Classification

Classifying animals

Distribute cards with names or pictures of various animals among your class. Students pin their cards to their chests. When a criterion for grouping is announced, students group themselves accordingly.

Examples of criteria could be:

- animals that hatch from eggs
- animals that are small
- nocturnal animals and diurnal animals
- animals that eat the same things
- animals that come from the same country
- animals that are endangered
- animals that are cute

Discuss the following:

- how easy or difficult is it to decide which group an animal should be placed
- how important is the criterion in grouping
- how prior knowledge is important in grouping

Animals classified according to one criterion may have other things in common. E.g carnivores have forward facing eyes, sharp teeth and hunting behaviours. Discuss how this applies to the other criteria listed above.

Fabulous Facts.....Did you Know?

New Zealand has 8000 different types of marine life!

61 kinds of seabirds

41 kinds of mammals

964 kinds of fish

2000 kinds of molluscs (snails, shellfish and squid)

350 kinds of sponges

400 kinds of echinoderms (kina and starfish)

900 kinds of seaweed

700 kinds of algae

Which classification?

Different classifications provide different information about an animal. Why would anyone classify animals according to:

- body features
- diet
- habitat
- colour
- breeding season
- edibility

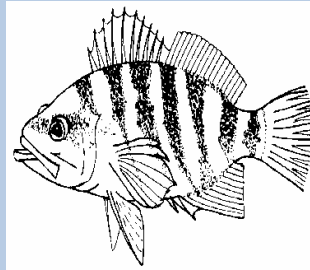
Discuss how each of these ways of classifying might be useful or not useful to different people.

Fish

Discuss: What is a fish? How many different groups of fish do you know?
What are: bony fish, cartilaginous fish, pipefish, 'starfish'

Fabulous Facts....What is a fish?

A fish has a backbone.
A fish is cold blooded.
A fish breathes with gills.
A fish has fins.
A fish lives in water.
Most fish have scales.



Discussion Question

How do we use classification in our everyday lives to make it easier? For example, how would you use classification to do the following: organize your desk, organize your drawers or closet, plan a meal, decide what clothes to take on a trip?

Found Objects

Distribute various animal objects/photos of these among the class. These may include: a feather, some hair, a piece of eggshell, a nest, animal skin (e.g with spots), a skull. Students in small groups, discuss what they can determine about the animal from the item provided. For example, where it lived and it's reproduction. Students should be clear on what details are certain and which are speculative, and their reasoning. Each group can then report to the class.

What's in a name? Scientific Naming

Most animals have two names – a common name and a scientific name. The shark *Carcharodon carcharias* is called the great white shark in New Zealand, the white pointer in Australia and white death in South Africa. How confusing!

You can see how important it is to have a scientific name for an animal so that it is clear which animal is being referred to.

There are six basic categories in the animal kingdom.

Phylum
 Class
 Order
 Family
 Genus
 Species

Within large classes of animals, each category may be divided into intermediate categories, such as sub class and super order. There is thought to be about 20,000 species of bony fish-these make up about 40% of all living vertebrate species.

Below is an example of full fish classification. This fish has the common name of 'Great White Shark'

Kingdom	-Animalia
Phylum	-Chordata
Sub-Phylum	-Vertebrata
Class	-Chondrichthyes
Order	-Lamniformes
Family	-Lamnidae
Genus	-Carcharodon
Species	-Carcharias

Fabulous Facts....Mnemonic for classification

How to remember the classification structure:

KINGS	KINGDOM
PLAY	PHYLUM
CHESS	CLASS
ON	ORDER
FINE	FAMILY
GRAINED	GENUS
SAND	SPECIES

Vertebrates are so-called because they have a row of vertebrae (vertebral column) made of bone or cartilage. This column supports the body and protects the spinal chord. They also have a skull enclosing a complex brain, a heart of 3 or 4 chambers and red blood corpuscles. This phylum contains 7 classes – bony fish, cartilaginous fish, jawless fish, amphibian, reptiles, birds and mammals.

At one time all fish had been considered as members of one class of vertebrates, Now the fish have been divided into three classes due to significant differences in their structure.

Invertebrates are animals without backbones. Some have an exoskeleton, a hard jointed covering on the outside to support their body.

There are seven classes of vertebrates:

1. BONY FISHES (CLASS OSTEICHTHYES)
Live in water, are cold blooded and breathe by means of gills. Most lay eggs to reproduce and have fins to move.
2. CARTILAGINOUS FISHES (CLASS CHONDRICHTHYES)
This class contains the sharks and rays which have a skeleton of cartilage, not bone.
3. JAWLESS FISHES (CLASS AGNATHA)
This class contain the less common fishes, eg lampreys and hagfish.
4. AMPHIBIA (CLASS AMPHIBIA)
Amphibians have slimy skin, are cold blooded, breathe with lungs and most lay eggs in water.
5. REPTILES (CLASS REPTILIA)
Reptiles have a dry scaly skin, are cold blooded, breathe with lungs and most lay hard shelled eggs.
6. BIRDS (CLASS AVES)
Birds have a covering of feathers, are warm blooded and lay eggs to reproduce. Their fore limbs are used for flight.
7. MAMMALS (CLASS MAMMALIA)
Mammals are warm-blooded, are covered in fur and suckle their young. They either bear live young, undeveloped young or lay eggs depending on the order of mammals.

