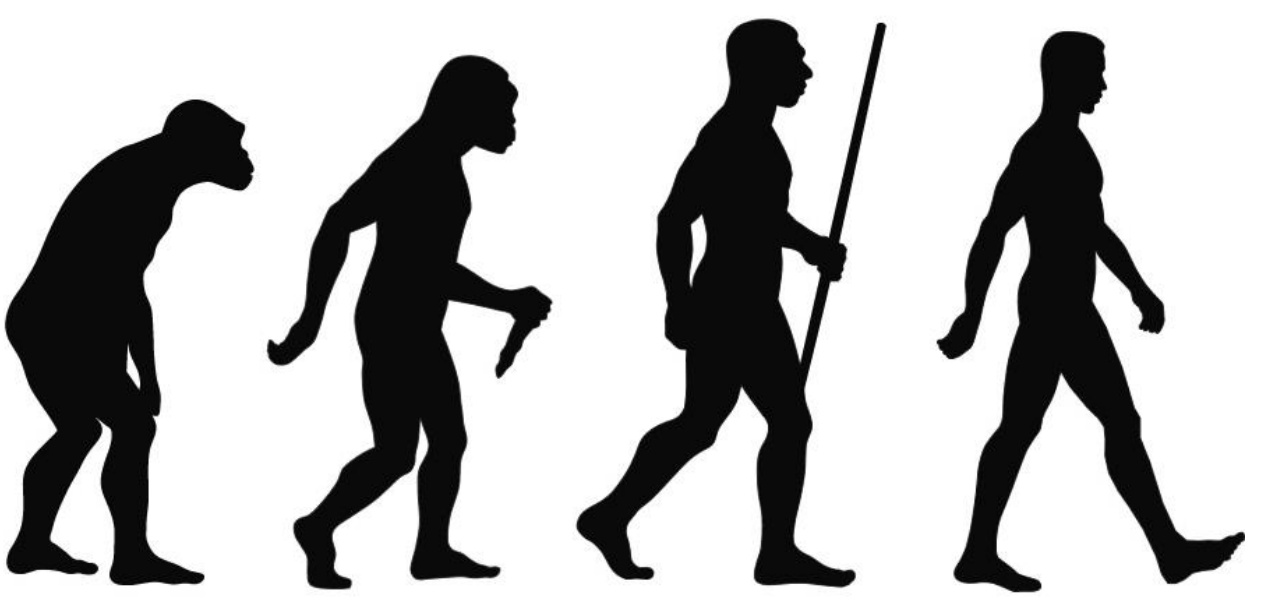
Activity Pack: Evolution

This pack is designed to provide teachers with information to help you lead a trip to Colchester Zoo focusing on Evolution



Contents

How to Use this Pack:

This Evolution Pack was designed to help your students learn about the history of evolutionary theory and classification, and prepare them for a trip to Colchester Zoo.

The pack starts with information about the history of evolution to help provide support for your sessions. There is also a map from the zoo that will help you plan your day, and your route around the zoo. We recommend all teachers read through this, and give copies to adult helpers attending your school trip. For feed and encounter times please head to the website.

The rest of the pack is broken into: pre-trip, at the zoo, and post-trip. Each of these sections starts with some general ideas, and then there are a variety of pre-made activities and worksheets. Activities are typically hands on ‘games’ that introduce and reinforce concepts. Worksheets are typically paper hand-outs teachers can photocopy and have pupils complete independently. Teachers can pick and choose which they want to use since all the activities/worksheets can be used independently (you can just use one worksheet if you wish; you don’t need to complete the others).

The activities and worksheets included in this pack are for KS3 and 4 students.

We suggest using the pre-trip activities/worksheets prior to your trip to familiarise your pupils with vocabulary, context, and the animals they will see during your trip. The at the zoo activities/worksheets typically require information your pupils can gather while they are at Colchester Zoo and are designed for completion during your school trip. The post-trip activities/worksheets are designed to be used after your visit to help consolidate learning and build on information gathered during your school trip. Within these sections, the activities/worksheets can be used in any order.

