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What Can We Learn About Animals?

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Introduction

"The Easter Rabbit lays Easter eggs." "My favorite animals are horses and unicorns". Young children have a natural curiosity about animals. However, they have many misconceptions and confusions about how animals survive, raise their young, and fit into the food chain. They may know that birds lay eggs, but are unsure about whether fish do. Most are unfamiliar with the words amphibian and reptile. Some are sure that dragons and unicorns are real animals.

The purpose of this unit is to introduce young children to the five animal classes (mammals, birds, amphibians, fish, reptiles) and invertebrates, to learn to identify animal adaptations, and to form an idea about how or why that adaptation helps that animal to survive in its environment.

They will be introduced to two great naturalists: Carl Linnaeus and Charles Darwin. The students will become animal experts, knowing facts about many different animals, such as animal habitat and diet, predators and prey, and how animals reproduce and care for their young. These junior zoologists will publish and share classroom books about animals, doing research on a focus animal with books and video, and by observing live animals. The students will observe invertebrates in the school garden. They will use the Science Process skills of observe, predict, hypothesize, question, communicate, and investigate as they observe animal adaptations, animal morphology, and animal behavior at the Oakland Zoo. Also, the following animals will visit the room: snake, lizard, salamander, tarantula, gerbil, and bird. Most students are able to verbalize how animals are alike and different from each other. This unit encourages students to use several sources of information to answer questions about their focus animal. The skills that they will acquire are the ability to classify animals by class, to identify adaptations that help animals meet their needs, and form hypotheses about why an animal has that adaptation.

The three activities in this unit are designed to introduce students to the range of biodiversity in the animal world, to encourage students to make connections between the adaptations that they see and the animal's ability to thrive in its environment, and to encourage students to form hypotheses about animal structures and behaviors.

This unit will supplement FOSS Science kits. These are hands on, inquiry based units that teach the Science process skills, and our school has developed Science Notebooks that are used across all grade levels.

However, the Life Sciences Kit for our grade is on plants, and there is not any content knowledge on animals. This unit will give them a vast amount of background information about animals.

Rationale

We can only care about what we know, and my desire is for these students to grow into people who care deeply about ecology and habitat conservation. By learning about animals in depth, they will develop a strong appreciation for nature that will stay with them for life. I have selected two naturalists to focus on, Linnaeus, to introduce the concept of classification and taxonomy, and Darwin, to introduce the concept of evolution and adaptation. It is interesting to note that currently, in the United States, slightly more than 50% of the public believes that Evolution is the explanation for biodiversity, as opposed to Creationism, and 20% are unsure which is true. The only other country that approaches this number of believers in Creationism is Turkey. [1] This unit is written for my group of 20 First Grade students, but can be used for Kindergarten, Grade One or Grade Two, as all study life science. I currently teach in Emery Unified School District in Emeryville, California, a small district nestled between Oakland and Berkeley. Our students come from a wide range of socio economic backgrounds and many are English Language Learners.

My students are emergent writers who exited Kindergarten with about 50 sight words and the ability to write a few short sentences. By the end of First Grade they will be writing short stories using correct punctuation and capitalization, and interesting adjectives. This unit is meant to occur early in the year, and relies upon cloze sentences (frame sentences with blank spaces), which scaffold the job of writing for these beginners. These students have had practice writing questions or having me record their questions for a bulletin board about our Language Arts unit. They are encouraged to ask questions and make connections between what we are reading about and experiences in their own lives in order to better comprehend what is being taught. They have also had experience using Science Notebooks in Kindergarten. Each Science lesson has a heading and a date, a drawing of the investigation and observations recorded by the student to the best of his/her ability. I taught the same group of students in Kindergarten last year (my school practices looping – teaching the same group for two years), and we studied the following concepts that gave them some background knowledge about animals:

- List animals that we saw at a farm
- Compare goldfish to guppies (Foss Animals Two by Two)
- Compare land snails to water snails (Foss Animals Two by Two)
- List body parts of a fish (gills, eye, fins, tail)
- List animals that we have at home as pets

This unit is meant to be taught over the course of 6 weeks and will begin three weeks after the first day of school. Our district mandated curriculum of Language Arts and Math is taught in the morning and the hour after lunch, so I will be teaching the content of this unit during the last hour of the day, and the research and writing of this unit integrated into the writing block (during the Language Arts block).

Background

What does a teacher need to know in order to teach this unit? Here are four areas of information to give you background knowledge: the legacy of Carl Linnaeus, classification, evolutionary theory up to 1800, and Darwin's concept of evolution and its effect.

Carl Linnaeus or Carl Von Linne, and Binomial Nomenclature

Carl Linnaeus (also known as Carl Von Linne) was a Swedish botanist who is credited with developing this first system to order and classify living things. He lived from 1707 to 1778, and his ideas were aligned with Creationism. As a boy, he enjoyed working in the garden with his father. He continually asked his father the names of plants, and forgot them as quickly. His irritated father told him he would be given no more names unless he remembered them. Perhaps this sparked his interest in naming plants that would be his life's work. [2] He began studying Latin at age seven, and apprenticed to a doctor at a young age. He was taught botany and medicine (the two subjects were considered to be practically one and the same), and that the sexual structure of plants is comparable to that of human beings.