What's in a name?

Divide your class into groups and have them devise their own system of classifying everyday objects around the room. Students should use at least four levels of classification, but they may use as many more levels as they find necessary. They should end up with a two-part name for each of several objects in the room. Advise students to use Linnaeus's system as a model, starting out with one classification level that divides all the objects in the room into two major categories. For example, the two "phyla" could be "natural" (made of natural materials) and "artificial" (made of artificial materials); or "useful" and "decorative." The two major categories combined should include all objects in the room, and the final "genus" and "species" names should exclude all objects but the one being identified. (Students may use descriptive phrases rather than single words, and, of course, they should not be required to use Greek or Latin terms.)

Dichotomous Key 20 Questions

Three students sit at the front of the class, each wearing a cap bearing a card with the name of an animal, visible only to the rest of the class. In turn, each contestant asks the class a yes/no question, proceeding in turn until a correct identification is made.

Discuss the effectiveness of the questions asked by each contestant. Which questions were the most/least useful in identifying the animal. **Also see the activity sheet at the end of this booklet.**

Fabulous Facts....Dichotomous Key

A dichotomous key is a method for determining the identity of something (like the name of a fish, a plant, a lichen, or a rock) by going through a series of choices that leads the user to the correct name of the item. Dichotomous means "divided in two parts".

At each step of the process of using the key, the user is given two choices; each alternative leads to another question until the item is identified. (It's like playing 20 questions.)

For example, a question in a dichotomous key for trees might be something like, "Are the leaves flat or needle-like?" If the answer was "needle-like," then the next question might be something like, "Are the needles in a bunch or are they spread along the branch?" Eventually, when enough questions have been answered, the identity of the tree is revealed.

Play Fish

Cut out the animals at the end of this booklet. Laminate them or paste them onto card. Divide your students into groups of 4 or 5. Give 5 cards to each person. Get your students to take turns asking questions for cards. E.g Do you have a mollusc? Yes I do. Is it an Octopus? No it isn't. If the student correctly guesses the animal on the card they keep the card. The student who has the most cards in the end wins!

CLASSIFICATION WORD FIND

F	I	L	T	I	Y	S	G	I	F	P	U	O	R	G	T	S	D	E
A	B	I	B	N	M	H	R	E	D	R	O	V	T	A	U	J	L	A
M	U	C	J	C	O	S	U	N	E	G	B	J	I	O	P	I	F	M
I	S	W	I	I	N	W	R	A	D	T	R	I	M	K	S	X	A	U
L	E	M	T	A	O	Q	F	T	A	M	N	O	S	G	C	F	M	L
Y	I	A	U	M	X	Z	T	I	O	V	T	V	W	X	I	I	P	Y
N	C	M	Q	K	A	X	L	F	E	O	O	V	Y	L	E	L	H	H
S	E	M	Y	X	T	A	W	R	H	S	S	A	L	C	N	X	I	P
J	P	A	Q	X	M	S	T	C	B	W	H	E	O	A	C	H	B	W
I	S	L	Z	I	B	E	I	N	N	I	T	A	L	L	E	T	I	F
D	G	K	N	M	B	D	M	S	I	N	A	G	R	O	C	D	A	Q
W	C	A	Z	R	X	M	O	D	G	N	I	K	S	U	V	C	N	W
E	D	A	A	F	I	S	H	I	Q	Q	N	A	X	N	Z	V	X	K
L	E	T	E	N	O	B	K	C	A	B	K	K	H	Y	Q	P	A	B
I	E	Q	N	C	L	A	S	S	I	F	I	C	A	T	I	O	N	G
T	E	X	H	N	W	M	E	T	A	R	B	E	T	R	E	V	F	J
P	V	P	D	U	K	E	O	C	U	E	Y	O	T	R	O	S	P	G
E	P	G	S	C	G	V	W	R	V	L	E	C	E	R	A	L	Y	Q
R	Y	F	L	V	D	R	I	B	X	X	K	D	V	W	D	S	Y	V

Amphibian Animalia Backbone Bird Class Classification Dichotomous
 Family Fish Genus Group Invertebrate Key Kingdom Latin Mammal Order
 Organism Phylum Reptile Science Sort Species Taxonomy Vertebrate

