S.E.A. AQUARIUM
EDUCATOR
RESOURCES

SECONDARY SCHOOL
Dichotomous Key

Dichotomous Key

Dichotomous Key is a useful tool that can be used for both species identification and classification. Students will get to identify the defining physical traits of animals at the S.E.A. Aquarium and actively classify them using a dichotomous key. This process elevates their awareness towards the diversity among living things and allows them to recognise that the process of classifying facilitates a better understanding of living things.

Educators can assist students in constructing their own dichotomous key using the step-by-step guide and examples of marine animals provided.

Target Group: Secondary 1 to 2

Duration: 70 minutes
- Part 1: 15 minutes
- Part 2: 25 minutes
- Part 3: 30 minutes

Learning Objectives:
- Identify and classify organisms with the use of a dichotomous key
- Construct a dichotomous key by identifying distinctive characteristics of various animal groups
- Recognise that classification is important for understanding living things

Materials required:
- Flipchart papers and markers
- Corresponding *Dichotomous Key* slides
- *Complete the Dichotomous Key* worksheet (provided in *Appendix*)

Note for educators: You may proceed to Part 3 if students are already familiar with the concept behind constructing a dichotomous key.

Introduction

Slide 2: Begin by introducing the nature and purposes of a dichotomous key.

- A tool used to identify organisms based on observable characteristics
- "Dichotomous" means divided into 2 parts, hence dichotomous keys always present 2 distinct choices at each step or branching point
- Selecting the right choices based on the observed characteristics allow the user to accurately identify an organism
- Useful with limited background knowledge of species and lack of access to other identification technologies e.g. DNA analysis
- Dichotomous keys are not only used to identify animals, but also other organisms such as plants and microorganisms

Using dichotomous keys will not only test the observation skills of students, but also enable them to learn more about an organism's qualitative and quantitative traits.

- Examples of qualitative traits:
    - Colour
    - Presence of physical features (e.g. horns, stings, fins, etc)

- Examples of quantitative traits:
    - Length
    - Weight
    - Number of fins, legs, tentacles, etc
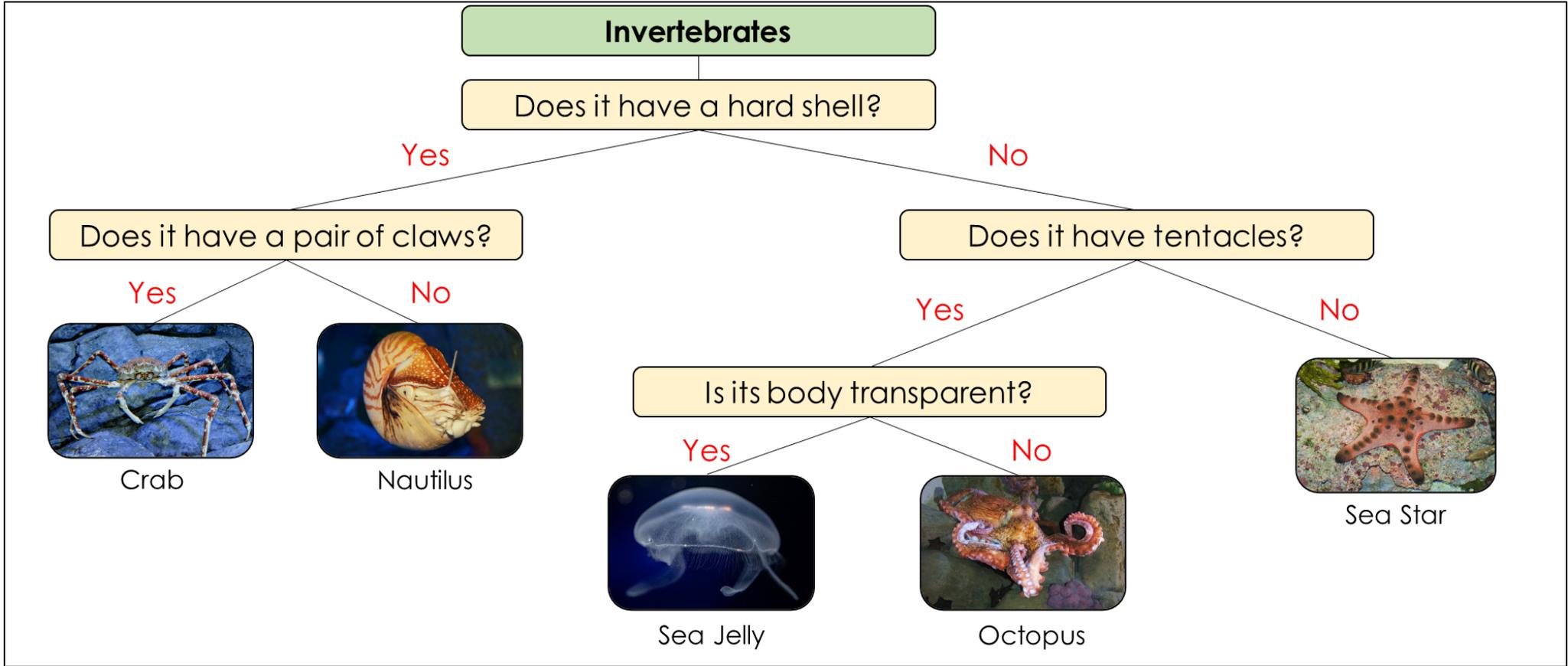
Part 1: Using a Dichotomous Key (15 minutes)