If you would like any more guidance, or have any questions about any of the information contained within this pack, please contact our education department at education@colchesterzoo.org


Map Keys
First Aid
Information
Gift Shop
Picnic Area
Play Area
Toilets
Fire Assembly Point
Face Painting
Kids' Safari

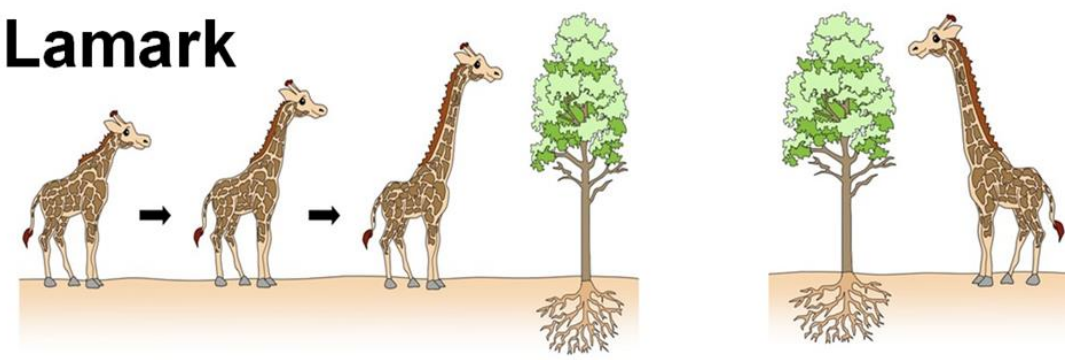
Evolution
Background Information

- **4th Century BC** Aristotle writes “History of Animals” . This model remains largely unchanged until the 16th Century.
- **1551** Gessner publishes History of Animals in Zurich.
- **1738** Linnaeus published his system of classification of species.
- **1795** Hutton proposed the idea that the Earth was shaped by gradual forces.
- **1796** Cuvier published his theory that fossils were from species that had become extinct.
- **1798** Malthus' Essay on the Principle of Population is published.
- **1809** Lamarck’s theory of evolution published — Darwin born.
- **1830** Lyell proposed his geological theory of uniformitarianism.
- **1831** Darwin set out on the voyage of the Beagle.
- **1858** Wallace wrote to Darwin setting out his theory of natural selection. Darwin's and Wallace's ideas were presented to the Linnaean Society of London.
- **1859** Darwin published the Origin of Species.
- **1865** Mendel’s experiments on heredity published.

Evolution
Background Information

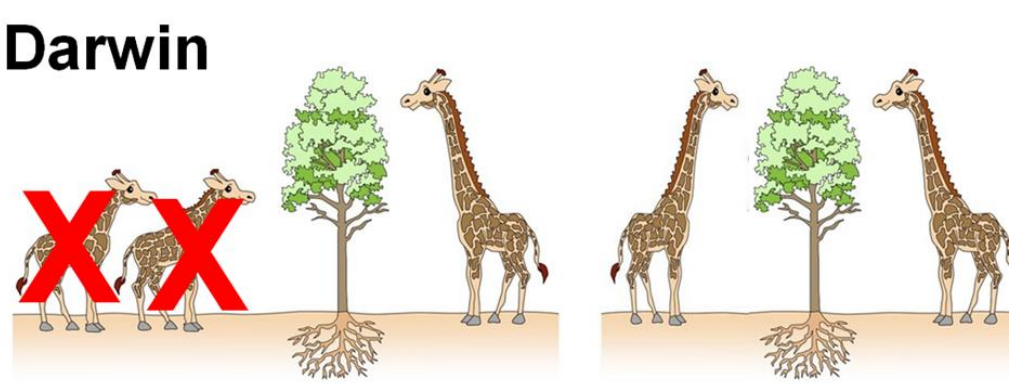
Jean-Baptiste Lamarck 1744 – 1829

Lamarck was a French Naturalist and an early proponent for the idea of evolution. His theory suggests that life started off simple and became complex over time, moving up a ‘ladder’ of progress. 1809 he published *Philosophie Zoologique,* which he theorized that change was gradually introduced into the species and passed down through generations. he classic example used to explain the concept of use and disuse is the elongated neck of the giraffe (see below). According to Lamarck's theory, a given giraffe could, over a lifetime of straining to reach high branches, develop an elongated neck. A major downfall of his theory was that he could not explain how this might happen, though he discussed a "natural tendency toward perfection."



Charles Darwin 1809-1882

Darwin was an English naturalist and Geologist, and is renowned for his evolutionary theories. He originally trained in medicine, but was much more interested in studying the natural world. In 1831, he became the naturalist for a scientific expedition on board the *HMS Beagle,* and discovered many new species and formed new evolutionary theories whilst travelling the world. Darwin suggested that all species are descended from common ancestors. He and his partner Alfred Wallace also produced a joint publication that the branching pattern of evolution was due to a process known as natural selection, where by the animals most suited to their environment are the ones that survive and continue to adapt (see below). He published his famous work *On the Origin of Species* in 1859.