CLASSIFICATION WORD FIND ANSWER

F	I	L	T	I	Y	S	G	I	F	P	U	O	R	G	T	S	D	E
A	B	I	B	N	M	H	R	E	D	R	O	V	T	A	U	J	L	A
M	U	C	J	C	O	S	U	N	E	G	B	J	I	O	P	I	F	M
I	S	W	I	I	N	W	R	A	D	T	R	I	M	K	S	X	A	U
L	E	M	T	A	O	Q	F	T	A	M	N	O	S	G	C	F	M	L
Y	I	A	U	M	X	Z	T	I	O	V	T	V	W	X	I	I	P	Y
N	C	M	Q	K	A	X	L	F	E	O	O	V	Y	L	E	L	H	H
S	E	M	Y	X	T	A	W	R	H	S	S	A	L	C	N	X	I	P
J	P	A	Q	X	M	S	T	C	B	W	H	E	O	A	C	H	B	W
I	S	L	Z	I	B	E	I	N	N	I	T	A	L	L	E	T	I	F
D	G	K	N	M	B	D	M	S	I	N	A	G	R	O	C	D	A	Q
W	C	A	Z	R	X	M	O	D	G	N	I	K	S	U	V	C	N	W
E	D	A	A	F	I	S	H	I	Q	Q	N	A	X	N	Z	V	X	K
L	E	T	E	N	O	B	K	C	A	B	K	K	H	Y	Q	P	A	B
I	E	Q	N	C	L	A	S	S	I	F	I	C	A	T	I	O	N	G
T	E	X	H	N	W	M	E	T	A	R	B	E	T	R	E	V	F	J
P	V	P	D	U	K	E	O	C	U	E	Y	O	T	R	O	S	P	G
E	P	G	S	C	G	V	W	R	V	L	E	C	E	R	A	L	Y	Q
R	Y	F	L	V	D	R	I	B	X	X	K	D	V	W	D	S	Y	V

Amphibian Animalia Backbone Bird Class Classification Dichotomous
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Post-visit activities

New Species

Have students work in pairs or groups to create new animal species. Invite students to imagine that they have discovered a new species of animal, never before seen. They should draw a picture of their animal, describe its physical and behavioural characteristics, describe its habitat, and make up a name for it that would fit into the system of binomial nomenclature. Encourage students to use their imaginations when creating their new species.

Using classification in everyday life

What are some examples of everyday words that name groups or classes of things? Get students to think about subjects you study in school such as grammar, math, and social studies. What problems would arise if words such as noun (a word for a class of words) and fraction (a word for a class of numbers) did not exist?

We classify people in many ways; for example, by race, religion, physical appearance, ethnic origin, profession, life style, and so on. In which ways can classification of human beings be helpful? In which ways can it be harmful?

Classification by behaviour or habitat

Get students to design a classification system based on behaviour or habitat, instead of physical appearance. In this new system get students to explain what animals would be classed together that are not classed together when using physical appearance.

Design an aquarium

Select 20 species. These may be diverse or belong to a particular group. E.g freshwater fish, or molluscs. Get students to design an aquarium in which to display these species, giving reasons for the various grouping you decide upon.

Dichotomous key

A dichotomous key divides things into two distinct groups.

Get students to construct a dichotomous key to enable easy identification of a species you observed at the National Aquarium. List the species.

Divide the list into two groups (it doesn't have to be an equal size), based on a criterion (e.g. marine or freshwater).

Keep dividing each group until there is only one species per group.

Test your key. Introduce another species. Does it fit into your key?

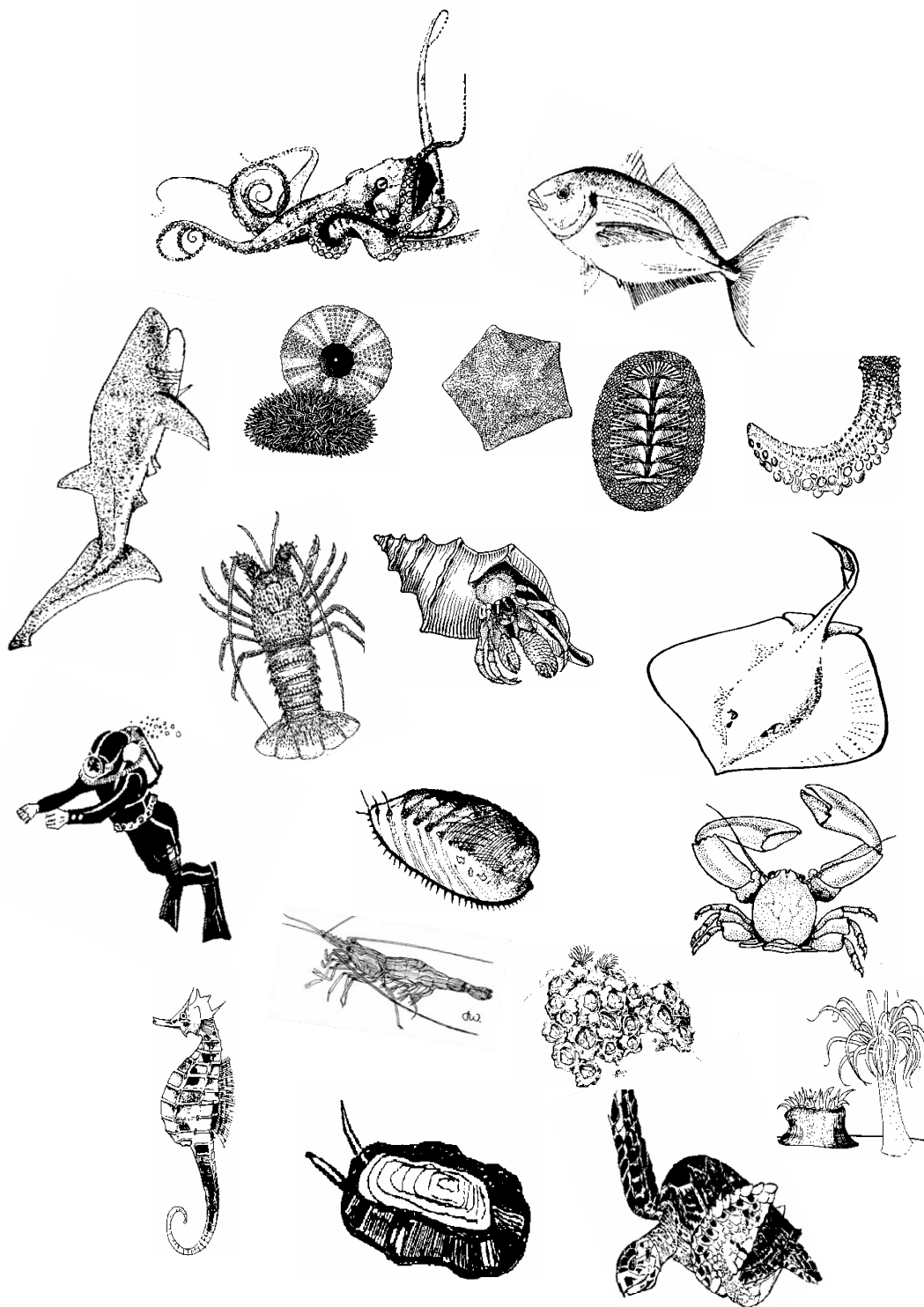
Get students to ask someone else to use your key.