By age 24, he had published four books on plants, and went in 1732 on an expedition to Lapland for five months to study and catalogue plants. He had a good friend named Pehr Artedi, who was an expert on fish, reptiles, and amphibians. The two worked together for seven years and developed a way of calling plants and animals: binomial (by two names) nomenclature (naming). Artedi drowned in an Amsterdam canal in 1735, and Linnaeus continued his work alone. Linnaeus did not invent the use of two names to describe plants. The Romans, for example, would have described two different kinds of wheat as triticum Africam, and triticum Alexandrinum. The naturalist John Ray also called plants by two, three, or four word names, which began with the genus and species, and then described the plant with a short phrase. Linnaeus simplified the names, often combining the vernacular name with the Latin name. The first name is genus (beginning with an upper case letter) and the second name is species (beginning with a lower case letter), although Linnaeus' full rank system included five levels: kingdom, class, order, genus, and species. The second name often incorporates the name of a person related to the species or the species' common name. Linnaeus often named plants after people. For example a Magnolia tree is named after the French botanist Pierre Magnol, whom he admired, and the genus Sigesbeckia, a small weed that grows in the mud was named after his main critic, Johann Siegesbeck. His system became generally adopted by botanists and zoologists in the second half of the 18 th century due to the comprehensive volumes that he published, which soon became indispensable to naturalists. His system of binomial names is still used today.

Classification

The *Systema Natura*, was published in 1735, using Latin, the language of science at that time. This book was very well received and he rose in fame and fortune quickly. Linnaeus' classification of plants relied primarily upon the sexual system of plants. He counted the number of stamens (the male organ) to determine the class, and the number of pistils (the female organ) to determine the order. Victorian botanists were outraged that he used sexual systems to classify plants, finding this revolting and disgusting, and wondering how ladies would ever be able to count the sexual parts of plants. However, this system ensured that botanists were talking about the same plant, and reduced confusion in classifying plants and animals, facilitating the study of botany and zoology. [3] In a similar way, Linnaeus developed a system to sort animals based upon the morphology of

their structures, into different varieties. There have been a few changes to his categories, however, we still basically use the system that he introduced: Kingdom, Phylum, Class, Order, Family, Genus, and Specie. Here is an example of how a domestic dog would be listed using Scientific classification: Kingdom: Animalia, Phylum: Chordata, Class: Mammalia, Order: Carnivora, Family: Canidae, Genus: Canis, Species: C. lupus.

These categories are based on common physical characteristics, which move from general to specific and narrow. Most of the animals that First Grade students will research are vertebrates or Chordata. However, there are eight other phylum: *Porifa, Cnidara, Platyhleminthes,* and *Nematoda* – these four take their place closest down to the base of the tree of *Animalia*, or Animals, followed by a two more branches. On one branch are three more phyla: *Mollusca* (marine animals with shells), *Arthropoda* (animals with jointed legs and an exoskeleton, such as insects, arachnids, crustaceans, millipedes, centipedes), and *Annelida* (worms). Finally on the other branch there are two phyla: *Echinoderm* (animals such as a star fish) and *Chordate* (animals with a backbone, or Vertebrates). When small children think of animals, they are usually thinking of this last group, Vertebrates, which make up only five per cent of all animals. Vertebrates are then separated into the five classes: *Mammalia (*Mammals*)*, *Reptilia* (Reptiles), *Aves* (Birds), *Amphibia* (Amphibians), and *Ichthyetes* (Fish). There are three kinds of Mammals: monotremes, marsupials, and placental mammals. Reptiles are ectothermal, and cannot regulate their inner body temperature. Birds have feathers and lay eggs. Amphibians have two different life stages. And finally there are three types of Fish: cartilaginous (like sharks), ray finned, and lobe finned.

Jean Baptiste Lamarck was responsible for organizing animals into the two major groups of vertebrates and invertebrates. He was the Chair of Botany at the Jardin du Roi in Paris, France from 1788 to 1793. After the French Revolution, this became the Musee National d'Histoire Naturelle (The National Natural History Museum). At age 49, he was given the role of 'Professor of Worms', which was a subject he knew little about. He spent the rest of his life categorizing invertebrates, a term that he coined. In 1803, he published on the groups Crustacea, Arachnida, Annelida, Insecta, and Mollusca, which he had named and defined.

Taxonomy is now the domain of an organization called the International Code of Zoological Nomenclature (ICZN), which names animals, and another called the International Code of Nomenclature for algae, fungi, and plants. The difference between classifying and taxonomy is that taxonomy is the science of identifying and naming species and organizing them into systems of classification. Taxonomy includes both classification and nomenclature. Classification deals with figuring out which species a specimen belongs in. Today, scientists look at DNA directly to sequence genetic code. [4]

It is interesting to note that Linnaeus added humans to the "Great Chain of Being", a popular concept from the middle ages, which ordered minerals, plants, and animals in an ascending hierarchy, placing humans at the top of the staircase of life, in the group of animals called primates, which includes humans, other apes, and monkeys. He gave us our name *Homo sapiens*, or wise man. Linnaeus' system alluded to the relationship between the members of the same genus, but did not assert that organisms are related. Reaction to his works sparked interest in natural history during the 18 th century.