Pre-Trip Classroom Ideas:

These are ideas to help teachers prepare their class before their visit to the zoo, in terms of gaining an understanding of evolution. Use these ideas as a starting point with or without the pre-made activities and worksheets on the next pages.

1. Learn Vocabulary words with students (see next page for list)
2. Discuss the term "Evolution".
3. Consider some pre-Darwin theories of Evolution, and create a classroom timeline.
4. Explore the history of Charles Darwin. Create a storyboard or cartoon strip with the class of his life lead up to the creation of his famous work *the Origin of Species.*
5. Search online for newly discovered species.
6. Have the students research an individual species and present it to the class, exploring how and why the animal has adapted and evolved to its current form.
7. Ask the students to research animals with unique evolutionary traits and adaptations before their visit to the zoo.

Pre-Trip Classroom Ideas:

Vocabulary Words:

Adaptation:	The process of change by which an organism or species becomes better suited to its environment.
Camouflage:	Colours and patterns that help and animal blend into its surroundings
Carnivore:	An animal that eats meat.
Classification:	The process of organising things into classes or categories
Darwinism:	The theory of the evolution of species by natural selection
Endangered:	Very few left, it faces major threats, and it might go extinct.
Evolution:	The process by which different kinds of living organism are believed to have developed from earlier forms during the history of the earth.
Extinct:	All of that species is now dead; it is no longer found anywhere
Habitat:	The type of place an animal lives (e.g. savannah, rainforest, etc.)
Herbivore:	An animal that mainly eats plants.
Natural Selection:	The process whereby organisms better adapted to their environment tend to survive and produce more offspring
Omnivore:	An animal that eats plants and meat
Predator:	An animal that hunts and eats other animals.
Prey:	An animal that is eaten by other animals.
Species:	A group of animals that have similar characteristics and can produce offspring.
Taxonomy:	The Classification of something, e.g. organisms
Vertebrate:	An animal of a large group distinguished by the possession of a backbone or spinal column, including mammals, birds, reptiles, amphibians, and fishes.
Invertebrate:	An animal lacking a backbone, such as an arthropod, mollusc, annelid, coelenterate, etc.

Pre-Trip Classroom Activities:

Sweet Natural Selection

This edible activity gives students the chance to understand the basics of Darwin's theory of natural selection.
Time: 1 hour
Subjects: Science
Materials Required: large bowl, a wide variety of sweets.

For this activity, you will need a large bowl and a mixture of different types of sweets. These should include popular sweets such as gummy bears, as well as less popular choices like black liquorice. Make sure you have a list of exactly how many of each sweet you have.

Without providing an explanation, pass the bowl around the classroom, asking each student to take one sweet. This can be repeated a couple of times until the bowl is half full.

Once this is done, begin to explain about variation—ask students to think of the variation between their classmates, for example. Ask them why this is significant– it should result in a discussion about different traits being important for survival.

Examine what sweets are left in the bowl with the class. Make a list and a tally of these on the board. Then create a list of the original sweets.

Then ask the students to list the traits the sweets that they tried (flavour ,texture, colour etc.) These can then be compared to the traits of the sweets left in the bowl. Make a list of the traits of the sweets that were selected(examples: bad flavours, small size). These are the traits that allowed the sweets to survive being passed around the room.

The fact that there were different sweets with different traits resulted in some sweets being eaten and others surviving. This is what natural selection does with individuals in a population. Each individual has unique traits; some traits will help an individual survive and some traits do not.

Pre-Trip Classroom Activities:

The Great Debate

When Darwin published his 'The Origin of Species ' he created an uproar in the academic community. This activity will help students to understand why Darwin's Theories were so revolutionary and encourage them to think about why he changed the world.

Time: 1 hour
Subjects: English, Citizenship, History, Science
Materials Required:

For this activity, the class will need to be split into 4 groups, and given one of these famous historical characters to research:

- **Charles Darwin:** Darwin claimed that his publication of The Origin of Species was like "confessing to murder", and was fully anticipating backlash from the scientific community. He largely tried to stay away from the debates, as he was more concerned over what was thought of his science rather than involving himself in politics and rhetoric.

- **Richard Owen**: an old colleague of Darwin's, who was deeply critical of his work. He believed that evolution was much more complicated than Darwin suggested. He was well known for his vicious temperament.

- **Bishop Samuel Wilberforce:** Coached by Owen, Wilberforce was strongly against Dawrin's theory as it stood against the church. He was one of the main antagonists in the great debate, battling against Huxley at the 1860 meeting of the British Association for the Advancement of Science.