Investigations

Get students to investigate the diversity of various groups of fish, such as sharks, deep sea fish, wrasse and migratory fish.

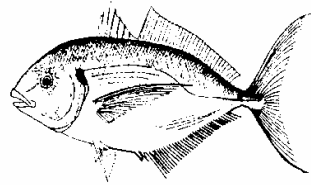
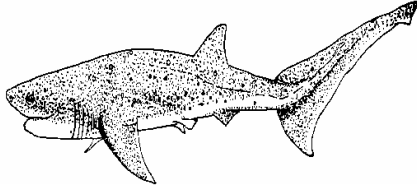
Activity sheets

Marine Life
Circle the invertebrates



Shark or Bony Fish?

Decide whether each of the statements below is true of sharks, a bony fish, or both.



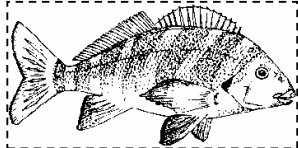
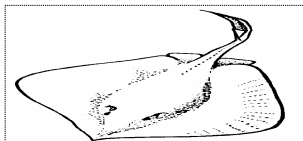
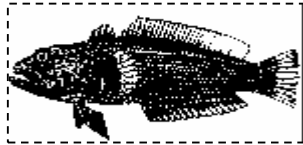
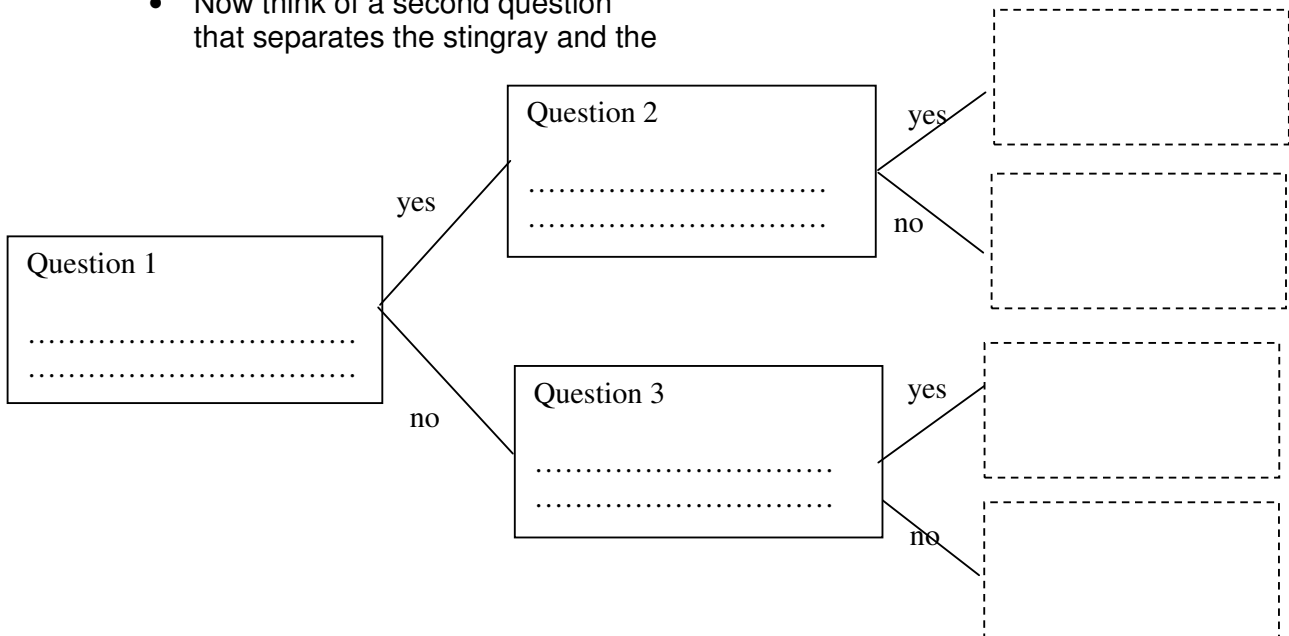
	sharks	bony fish	both
1. have fins			
2. have rays or spines on their fins			
3. have a swim bladder			
4. gills take oxygen from the water			
5. have a lateral line			
6. have a skeleton made of cartilage			
7. have spiracles behind the eyes			
8. have scales made of tiny teeth			
9. have a backbone			
10. have anal fins			
11. have an operculum (gill cover)			