Evolutionary Theory (or the lack thereof) up to 1800

Until the publication of Darwin's *On The Origin of Species*, common belief among educated Westerners was that the account in Genesis, the first book of the Bible, was literally true, that the earth was thousands, and not billions of years old. It was believed that God created all species on Earth in the Garden of Eden, Adam named them, and they were in their original state, waiting to be discovered by explorers. God was thought of

as a benevolent Creator, who had made all the plants and animals for human beings to enjoy. In Europe, as explorers returned to Europe with new specimens that were unknown, it became difficult to justify the diversity being encountered within the Biblical paradigm. Essays were being published (The Edinburgh Review) about the new life forms being discovered on oceanic islands, but they were published anonymously for fear of persecution for heresy. [5]

In 1654, James Ussher, an Irish Archbishop, determined that the Earth was created in 4004 BC, by counting generations in the Bible. Up until late the 1800's, it was thought that the earth was thousands, and not billions, of years old. Likewise the idea that fossils represent extinct species had not yet been introduced. Fossilized shells found in high mountain areas and mines far from the sea were explained as having been brought there by Noah's flood. Fossils of animals that seemed to be extinct were thought to still be alive, undiscovered, somewhere on earth. However the works of Jean Baptiste Lamarck and Charles Lyell greatly influenced Darwin's wonderings about a different explanation. They put forth ideas about the Earth's dramatic past, along with Georges-Louis Leclerc (The Comte de Buffon), John Ray, James Hutton, William Smith, and the Baron George Cuvier. Jean Baptiste Lamarck posited that living things can change in reaction to their environments and acquire characteristics, and was a great influence on Charles Darwin. Charles Lyell, a British lawyer and geologist who published *The Principles of Geology* in three volumes between 1830 and 1833. Lyell estimated the age of the earth to be hundreds of millions of years old. His main idea in Volume 1 was his doctrine of Unifomitarianism -the assumption that what we see now here on Earth can describe the story of the Earth's past. Charles Darwin built upon Lyell's ideas, and became a close friend of Lyell in his later life. Lyell's work was the single greatest influence upon Darwin's thinking. It is unlikely that he could have put forth his theory of Evolution without it. Lyell remained a Creationist until late in his life.

Charles Darwin

Life from 1809-1831

Charles Darwin was a British naturalist who was born in 1809, the son of a physician, and the grandson of Erasmus Darwin, a physician and biologist. He loved collecting rocks and insects, and studying birds as a young boy. He enjoyed helping his older brother in conducting chemistry experiments in the tool house, and went in 1825 with the same brother to study medicine at Edinburgh University (in Scotland). The reluctant medical student began studying natural history, and was introduced to the ideas of Jean Baptiste Lamarck, whose *Philosophie Zoologique* (1809) stated that species had the ability to acquire characteristics in response to their environment, and pass those characteristics on to their offspring. Charles' Grandfather, Erasmus Darwin, who published *Zoonomia: or the Laws of Organic Life* in 1796, shared this view. Although Charles never met his grandfather, who died before he was born, ideas about evolution were discussed in Charles' free thinking family's home, and certainly influenced young Charles. He began to study Marine Biology, attending the Royal Society of Edinburgh, which met to discuss and debate Scientific Research. Charles then spent three years at Cambridge, ostensibly to study Theology; however, Darwin described these as wasted years. [6] He developed a friendship with Prof. Henslow, a geologist, and accompanied him on several outings to look for fossils in North Wales.

The Voyage of the Beagle 1831 to 1836

Professor Henslow recommended Darwin as a naturalist to the captain of the Beagle, a ship that was setting out on a mapping and exploring mission. Darwin described the voyage of the Beagle as the most important event in his life. In 1831, the Beagle set out on the journey that was meant to last two years. In fact it lasted

five years. Darwin's own account of the trip implies that he began with a strong hunch about evolution, and it grew stronger with observations that led to the distillation of the principle of natural selection and the law of divergence. [7] Darwin recorded his experiences on this trip in his journal, *The Voyage of HMS Beagle*. The Beagle made its voyage down the eastern side of South America, around Tierra Del Fuego, and up the western side of South America, with an important stop at the Galapagos Islands. It also traveled to Tahiti, New Zealand, and Australia. Darwin made extensive observations of geology, plant life, and animals along the way, and collected specimens. Here are a few of his key findings: he discovered a fossil of a giant extinct armadillo-like animal (glyptodon) that shared the body armor and shape of extant armadillo species. Darwin described the phenomenon of species changing only moderately (usually becoming smaller) than their extinct prototypes, calling it a "law of the succession of types". This had also been described by Lyell, who had commented on finding extinct marsupials in caves of Australia. Darwin also noticed that as he travelled down the east side of South America he saw similar, or "closely allied animals replace one another in proceeding southwards" [8] . The paleontological and geographic variation gave him evidence of the ability of species to change over time. Darwin wrote of "becoming a zealous disciple of Mr. Lyell's book", and proclaimed himself to be a uniformitarian. He described, in a letter to his sister (April 1835), collecting shells at an elevation of 12,000 feet in the Andes, and how he hopes they will "give an approximate age to these mountains." [9]

Darwin is usually associated with the Galapagos Islands, an archipelago with many endemic species located 600 miles off the coast of South America near Ecuador. The islands are named for the Spanish word, tortoise, because of the giant tortoises which sailors found so tasty. The Beagle stopped here for five weeks, of which Darwin spent three on shore. The islands had been a stop for pirates and whalers, and only recently, on Charles Island, a small settlement of two or three hundred Ecuadoran people who were banished for different crimes had been established. The islands are about 50 or 60 miles from each other, some being lush and forested, others arid and barren of vegetation. The sea is very deep between them, so there is no evidence that the islands were ever united, but rather formed volcanically. Here, Darwin found evidence that species variation can occur within a geographic area. Darwin found finches with different beaks on each different island, perfectly adapted to their island's food sources. He believed that all the varieties of finches originally came from one variety of mainland finches. He also found tortoises from each island having distinctions. Some tortoises had shells that turned up in the front "like an English saddle", while others had rounder, blacker shells, and were tastier to eat. Darwin observed marine iguanas, unique to the Galapagos, that swim in the sea to feed on seaweed. Darwin also found plenty of variety among insects and plants of the Galapagos. Now, in addition to seeing how variation could occur over wide geographic areas of across great distances of time, was evidence that within the same geographic area, variation in isolation could occur.