- **Thomas Huxley:** a very outspoken support of Darwin's Theory. He was nicknamed "Darwin's Bulldog." He stood up for Darwin during the great debate, as Darwin was sick on the occasion.

Have students collect quotations and publications from this time, and then stage an in class debate. They should be expected to provide strong evidence to back up their arguments. An extension of this activity could be to create 1800s style newspaper articles to either condemn or celebrate Darwin's Theory.

At the Zoo Ideas:

These are ideas to help your class focus during their trip to the zoo. Use these ideas as a starting point with or without the pre-made activities and worksheets on the next pages.

1. Use the worksheets in this pack to help focus your students

2. Encourage students to spend time observing the animals. Some unique animal behaviours can only be seen if we watch very carefully.

3. Have students make a detailed sketch of a zoo animal. Sketching encourages careful observation.

4. Take photos of the animals and around the zoo. When you get back to school make a photo scrapbook of your trip.

5. Attend the feeds, displays or talks and have your students take notes. Often the keepers are available after to answer questions if you want to learn more.

6. As the students go around the zoo get them to make a list of animals they think share a common ancestor. Once back at school discuss the students findings.

7. Give the students a type of diet the animals eat and get them to make notes on what adaptations that animals has. Discuss the finding when back in the classroom. A good example of this is the anteater and aardvark. They are found on different continents and are not closely related , yet they have evolved very similar ways to eat insects. This is good way to explain convergent evolution.

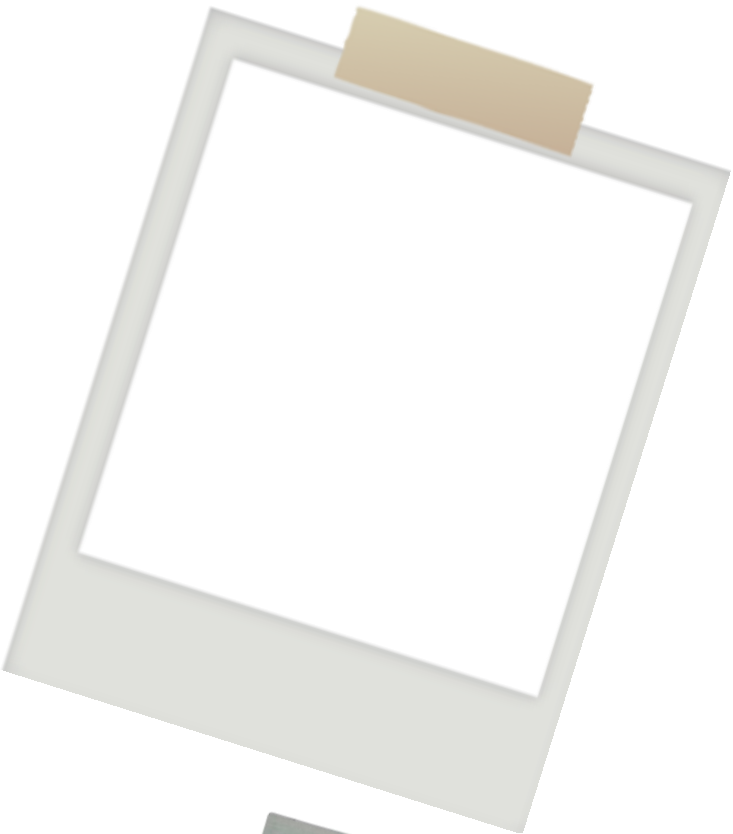
At the Zoo Activities:

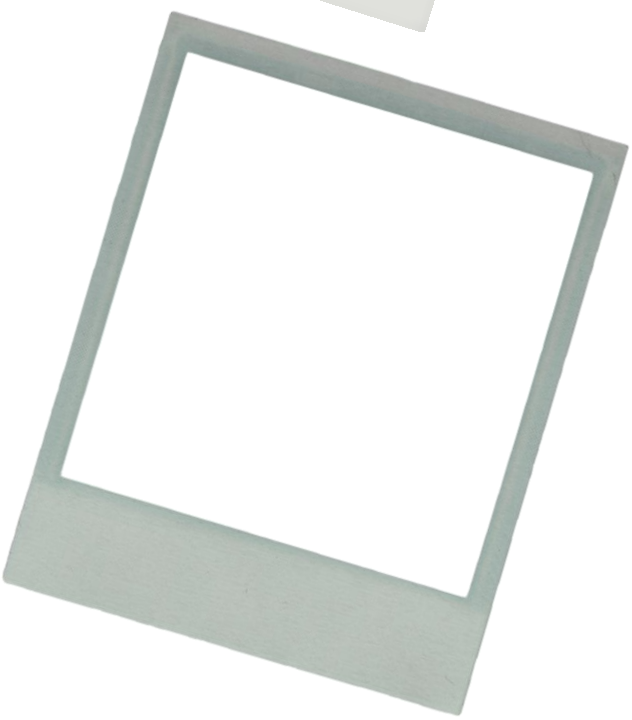
Fill in the table below by finding the list of animals at the zoo to help you answer the question.