Keys for Classifying

A fishy key

Look at the pictures of fish below. They are all fish, but they are all different.

- Think of a first question that could divide the fish into two pairs. It might be something like 'Is the fish flat from top to 'bottom'? The stingray and flounder are. They make one pair. The cod and red moki are not. They make the other pair.
- Now think of a second question that separates the stingray and the flounder. You will need a second question to separate the other pair too. Put your questions in the key.
- Cut out the pictures of the fish and glue them in the right places on the key.



Extension Task

Get students to imagine they are given an octopus, a seahorse, a crab and a starfish.

- Make a key to identify them correctly by asking three questions.

What's its name?

What to do: Read about a weird sea creature under a scientific name. After reading the descriptions, try to match each scientific name with its common name.

Palibythus magnificus

This crustacean is completely covered in short hairs. But it hardly comes up short. What makes it unusual is its ability to make music – short 'chirping' sounds like a cricket.

FANGTOOTH

Anoplogaster comuta

Picture it: a fish covered with small, prickly scales that has sharp fangs hanging out of its oversized mouth. When it closes its mouth, the lower jaw fangs slide into pockets on the roof of its mouth.

SLIME EEL

Eurypharynx pelecanoides

Talk about a big gulp! This fish can stretch its mouth almost as wide as an opened umbrella. It has a glowing red light on the end of its tail that attracts fishes and shrimp.

GIANT TUBE
WORM

Rhinochimaera pacifica

Imagine if you had a body part that detected electricity. This long – nosed fish does! It uses its snout to sense the electrical currents of its prey under the sand, sort of like a metal detector.

CHAMBERED
NAUTILUS

Myxine glutinosa

This animal has glands that can produce enough slime at one time to fill a milk jug. It doesn't make 'ooey-gooney' slime, just one with very strong fibers. It covers its body with the slime to suffocate predators.

PACIFIC
SPOOKFISH

Diodon hystrix

Huff, puff and blow! That's what this fish does when danger is near. It can inflate itself by filling its very stretchable stomach with water or air until it looks like a balloon (three times its normal size). It's also covered in prickly spines.

UMBRELLAMOUTH
GULPER EEL

Nautilus popilius

This sea creature has tentacles (up to ninety) just like it's relatives, the squid, octopus, and cuttlefish. But, it has hung on to its shell! The calcium-rich shell is divided into spiralled chambers. It lives in the last- and largest- of the chambers.

MUSICAL FURRY
LOBSTER

Riftia pachyptila

Hot ! Hot! Hot! These eight-foot long, tube shaped animals can tolerate the hottest temperatures of any living thing on Earth. They don't even need sunlight or oxygen to survive.