The Long Delay 1836-1859

There was a twenty-three year delay between Darwin's return from his trip on the Beagle in 1836, to the publication in the year 1859. Both Erasmus Darwin (Charles' grandfather) and Jean Baptiste Lamarck had presented the heretical idea that species are derived from, and descend from, common ancestors, rather than being specially created. The work of Erasmus Darwin (*Zoonomia* in 1796), and Lamarck (*Zoological Philosophy* in 1809) had been met with a hostile reaction from the church, and Erasmus Darwin's publisher had been jailed. In the eyes of the Church, to discredit the Bible meant removing human beings from the center of the universe, and detaching man from God. During this time, Darwin refined his ideas and gathered more information to support his theories. He published his journal of the trip on the Beagle in 1839, which was well received and established him as a popular author. His friend Henslow, who had set him up with the trip, had shared some of his letters written from the Beagle with other biologists at the Philosophical Society of Cambridge, and Darwin found himself welcomed into the world of Scientists. In 1839 he married his cousin,

Emma Wedgewood, and they started a family. He became a geologist alongside of Lyell, and studied Coral Reefs, publishing on that subject in 1842. At some point during his trip, Darwin had contracted a parasitic disease (probably Chagas' disease) that he struggled with for the rest of his life. Because he was so often confined to his home, he became a prolific letter writer, corresponding with other biologists, gardeners, gamekeepers, animal and plant breeders, and people he had met in different parts of the world. These letters have been great source of information. He also became an expert on barnacles, and spent eight years deeply involved in barnacle research.

On The Origin of Species

In 1844, Darwin finished his first draft of *On The Origin of Species*. He still didn't feel compelled to publish, but rather seemed content to continue his daily research. Ironically, after a long wait, Darwin rushed to finish his opus at the end of 1858. His friend and colleague, Alfred Russel Wallace, was simultaneously working on a similar theory, and had written to him for advice. Wallace and Darwin wrote a joint paper in June of 1858 entitled *The Tendency of Species to form Varieties; and on the perpetuation of Varieties and Species by Means of Selection*, which was presented, to the Linnaean Society. The paper did not get much attention, however Darwin hurriedly got his book published 18 months later in order to establish public claim. Darwin was the first to use empirical data, argument upon argument, and simple logic to prove his idea that the reason we see biodiversity was not because each species was individually created, as previously thought, but because each species are lineal descendants of other species. This is the idea that the fastest, strongest, or best able to withstand hardships and successfully reproduce, will be the species that we see before us.

Natural Selection

Darwin used the example of how man has domesticated wild plants by choosing the best ones to propagate, allowing for better quality fruits than one would find in the wild. Likewise, domesticated animals are bred to improve certain qualities. Darwin became very familiar with pigeon breeders, and learned how breeds are improved when breeders notice small differences among their animals. These same individual differences occur in nature. Flowers with the most attractive blossoms get more bee visits and have greater pollination. He noted that some plants and animals evolved together, such as the red clover and the 'humble-bees' corolla and proboscis that encouraged the maximum amount of pollen to get on the bees head during visits to the clover. These adaptations, or traits, that helps an organism to function and meet its needs, are evident in all animals and plants:

> "How have all those exquisite adaptations of one part of the organization to another part and to the conditions of life and of one distinct organic being to another being been perfected? We see these beautiful co-adaptations most plainly in the woodpecker and mistletoe; and only a little less plainly in the humblest parasite which clings to the hairs of a quadruped or feathers of a bird; in the structure of the beetle which dives through the water; in the plumed seed which is wafted by the gentlest breeze; in short, we see beautiful adaptations everywhere and in every part of the organic world." [10]

The Struggle for Existence

Upon returning home from his trip, Darwin read the work of Thomas Robert Malthus, an English scholar who wrote about the effect that the Industrial Revolution had upon human populations. He observed that two factors that work upon population growth are famine and disease. At some point, he wrote, "The power of population is indefinitely greater than the power in the earth to produce subsistence for man." [11] To Darwin,

this meant that as a group of animals became more numerous, at some point the limit of resources available to those animals would put pressure on the group. Darwin stated, "It at once struck me that under these circumstances favorable variations would tend to be preserved, and unfavorable ones destroyed. The results of this would be the formation of new species. Here, then, I had at last got a theory by which to work." [12] Darwin noted many other issues that cause a group to struggle. Some animals have to endure very harsh climates. Their ability to live in very cold or very hot places determines their success (for example, the Emperor Penguin or the Desert Tortoise). Other species face the attacks of predators or the challenge of catching prey. Although a frog may lay hundreds of eggs, only one or two will survive to adulthood and breed. The ability to run the fastest, hide, or attack and catch enough prey determines their success. Still others compete with similar species struggling over the same district for food, or surviving drought or severe storms.