Slide 3: An example of a simple dichotomous key constructed using marine invertebrates is provided on page 5. Educators can demonstrate how to use a dichotomous key using the example provided:

- At each branching point, a question is asked based on observable traits of organisms, which should lead to only 2 outcomes, either a **Yes** or **No**
    - E.g. Does it have a hard shell?

- Each outcome in the key should narrow down the identification and questions are continuously asked until each organism is identified

- It is important to note that the organisms are identified based on very general traits in the beginning and then more specific or less obvious traits as the identification process progresses in the dichotomous key

The 5 animals featured are first sorted into 2 categories based on the presence of a hard shell. Since the crab and nautilus both have shells, the next question asked must be of a distinguishable trait between the 2. Hence both animals are separated based on the presence of claws.

The 3 animals without a hard shell are further divided into 2 categories based on the presence of tentacles. Since the sea star does not have tentacles, it can be easily identified from the sea jelly and octopus. Next, the presence of a transparent body can easily distinguish the sea jelly from the octopus.

Example of a dichotomous key in corresponding Slide 3

Part 2: Complete the Dichotomous Key (25 minutes)

Slide 4: In this part, students can practise the principles of constructing a dichotomous key by filling in the blanks of a partially-constructed one.

This activity requires each student to use the *Complete the Dichotomous Key* worksheet, which can be printed from pages 16 and 17 under *Appendix*.

Procedure:

1. Split students into groups of 4.

2. Educators are to show the 5 different marine animals that students can use to complete the dichotomous key in their worksheets.