PORCUPINE
PUFFERFISH

What's its name? ANSWERS

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FANGTOOTH

SLIME EEL

GIANT TUBE WORM

CHAMBERED NAUTILUS

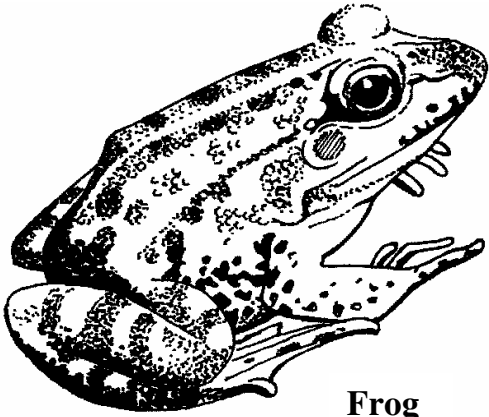
PACIFIC SPOOKFISH

UMBRELLAMOUTH GULPER EEL

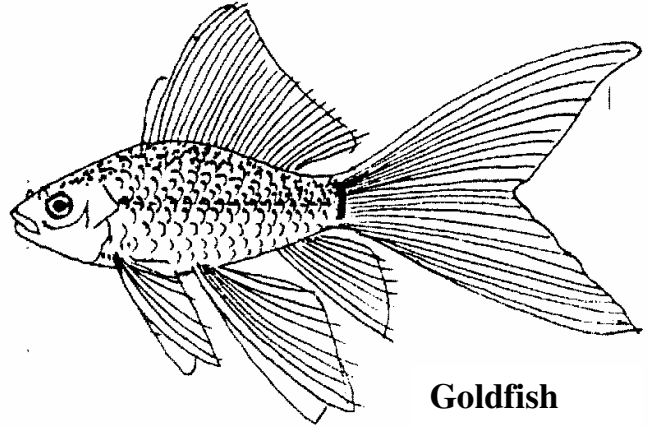
MUSICAL FURRY LOBSTER

PORCUPINE PUFFERFISH

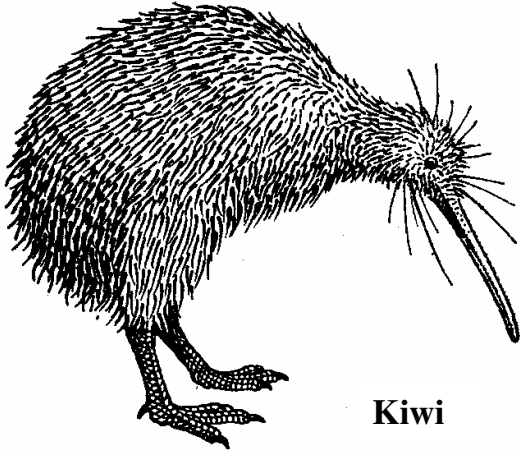
Animal Cut Outs



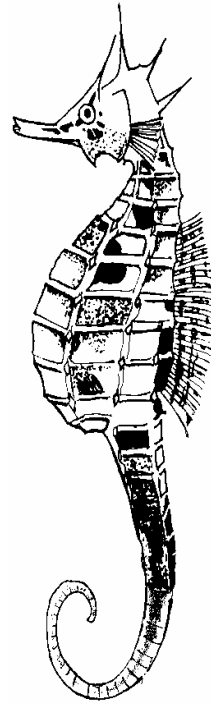