What evolutionary benefit do tigers gain from having stripes?	
What evolutionary benefit do anteaters gain from an elongated face and jaw?	
What evolutionary benefit do spider monkeys gain from having a prehensile tail?	
What evolutionary benefit do owls gain from having silent flight feathers?	
What evolutionary benefit do fennec fox gain from having large ears?	
What evolutionary benefit do king vultures gain from have featherless heads and necks?	
What evolutionary advantage do African hunting dogs gain from living in groups?	
What evolutionary benefit does shedding their tail give the green iguana?	

At the Zoo Activities

As you go around the zoo, keep an eye out and if you see an animal that has a unique evolutionary trait, draw that trait. Make sure you write down the species!





At the Zoo Activities

This activity is to be used in the Nature Area of zoo, which is located past the Tiger Taiga enclosure and accessed through the tiger viewing tunnel.

Have the students explore the Nature Area and use the worksheet on the next page explore the Nature Area.

This can help understand how habitat has an impact on how animals adapt and evolve to survive in specific habitats.

Whilst the students are in the Nature Area, they can take the opportunity to discover what animals live there already. Remind the students that it won't be just birds and mammals that might live within the Nature Area—there could be reptiles, amphibians and invertebrates living in and around the water. The map below shows where the Nature Area is found within the zoo.

At the Zoo Activities

Exploring The Nature Area

Fill in the tally table below

Number of ponds:	
Number of streams/rivers:	
Number of trees:	
Number of flowers:	
Number of water plants:	
Number of open grass areas:	
Number of bushes and shrubs:	

What is the temperature? Circle the most relevant.

Cold **Warm** **Hot**

From the animals below circle the animals you think would survive in this habitat.

Fennec Fox	Eurasian Otter	Owl faced Butterfly
Burmese python	Humboldt's penguin	Rhinoceros iguana
Tarantula	Native frog	Roach

Post-Trip Classroom Ideas:

These are ideas to help teachers relate animals they have seen at the zoo to further learning about evolution. Use these ideas as a starting point with or without the pre-made activities and worksheets on the next pages.

1. Choose a species from the zoo and research its evolutionary history and create a timeline for that animal. More advanced students can research multiple animals.
2. Look into past civilisations creation myths, e.g. Ancient Egyptian, Aztec and Viking etc. and create a discussion about them seeing if there are any similarities between them, and if animals played a role in these. Comparisons could be drawn with present day civilisations.
3. Did the dinosaurs really go extinct? You may find some research into the theory that some dinosaurs evolved into birds. This can be used to stimulate class discussion.
4. Identify an animal that has not changed for millions of years and discuss why they have not changed for so long. This can be done in poster form or as a presentation.
5. Leading from Number 4, discuss if that animal could survive a major event such as climate change or a rapid decline in food or habitat. (Look into the animals' past. Has it survived a previous event?)
6. Create a poster for how island evolution can cause unique animals and plants. Australia and Madagascar are good examples.
7. Consider future evolution. Research into how the earth may change and how this might effect species evolution. Students could also look into human evolution; will the development of better technology affect our own evolution? Create a poster with a chosen species and using knowledge about adaptions, guess where evolution will take that species.

Post-Trip Classroom Activities:

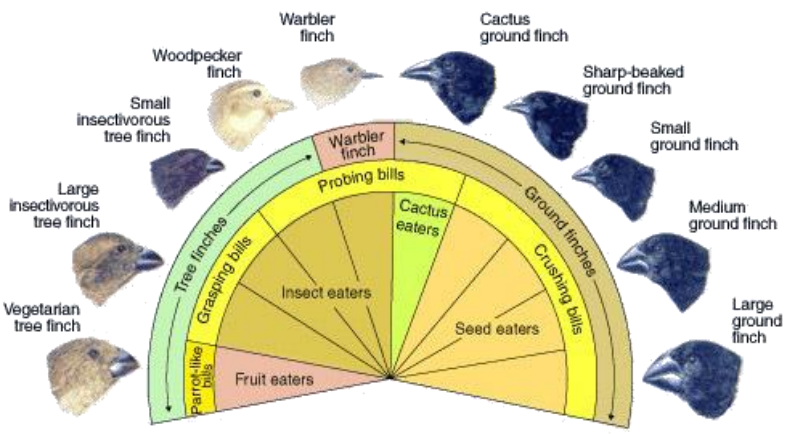
Darwin Finches Life Lottery

This activity is a good way to reinforce the concept of how different situations affect the survival of species.