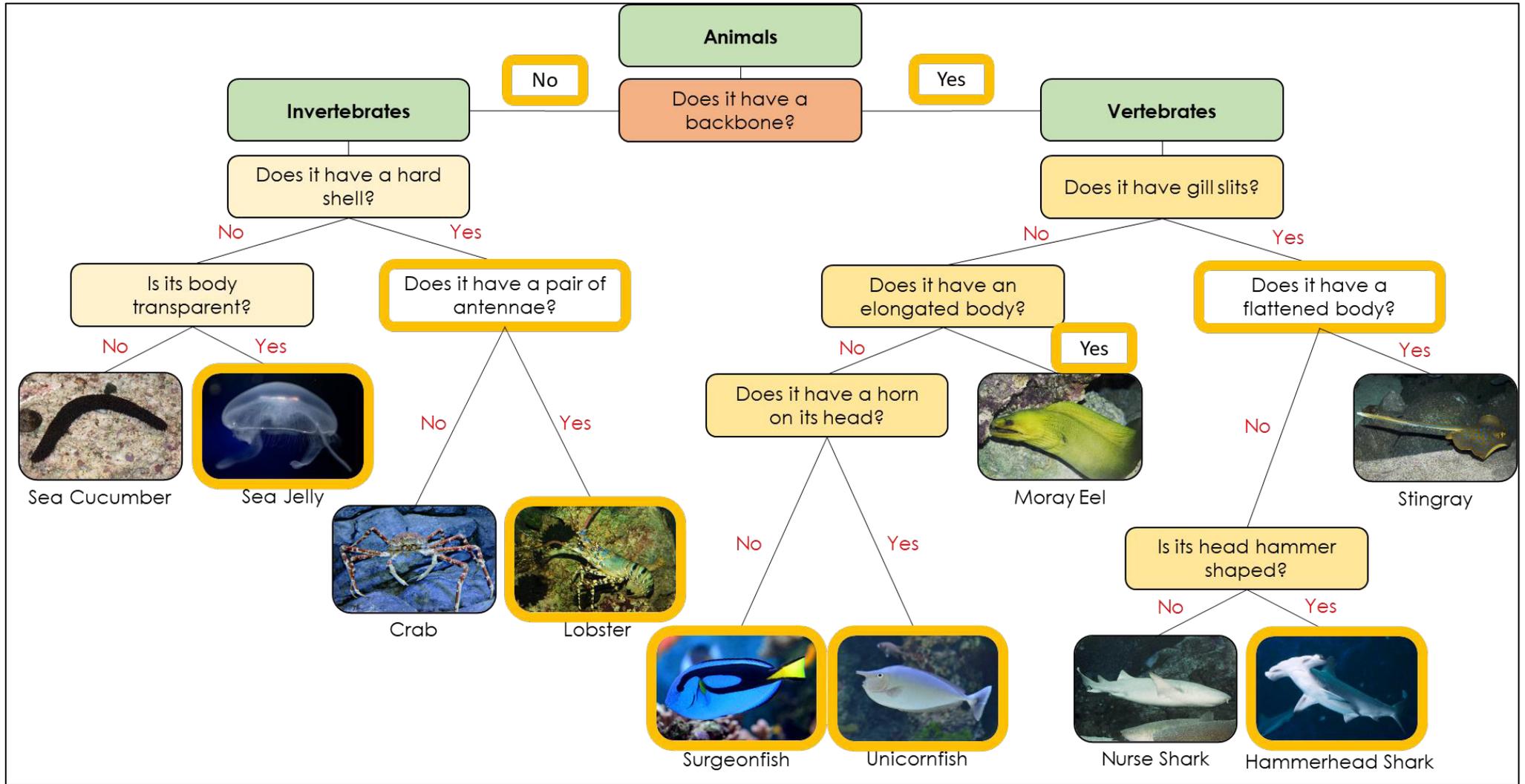Surgeonfish   Sea Jelly   Unicornfish   Lobster   Hammerhead Shark

3. Allow 10 minutes for students to discuss in their groups and complete the dichotomous key.
   - Educators can help to prompt students with the following questions:
     - Would questions asked at each branching point only result in either a **Yes** or **No**?
     - What are the observable traits that can distinguish the animals?

4. Educators can run through a set of suggested answers with the entire class. Suggested answers are provided below (highlighted yellow).
   - Educators are recommended to consider any other acceptable answers, for example:
     - Differentiations between the crab and lobster can include the presence of a tail or difference in colours of the shell
     - Differentiating between the unicornfish and surgeonfish can be via the colours of the body or tail
     - Differentiating a stingray from other sharks can be through the presence of a stinging barb on its tail, position of the mouth, or location of the gill slits

Animals

No — **Does it have a backbone?** — Yes

Invertebrates

Vertebrates

Does it have a hard shell?

Does it have gill slits?

No   Yes

No   Yes

Is its body transparent?

Does it have a pair of antennae?

Does it have an elongated body?

Does it have a flattened body?

No   Yes

No   Yes

No   Yes

No   Yes

Sea Cucumber   Sea Jelly

Does it have a horn on its head?

Moray Eel

Stingray

Crab   Lobster

No   Yes

Is its head hammer shaped?