Inheritance

Darwin stated that the individuals with traits that helped them survive were most likely to survive and reproduce. In turn, the offspring of these animals would inherit those traits that had made their parents the fittest. The phrase 'survival of the fittest' came from Darwin's friend Herbert Spencer. He emphasized that a fit individual was one of the species that reproduced. Individuals with those traits that had handicapped them would be less likely to reach maturity, and would find it more difficult to find a mate and reproduce. As a result, those traits would slowly disappear form the population. Over many generations, the species would transform. Darwin called this process Natural Selection.

The Effect of the Origin

On The Origin of Species was published in 1859, and over 90 publications reviewed it. There was, as expected, a tremendous amount of hostile reaction to it from the Church. Anglican clergymen (11,000) made a declaration stating that the Bible must be read literally. Many scientists, however, received it with enthusiasm. There was a famous debate in June of 1860, between Henry Huxley, a biologist known as Darwin's bulldog for his defense of Darwin, and Bishop Wilberforce. Most believe Huxley to have won the debate, and within a decade, most educated people believed his theory of Evolution, and not Creationism, to be the reason why biodiversity occurs.

Charles Darwin continued his work, publishing *The Descent of Man* in 1871. Asa Gray spread his work to the United States, and Ernst Haeckel spread his work to Germany. Darwin died in 1882, and was buried in Westminster Abbey next to Lyell. In the United States, evolution teaching was challenged in 1925 during the Scopes trial. This led to the Butler Act, which banned the teaching of evolution. However, in 1967 the Butler Act was repealed, and in 1968, the U.S. Supreme Court prevented any State from banning evolutionary teaching to promote religion.

Darwin's ideas have influenced the fields of virology and bacteriology and how doctors use anti-viral and antibiotic drugs to fight infections, as they have to consider antibiotic resistance to drugs. Darwin's ideas have led to animal welfare laws, and the outlawing of research on primates, whereas before Darwin, animals were seen as having been created for man's pleasure and benefit. His ideas have changed the way we think about our natural world, and how we affect it.

Classroom Activities

These classroom activities help students to be introduced to a focal animal, then look closely at the animal's adaptations, and then form a hypothesis about why their animal has that adaptation.

Activity One: Expository Writing

The second unit in our Language Arts series (Open Court Reading) is titled Animals, and consists of a six -week unit with fiction, poetry, and non -fiction about animals. This will provide a great introduction to our unit about animals and adaptations. The first activity has the goal of showing students the range of biodiversity contained in the kingdom of animals. They will each complete at least on booklet about an animal, so we will have between twenty and forty booklets about a variety of animal families. This will be their first research and expository writing activity. This activity will begin with students generating an extensive list of animal names. Prompts such as "Can you think of an animal with wings? With a tail? With fins? With no legs?" will help students to brainstorm. We will draw upon the students' experiences in the garden with insects, snails, and slugs. Students can be invited up to write the name phonetically on the list. This activity can be done for a ten -minute period on several days cumulatively. When we have a long list of many animals, I will introduce the concept that we can sort these animals into different groups, and introduce the word class, explaining that animals that share certain traits make a class, just like our learning community is called a class. Use large pieces of construction paper to make six posters labeled: *Mammalia (*Mammals*)*, *Reptilia* (Reptiles), *Aves* (Birds), *Amphibia* (Amphibians), *Ichthyetes* (Fish) and *Invertebrates*. Leave a blank space (about 12 inches) under the title for adaptations. These will be added to the poster during the second activity. Students will choose an animal from the long list that interests and excites them by writing their name next it on the list, hopefully a few from each order/genus. Transfer these species' names onto the appropriate class poster. You will have the names of twenty species on the class posters. These will be posted in the writing area. We will then go to the school library and check out trade books on their focal animal.

Students are emergent writers at this point in the first grade year, and will need the support of a cloze (frame) sentence to write their first piece of expository writing. I will post the following sentence strips in a pocket chart at eye level in the writing center, and help students write these sentences into six-page booklets. I use a simple two-page, two-sided template, which has a cover and pages one through six with four lines of first –grade writing space on each page (room for an illustration on top).

- Title: All about _____ by _____
- Page 1: Do you know about ___?
- Page 2: ___can ___(swim, jump, run).
- Page 3: ___ live in ___(continent).
- Page 4: ___ eat ___(other animals, plants).
- Page 5: ___do/do not take care of their babies.
- Page 6: An interesting fact about ___ is ___.

The writing will be introduced during small group work time, when I work with a different group of four students daily. Students will conference with me during small group time to focus on the writing process and help with print conventions and content, so each child can successfully finish a report. Most students will need help with finding 'one interesting fact' about the focus animal for page 6. Students will continue working on their writing independently during writing time. This is a separate block of time when the whole class is writing

silently. During this time, I call students up for a quick check (about two minutes), one at a time, to keep them on task. Here is the way I teach them to complete their books: 1) Write sentence one on page one, sentence two on page two, etc. 2) Draw pictures with a pencil. 3) Color in your illustrations. 4) Decorate the cover and add a photo from the animal photo file. During this writing process, some students who are fluent writers will complete a book and go on to begin a second book in the same time it takes reluctant writers to write the text of their booklet. I will provide photos of pictures that the students select for the reports from donated nature magazines, National Geographic, and animal files that I have been collecting for the past few months to use on the cover or on other pages.

Students will be motivated to complete their booklets in order to report out to the class, reading his/her report aloud, and sharing it with parents at home as part of homework. Students will also present his/her report to other students as part of Buddy Reading (reading to an older student), and to other first grade classes. Finally, the books will be housed in our classroom library for students to read during free choice time. This section of the unit will take four weeks from introduction to final booklets being published and illustrated.