Time: 10 minutes
Subjects: Science
Materials Required: The number cards found on the next page. If there are more than 10 students, multiples can be used.

Have the students stand in a circle and give out the numbered bird cards. Explain that when you call out a number the student(s) with that number sit down as they are out (can ask them to do a dramatic death or pretend to fly away).

Below is a graphic of the some of different finches that can help in creating new games.



Below is an example that can be used or feel free to develop your own scenario. Imagine that all of Darwin's finches are on one island. Times are changing and the finches face some challenges.

Bird card 2: The climate starts to warm and the fruiting plants die off as it's too hot. Bird 2 starves to death.

Bird card 4, 5, 7 and 10: As there are no fruits the insects all die off. Bird 4,5, 7 and 10 die from hunger too.

Bird card 8 and 9: The plants that produce the large seeds now die off. Meaning the beaks are too large and they lack the dexterity needed to eat the small seeds.

Bird card 1 and 6: the temperature continues to rise and now the plants with the small seeds die off.

Bird card 3: The plant that can survive the hotter climate is the cactus which means the cactus ground finch is the only survivor and thus the winner!

Evolution Life Lottery

1

Evolution Life Lottery

2

Evolution Life Lottery

3

Evolution Life Lottery

4

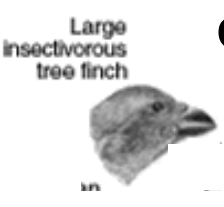
Evolution Life Lottery

5

Evolution Life Lottery

6

Evolution Life Lottery



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Evolution Life Lottery

8

Evolution Life Lottery

9

Evolution Life Lottery

10

Post-Trip Classroom Activities:
An Arms Race Top Trumps

This activity can help show how predator and prey animals compete in a race for survival to try and best each other.

Time: 45mins designing. 10mins playing the game.
Subject: Science
Materials needed: Drawing items.

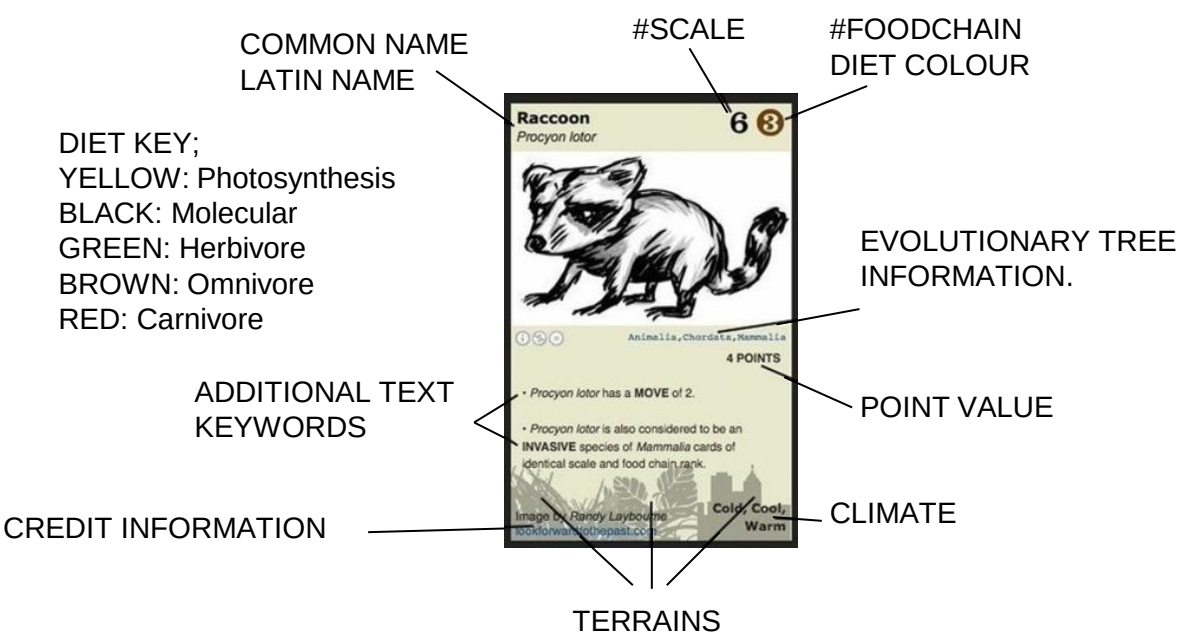
Divide the class into half and have one half create imaginary herbivores and the other half create imaginary carnivores. Can either create one each or work in small teams.
To ensure clarity the teacher can come up with layout and rules.
Key aspects to include are:

- What defences the animal would have—i.e. horns, camouflage, living in groups etc
- What weapons—i.e. types of claws, size of the teeth etc
- Tactics—i.e. ambush or living in groups etc.
- Once the cards have been created play rounds till you have winner!

Don't forget the birds, fish and other animals, not just mammals.

The students can also research real animals and create top trump cards on these animals. Can also include plants as well.

Below is an example of the type of playing card the students could create.



Post-Trip Classroom Activities:

Genetic Diversity

To explore the concept of genetic diversity.

Time: 20 minutes
Subjects: Science
Materials Required: Copies of the genetic wheel for each student.

Variation in animals is caused by genetic or environmental diversity. This variation might be beneficial to the animals survival. If the variation is beneficial, then over the course of many generations of animals, the might evolve so that this variation becomes a new adaptations that makes them better suited to their environment.

Have students fill in their genetic wheels. They should colour in each characteristic as it applies to them. Move circle by circle from the centre to the outside. They should record the number when they reach the edge of the circle.

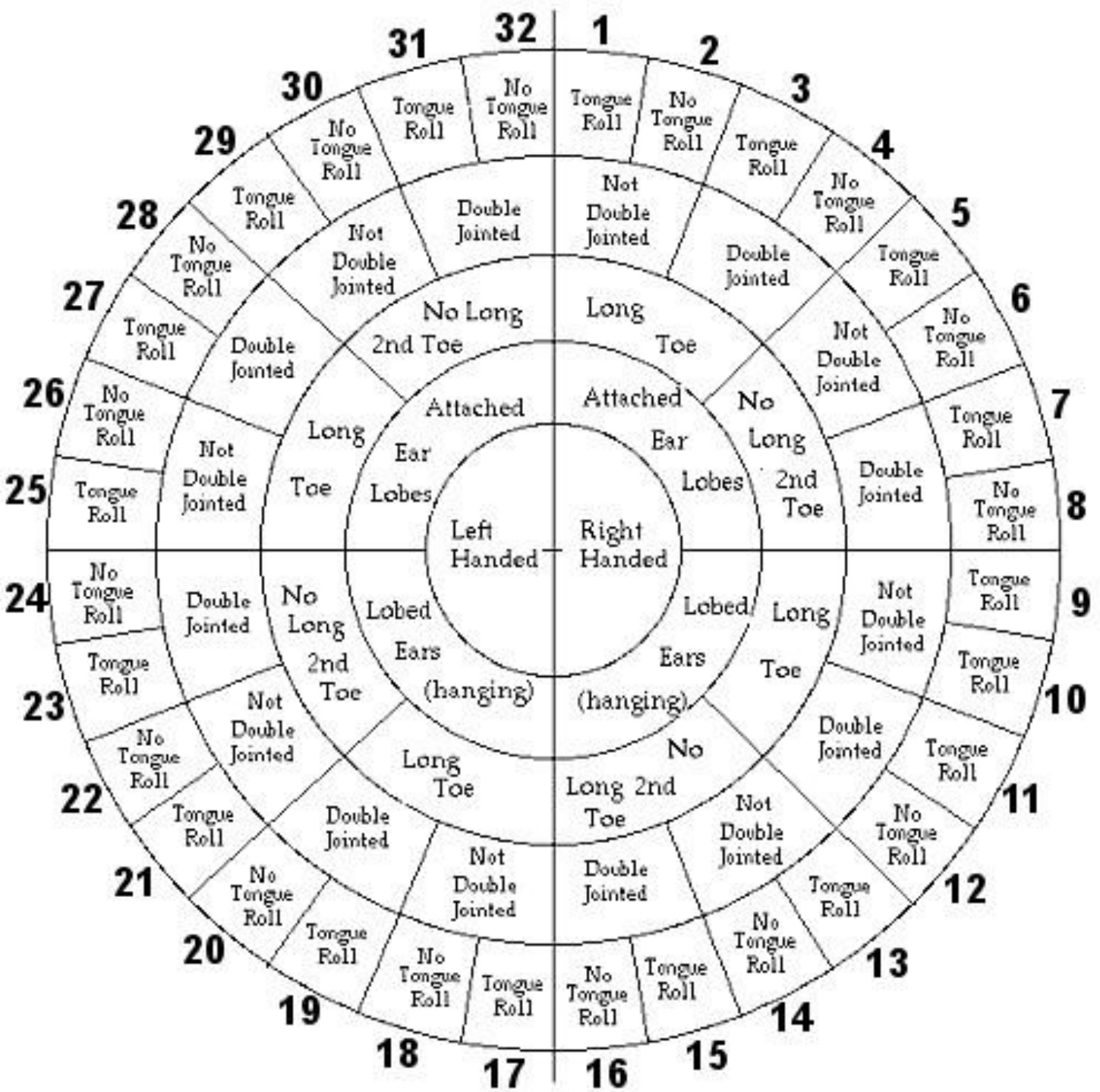
This is a very simplified study of genetics. Most of these traits are controlled by many genes, and are measured on a scale (not simply presence or absence). For the purposes of this study, it is assumed that the traits are genetically controlled by one gene which is recessive and the trait is present or absent.