No   Yes

Surgeonfish   Unicornfish

Nurse Shark   Hammerhead Shark

Suggested answers for Complete the Dichotomous Key Activity

Part 3: Construct Your Own Dichotomous Key (30 minutes)

Slide 9: A friendly alien from our neighbouring planet will be visiting Earth for the first time! As such, students are enlisted to help create a dichotomous key with 15 different marine animals for our alien friend to easily identify them during his visit here!

Procedure:

1. Split students into groups of 4. Hand out flipchart papers and markers to each group.

2. Educators are to show the 15 marine animals that students will use to create their dichotomous keys.

3. Have students work together to draw out their dichotomous key as a group. Students should consider the following:

   - List and organise observable characteristics, starting with the more general ones
     - For example, students may notice that some animals have fins and some do not, or some have a dull-coloured body while others are brightly coloured
   - Students should use more specific questions as they progress further
     - For example, does it have more than 1 dorsal fin, or does it have a curly tail?
   - At each branching point, use questions that lead to a **Yes** or **No**

- Only focus on one characteristic at a time
- Avoid using the same questions that address the same characteristics

4. Once each group has completed their dichotomous key, they can exchange it with a neighbouring group and test it out!
   - Students are encouraged to make adjustments if necessary to ensure that all 15 marine animals can be identified

5. At the end of the activity, educators can select 2 groups to present their dichotomous keys to the class.

More details on various physical traits and animal categories can be found in the information sheet from pages 10 to 15. Educators may use these information to prompt students and help them in constructing their own dichotomous keys. Alternatively, educators may choose to print the information sheet as handouts for students.

APPENDIX

Information Sheet – Animal Categories

The table below shows ways that the 15 animals can be classified based on their shared characteristics, which students may use in their dichotomous keys.

Classification	Description	Animals
Vertebrates	• Animals with a backbone or spinal column	• Bumphead Parrotfish • Sand Tiger Shark • Nurse Shark • Stingray • Manta Ray • Seahorse • Sea Dragon • Lionfish • Eagle Ray • Grouper • Clownfish
Invertebrates	• Animals that lack a backbone or spinal column	• Sea Star • Sea Anemone • Coral
Sessile organisms (organisms that are immobile or fixed in one place)	• Organisms are usually anchored to a substrate and do not move about • Not limited to plants, some marine animals are sessile as they lack appendages to help them move • Adult phases of corals and sea anemones are sessile	• Sea Anemone • Coral

Animals with fins	- Most fish have fins that allow them to swim - Fins can appear broad or small and membrane-like - Main fins include: - Dorsal fin (on the back) - Pectoral fins (on either sides) - Tail fin (at the end of body)	- Bumphead Parrotfish - Sand Tiger Shark - Nurse Shark - Stingray - Manta Ray - Seahorse - Sea Dragon - Lionfish - Eagle Ray - Grouper - Clownfish
Animals with gill slits	- A common feature of cartilaginous fish such as sharks and rays - Look like a series of lines on either sides of the body (sharks) or on the underside (rays)	- Sand Tiger Shark - Nurse Shark - Stingray - Manta Ray - Eagle Ray
Animals with flattened bodies	- Have a dorsoventrally flattened body (compressed from the top and bottom) - Most rays have adapted this body shape	- Stingray - Manta Ray - Eagle Ray
Animals with downward-facing mouths	- Usually found on animals that spend most of their time close to the sea bed - Help animals like rays to hunt for and feed on bottom-dwelling prey - Manta rays do not have a downward-facing mouth as they feed on plankton found in the water column	- Stingray - Eagle Ray

Animals with protruding mouths	• Some organisms have long snouts • These mouths are often small and narrow, which suggests that they consume small prey	• Seahorse • Sea Dragon
Striking colouration	• Striking or bright colouration serves as a warning to predators that these animals are poisonous or venomous	• Lionfish • Poison Arrow Frog
Stripped body patterns	• Function as disruptive colouration • Break the outline of an animal so that they can hide better from prey or predators	• Lionfish • Clownfish

Information Sheet - Additional Animal Information

This section includes additional information on specific animal groups and specialised features of some animals.