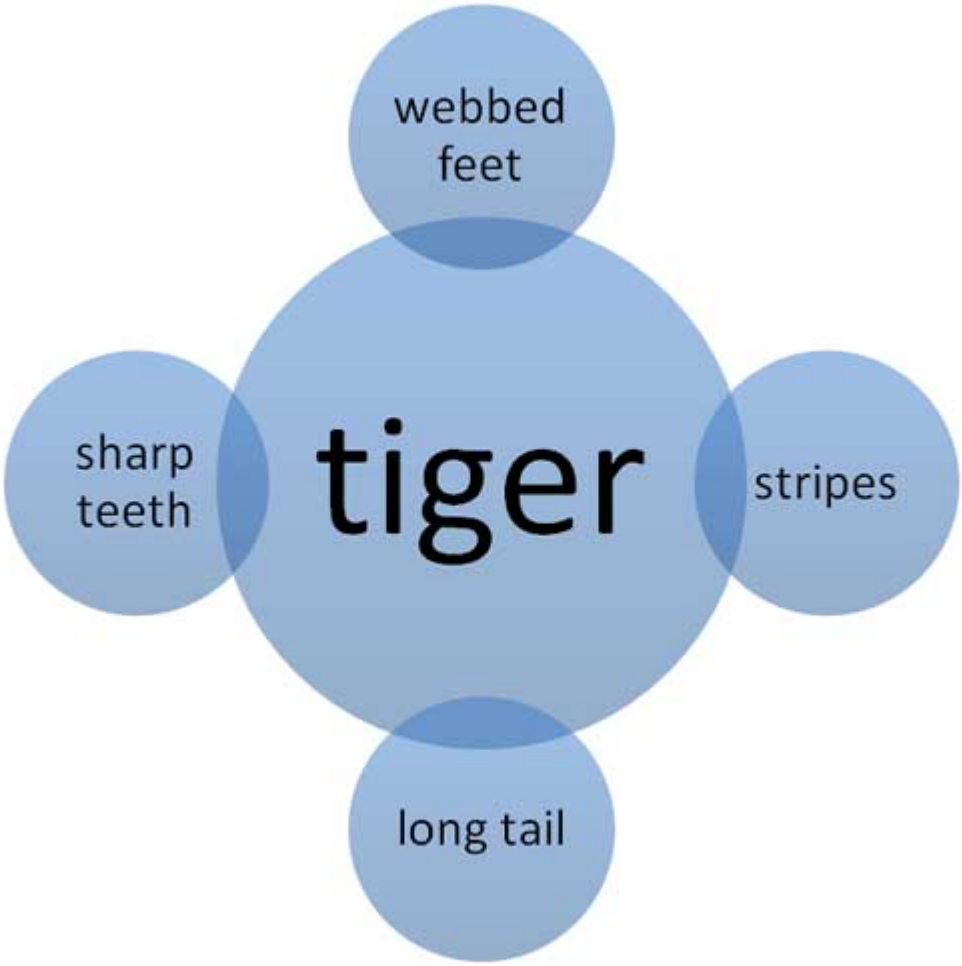
Activity Two: Exploring Animal Traits

It is important for students to understand that animals can be described by looking at their physical structures and adaptations. The second activity will teach students to identify adaptations as a trait that helps an animal to survive in its environment. We will go on a field trip to the Oakland Zoo to observe many different animals, and observe animal adaptations.

Parents will be enlisted to ask the students what adaptations they would like photographed, and we will use these photos in class to accompany pieces of writing.

Students will be introduced to this concept by filling in a "web" listing the adaptations of their focal animal. This is a graphic organizer with an oval in the center where the animal name is, surrounded by lines coming out from the oval (like legs from a spider) where the student records traits that the animal has. I will model this in class, before the trip, and we will practice by filling out several each day in the week leading up to the zoo trip. At the zoo, each student will have a clipboard and a packet of 10 blank webs to fill out. He/she will choose an animal, list it's name in the center of the web, and record four structural details of the animal. Space will be provided at the side for an illustration of the animal and notes.

Example:



Back at school, this worksheet will assist the student in forming sentences about adaptations. Example: "A tiger has stripes. A tiger has webbed feet. A tiger has a long tail. A tiger has sharp teeth." These will be stapled together into books for each Class (Mammals, Birds, Fish, Amphibians, Reptiles). I will also introduce the game "Guess my animal". A student will choose a web worksheet, holding it so that the class cannot see. He/she will give clues such as "This animal has no legs. This animal has fins. This animal is a large predator. This animal keeps growing teeth its whole life." Class members can guess and, if correct, the player will turn over the web to reveal the answer. Students will also write riddles based on questions using the word "who". Example "Who has a long neck? Who has spots? Who is an herbivore? Who lives in Africa? A giraffe, that's who! ".

I will begin introducing animal guests to our classroom, some from our Science lab, colleagues' classrooms, and others from the student's homes. This will provide an opportunity for observation and communication. Students will be enlisted to make identification signs for the guests, including specie, binomial nomenclature, habitat and diet.

Building on the concept that animals have traits and adaptations, the students will be introduced to how and why people study animals. Write the words *biologist* (from the Latin bio, or life), *naturalist* (from the word nature), and *zoologist* on the board and ask the students to guess what these words mean. Underline bio (from the Latin bio, or life), natura (from the word nature), and zoo to help them see the roots of these words.