Frog



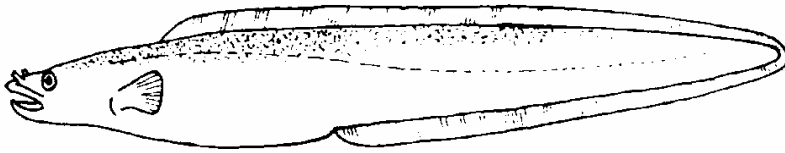
Goldfish



Kiwi



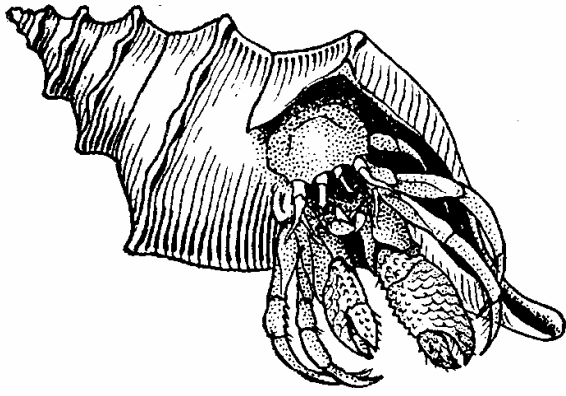
Seahorse



Eel



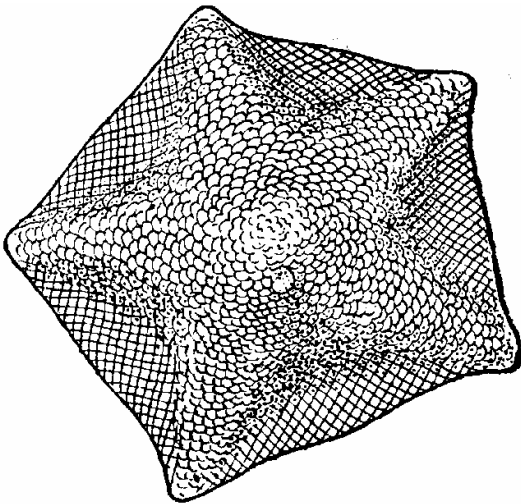
Mussel



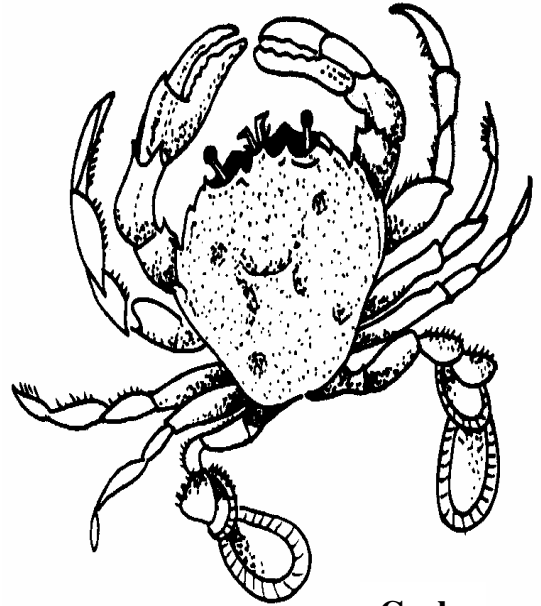
Hermit



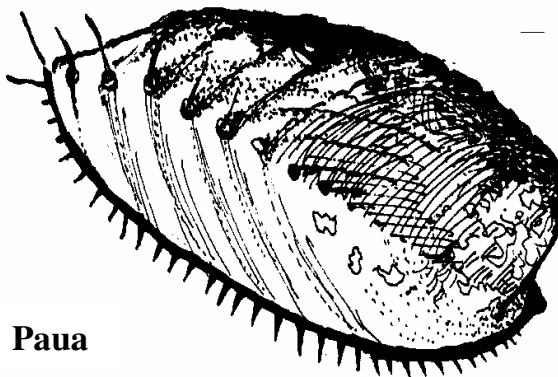
Barnacles



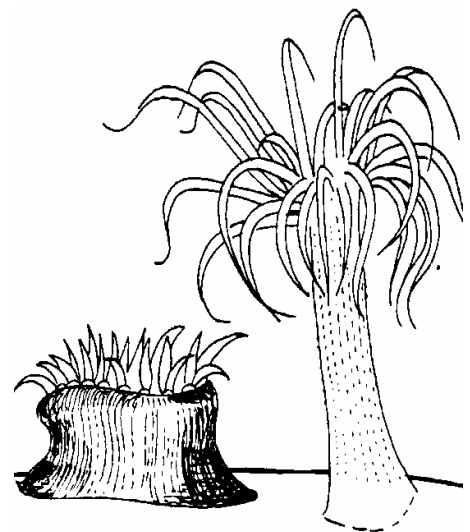
Cushion Star



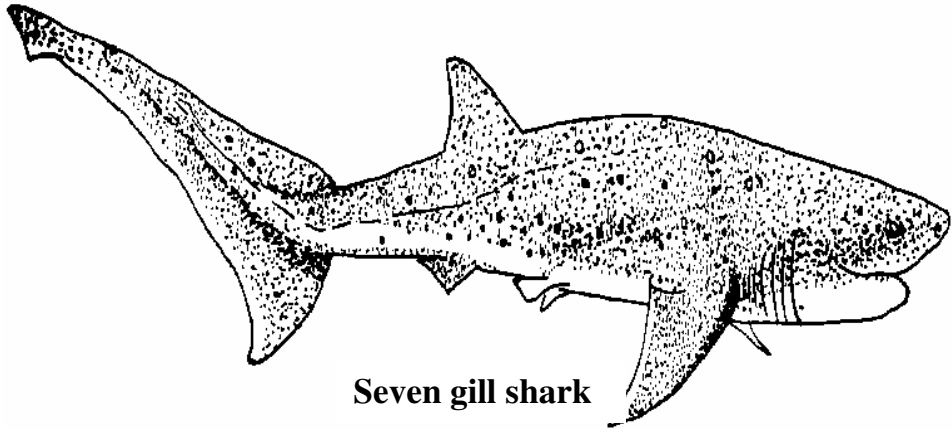
Crab