Fish

- Fish possess specific characteristics which classify them accordingly:
    - Gills
    - Fins
    - Scales
- Organisms with absence of these features are not classified as fish (e.g. sea jellies, corals, sea anemones, squids, etc.)
- Take note that there are some exceptions. For example, moray eels are classified as fish even though they do not have scales

Bony and cartilaginous fish

A shark is a type of cartilaginous fish

A grouper is a type of bony fish

- Bony fish possess a skeleton made up of bones and a gill cover (operculum) as a defining trait
    - Bony fish include groupers, clownfish, seahorse, etc.
- Cartilaginous fish possess a skeleton made up of cartilage and have gill slits instead of a gill cover
    - Cartilaginous fish include animals such as sharks, rays and skates

Cnidarians

- A group of animals that possess stinging cells, which they use to capture their prey and defend themselves
- They do not possess a skeleton, and are therefore considered invertebrates
- Examples include:
  - Sessile organisms
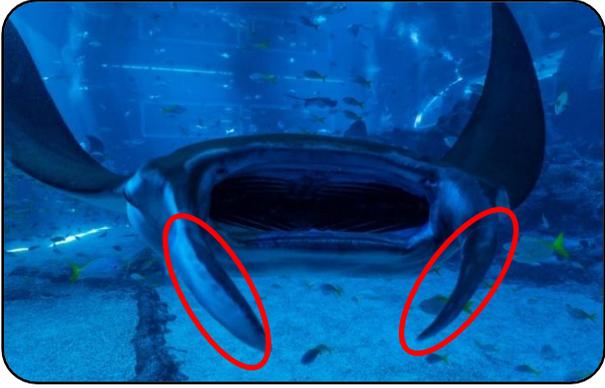

Corals

Sea Anemones

 - Free swimming organisms

Sea Jellies

Examples of specialised features

- Manta Rays – cephalic lobes

  o Fin extensions that flank the mouths of manta rays and facilitate feeding
  o Cephalic lobes uncurl while manta rays are feeding and direct plankton-rich water into their mouths
  o When not feeding, the cephalic lobes are curled up and appear to look like horns, giving them the nickname "devil rays

- Nurse Sharks – barbels
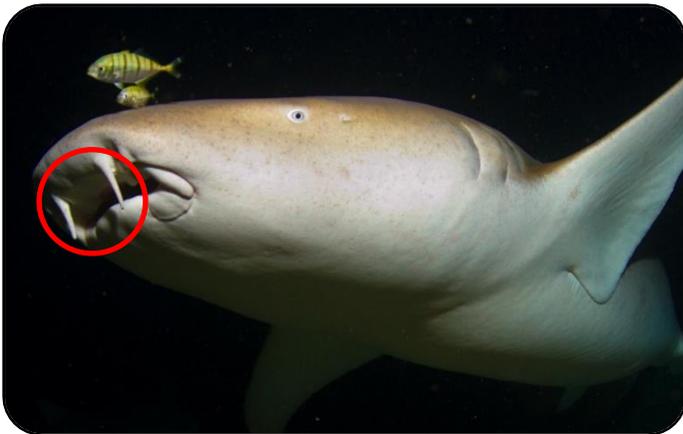
  o Located on the mouths of nurse sharks, barbels can also be found in other fish such as catfish
  o These whisker-like extensions contain sensory receptors, which allow them to detect and locate their prey

Complete the Dichotomous Key

Name: _____

Class: _____

Complete the dichotomous key in the next page using these 5 animals, and fill in the given blanks.

Sea Jelly

Unicornfish

Surgeonfish

Lobster

Hammerhead Shark

Animals

Does it have a backbone?

Invertebrates

Does it have a hard shell?

- **No** → Is its body transparent?
  - **No** →
    Sea Cucumber
  - **Yes** → [ ]
- **Yes** → [ ]
  - **No** →
    Crab
  - **Yes** → [ ]

Vertebrates

Does it have gill slits?

- **No** → Does it have an elongated body?
  - **No** → Does it have a horn on its head?
    - **No** → [ ]
    - **Yes** → [ ]
  - **Yes** →
    Moray Eel
- **Yes** → [ ]
  - **No** → Is its head hammer shaped?
    - **No** →
      Nurse Shark
    - **Yes** → [ ]
  - **Yes** →
    Stingray