Explain that many people have studied animals and plants, and they are called biologists. People who study animals are zoologists, and point out that the students are all becoming zoologists. Tell the students that we will learn about two of these biologists, Carl Von Linne, or Linnaeus, and Charles Darwin. Highlight that both of these biologists lived over 200 years ago, and we have learned a lot more about animals since then, as ideas change because we make new discoveries. As you read about Linnaeus' work on classification, add these traits to the six different animal family posters.

Mammalia (Mammals*)*

- have hair (whales and other cetaceans only have hair during their early development)
- feed their babies milk
- have a jawbone
- are endothermic (their body temperature can be regulated)

Reptilia (Reptiles)

- have scales on their skin
- some have 4 legs and claws
- some have no legs (snakes)
- are ectothermic (unable to regulate their body temperature)
- lay eggs, but a few give birth to live young

Aves (Birds)

- lay eggs
- are endothermic (their body temperature can be regulated)
- have feathers
- most birds can fly (ostrich, emu, penguin can not)

Amphibia (Amphibians)

- have moist, scaleless skin (they need to stay wet or they will die)
- can 'go to sleep" in hot weather (estivation) or in cold weather (hibernation)
- are ectothermic (unable to regulate their body temperature)
- lay eggs that hatch into a larval stage
- do not have claws

Ichthyetes (Fish)

- are mostly ectothermic
- have gills slits which they use to breathe by drawing oxygen out of the water
- are covered with scales
- have fins

Invertebrates

- have no backbone
- lay eggs
- some have a soft body covering

- some have an exoskeleton
- there are many kinds of invertebrates

At this point you will need several books to introduce the students to the work of Carl Von Linne, or Linnnaeus, and Charles Darwin. These are listed in the resources section. After reading about the work of Carl Linnaeus, discuss why biologists need to know how to classify animals and plants, review the idea that different animal families share similar traits and structures. Here is a game that will reinforce the concept of classification: prepare a few photos of animals from all six families and have double sided tape available. Students will be divided into teams and given a photo of one animal. They need to decide where it belongs (five minutes) and then come back to the rug area to share out. Each group can post the picture on the poster where it belongs and explain why. Each student should be encouraged to read one of the traits and form a sentence about the animal (Example: "This is a fish because it has scales and it swims."). This activity can be played as a short transition between activities (fifteen minutes) or repeated through several times. The teacher should celebrate questions and assist students who are not sure where to place animal photos.

The concepts of Charles Darwin can be simplified for young children by explaining that in nature, animals have to face different challenges. To explain the survival of the fittest, we will look at how climate and food supply affects a group of animals. How do animals survive through a drought or a harsh storm? Sometimes it is through behaviors of a flock or a group of animals. Sometimes it is the fastest and strongest animals that survive. Nature videos will be helpful to illustrate the struggle that species have to endure harsh weather challenges and predator/prey issues. Students will understand that the animals that survive challenges are the most likely to reproduce. Students also need to recognize the need to help animals survive in the wild, because people are moving into their habitats, and changing their habitat.

Activity Three: Forming a Hypothesis

By now, the students have gained knowledge about how animals differ from each other, and how animal adaptations help animals survive in their environment. The last activity will focus on the connection between morphology and environment. As we read about, view video of, or view photos of animals, I will model asking the following questions:

- Where does this animal live?
- What is its habitat?
- What structures do you notice that help this animal live in its habitat?
- What does this animal need to live?
- What does it like to eat?
- How do its structures help it to get food?
- Is it a predator or prey?
- Is it nocturnal and diurnal?
- What is the animal's place in the food chain?

Students will then be encouraged to ask questions about animal's adaptations and structures, based on observations and research. This is a difficult task for young children – they will often make a statement when asked to form a question, so the use of many examples, and practice will be necessary. Post a bulletin board with the heading "That's a good question!" Students will be given index cards to record questions. We will then pair up for a pair/share. Students will exchange questions with a classmate, and have 5 minutes to discuss the questions (then they switch roles). The use of pair/share helps the student to practice the sentence aloud, and will make the task of writing easier. Students will then go their seats to answer the

question with a hypothesis, finishing the sentence "I think that ___ have ___ so that they can _____." This frame sentence will be posted at eye level. This activity can be done a few days in a row for a short amount of time, or extended to a thirty -minute period.

Following this activity, we will practice forming hypotheses with one more writing activity. We will use photos taken on the zoo trip to illustrate the following form: "At the zoo, I saw a ____. It is a kind of (mammal, bird, amphibian, reptile, fish). It has _____ that help them to _____." These can be mounted with photos and displayed on our writer's wall.

Through completing this unit, students will gain a love of learning about animals, critical thinking skills, and the courage to form new ideas by observing and communicating with their peers.

Bibliography/Resources

Bibliography/Resources for the Teacher:

Coyne, Jerry A. *Why evolution is true*. New York: Viking, 2009. Print.

Darwin, Charles. *The Voyage of the Beagle*. Auckland: Floating Press, 1839. Print.

Darwin, Charles, and Francis Darwin. *The life and letters of Charles Darwin, including an autobiographical chapter.* New York: Basic Books, 1959. Print.

Darwin, Charles, Robert Jastrow, and Kenneth Korey. *The essential Darwin*. Boston: Little, Brown, 1984. Print.

Darwin, Charles, and Francis Darwin. *The autobiography of Charles Darwin*. Amherst, N.Y.: Prometheus Books, 2000. Print.