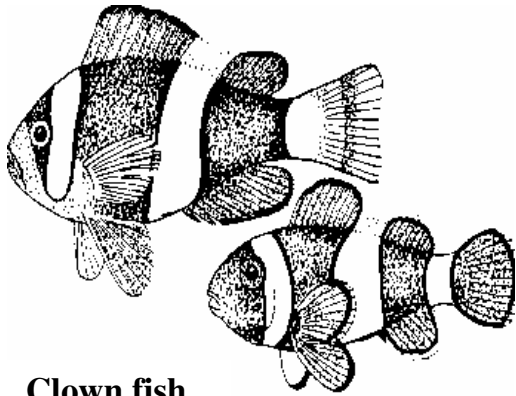
Paua



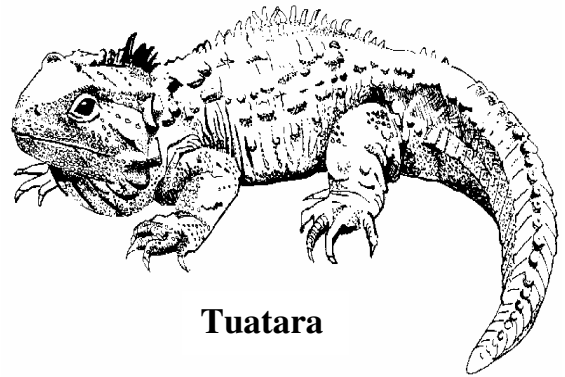
Sea anemone



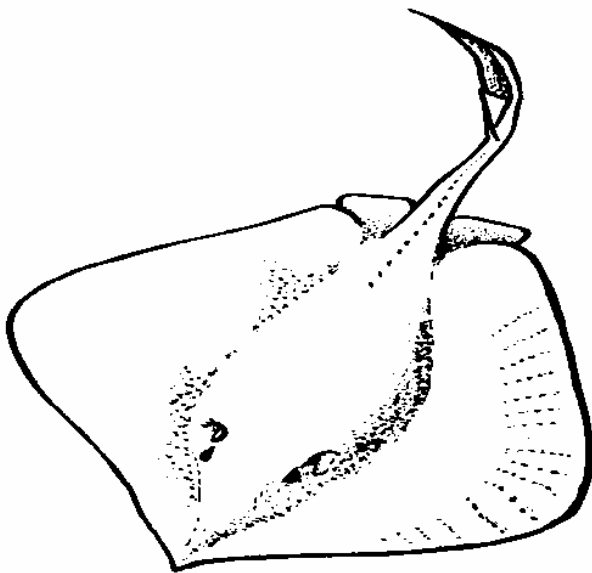
Seven gill shark



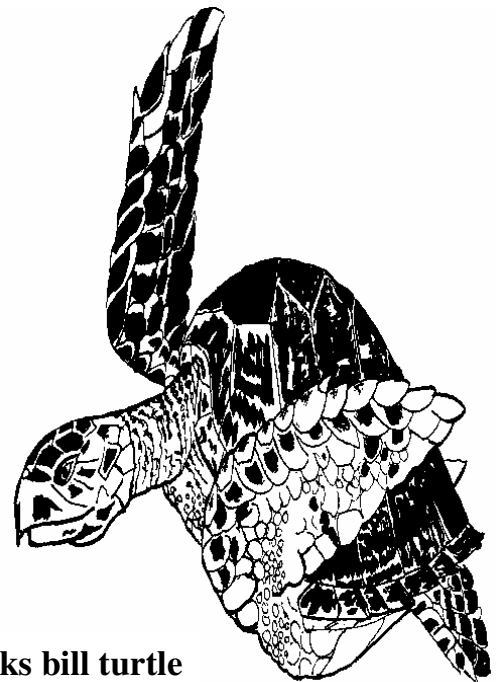
Clown fish



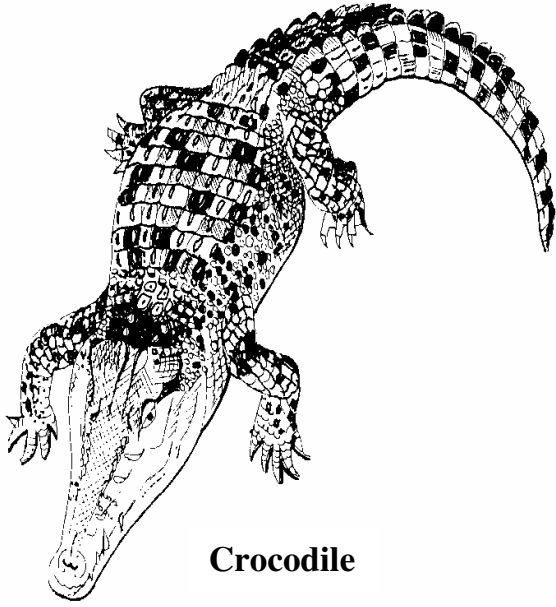
Tuatara



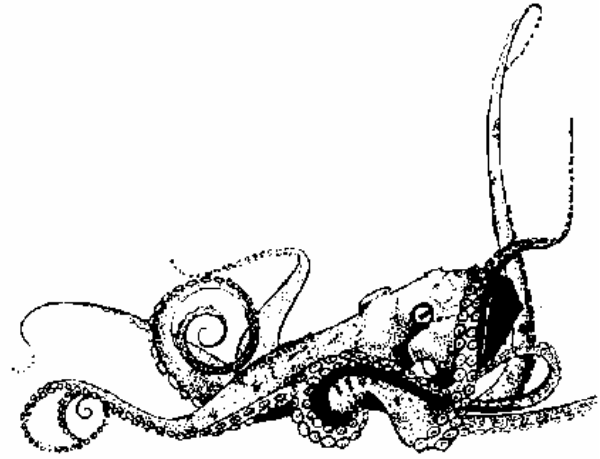
Stingray



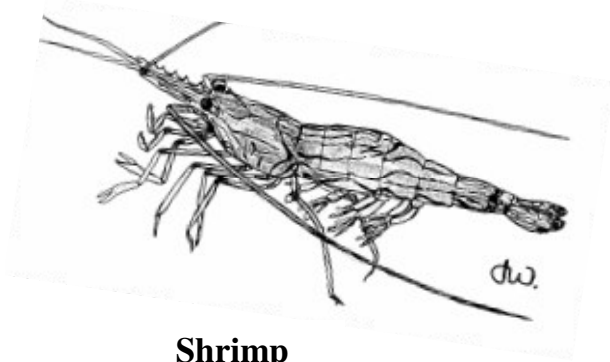
Hawks bill turtle



Crocodile



Octopus



Shrimp