Have students compare their numbers to others. How many of them had the same number? Find out where their numbers branches off.

Have students take copies home and create genetic wheels for their parents to investigate how their genetic inheritance works.

- Discuss if they think any of this variation might have benefits.
- Is it useful for survival to be right or left handed?
- Does having a tongue that rolls up provide any benefits?
- This can be tied into a discussion about the difference between variation/mutation and adaptations and why some adaptations evolve.

Genetic Diversity Wheel



Post-Trip Classroom Activities:

Reproductive Isolation

When two populations of the same species change sufficiently, they are unable to interbreed. When this happens the two populations are reproductively isolated. They are now two separate species, which are genetically isolated.

Reproductive Isolation Mechanisms

These are barriers that prevent successful interbreeding. There are two types of barriers;

PREZYGOTIC or POST ZYGOTIC

PREZYGOTIC Zygotes do not because gametes do not meet.	**POST ZYGOTIC** Zygotes are formed, but they do not produce mature fertile offspring.
Geographical isolation: the populations never meet because they inhabit different areas.	**Hybrid inviability**: the populations Interbreed, however the hybrid offspring produced fail to live to maturity.
Ecological isolation: the populations never meet because despite living in the same area, they live in different habitats within that area.	**Hybrid sterility**: The populations interbreed, however the hybrid offspring are sterile.
Temporal isolation: the populations never meet because despite living in the same area, they are active at different times of the day or reproduce at different times of the year.	**A zygote is the cell that is formed when the sperm and the eggs nuclei fuse**
Behavioural isolation: the populations meet, however they don't recognise each other's courtship displays.	 
Mechanical isolation: the populations meet, however they can't interbreed because their reproductive parts don't fit each other.	

Post-Trip Classroom Activities

Reproductive Isolation

Glenda and Derek

Use the information on the pervious sheet and once you have read through it decide which type of reproductive isolation mechanism is present for the following scenarios.
(The first one has been done for you as an example).

A. Glenda lives in Dublin and Derek lives in Perth. The two never meet…

PREZYGOTIC: GEOGRAPHICAL ISOLATION

B. Glenda and Derek live in Lyme Regis. Derek socialises at the Cliff Top Social Club. Glenda enjoys fine dining and the ballet. Glenda doesn't know where Cliff Top Social Club is or what a social club is!

_____

C. Glenda and Derek saw their 12 children grow up and reach adulthood, however none of the children had any of their own. Glenda and Derek had no grandchildren.

_____

D. Glenda and Derek both live in Southampton. Glenda works nightshift at an emergency animal rescue centre. If she does get out it is in early afternoon when Derek is at work. The two never meet.

_____

E. Derek has a big one! Too big! No way Mr!

_____

F. Glenda and Derek had 7 sickly children who all died in infancy. Glenda and Derek had no grandchildren.

_____

G. Glenda and Derek where on a date at the Golden Fleece Restaurant which was just off the A185. Over a sharing plater of deep fried mushroom and dips, Derek said, "Voulez vous couchez avec moi, ce soir?" Glenda stared blankly and replied, "No ta love, you can have the last two mushrooms". Derek looked confused. They then parted company and went to their separate homes.

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We hope you enjoyed your trip to

Learning about

Evolution