Eiseley, Loren C.. *Darwin's century: evolution and the men who discovered it*. [1st ed. Garden City, N.Y.: Doubleday, 1958. Print.

FitzRoy, Robert, and Charles Darwin. *A narrative of the voyage of HMS Beagle: being passages from the 'Narrative' written by Captain Robert FitzRoy, R.N., together with extracts from his logs, reports and letters, additional material from the diary and letters of Charles Darwin, notes from M*. London: Folio Society, 1977. Print.

Hickson, W. E., and T. R. Malthus. *Malthus an essay on the principle of population in refutation of the theory of the Rev. T.R. Malthus.* London: Taylor, Walton, and Maberly, 1849. Print.

Huxley, Robert. *The great naturalists*. London: Thames & Hudson, 2007. Print.

Knapp, Sandra. "What is Taxonomy?" *Natural History Museum*. London Museum of Natural History, 1 Jan. 2012. Web. 14 July 2012. www.nhm.ac.uk/nature-online/ science-of-natural-history>.

Lyell, Charles, and M. J. S. Rudwick. *Principles of geology*. Chicago: University of Chicago Press, 19901991. Print.

Stearns, S. C., and Rolf F. Hoekstra. *Evolution: an introduction*. London: Oxford University Press, 2000. Print.

"The Linnaean Correspondence." *c18*. Version 1. Swedish Linnaean Society, The Royal Swedish Academy of Sciences, Uppsala University, the Linnaean Society of London, 1 Jan. 2012. Web. 13 July 2012. http://linnaeus.c18.net/Doc/lbio.php>.

Bibliography/Resources for the Classroom and Read Aloud

Anderson, Margaret Jean. *Carl Linnaeus: father of classification*. Springfield, NJ: Enslow Publishers, 1997. Print.

Gutnik, Martin J. *The science of classification: finding order among living and nonliving objects*. New York: F. Watts, 1980. Print. Read Aloud

Lasky, Kathryn, Matthew Trueman, and LLC Books. *One beetle too many the extraordinary adventures of Charles Darwin*. Unabridged. ed. Prince Frederick, MD: Recorded Books, 2010. Print. Read Aloud

Pringle, Laurence P., and Steve Jenkins. *Billions of years, amazing changes: the story of evolution*. Honesdale, Pa.: Boyds Mills, 2011. Print. Read Aloud

Schanzer, Rosalyn. *What Darwin saw: the journey that changed the world*. Washington, D.C.: National Geographic, 2009. Print. Read Aloud

Silverstein, Alvin, Virginia B. Silverstein, and Lee J. Ames. *Carl Linnaeus: the man who put the world of life in order*. New York: John Day, 1969. Print. Read Aloud

The tree of life: a book depicting the life of Charles Darwin, naturalist, geologist & thinker. New York: Farrar Straus Giroux, 2003. Print. Read Aloud

Winston, Robert M. L. *Evolution revolution*. London: DK Pub. 2009. Print. Read Aloud

Endnotes

1. Coyne, Jerry A. *Why evolution is true*. New York: Viking, 2009.
2. Swedish Linnaean Society, The Royal Swedish Academy of Sciences, Uppsala University, the Linnaean Society of London. "The Linnaean Correspondence." c18. http://linnaeus.c18.net/Doc/lbio.php
3. Huxley, Robert. *The great naturalists*. London: Thames & Hudson, 2007.
4. Knapp, Sandra. "What is Taxonomy?." *Natural History Museum*. London Museum of Natural History, 1 Jan. 2012. Web. 14 July 2012. www.nhm.ac.uk/nature-online/ science-of-natural-history
5. Eiseley, Loren C. *Darwin's century: evolution and the men who discovered it*. [1st ed. Garden City, N.Y.: Doubleday, 1958. Print.
6. Darwin, Charles, and Francis Darwin. *The autobiography of Charles Darwin*. Amherst, N.Y.: Prometheus Books, 2000. Print.
7. Darwin, Charles. *The Voyage of the Beagle*. Auckland: Floating Press, 1839. Print.
8. Darwin, Charles, and Francis Darwin. *The life and letters of Charles Darwin, including an autobiographical chapter.* New York: Basic Books, 1959. Print.
9. Ibid
10. Darwin, Charles, Robert Jastrow, and Kenneth Korey. *The essential Darwin*. Boston: Little, Brown, 1984. Print.
11. Hickson, W. E., and T. R. Malthus. *Malthus an essay on the principle of population in refutation of the theory of the Rev. T.R. Malthus.* London: Taylor, Walton, and Maberly, 1849. Print.
12. Darwin, Charles, and Francis Darwin. *The life and letters of Charles Darwin, including an autobiographical chapter.* New York: Basic Books, 1959. Print.

Appendix

This unit is aligned with the following common core standards for Reading and Language Arts:

Key Ideas and Details: RL.1.1. Ask and answer questions about key details in a text.

Craft and Structure: RL.1.4. Identify words and phrases in stories or poems that suggest feelings or appeal to the senses. RL.1.5. Explain major differences between books that tell stories and books that give information, drawing on a wide reading of a range of text types.

Integration of Knowledge and Ideas: RL.1.7. Use illustrations and details in a story to describe its characters, setting, or events. RL.1.9. Compare and contrast the adventures and experiences of characters in stories.

This unit is aligned with the following common core standards for California Life Sciences Standards:

Plants and animals meet their needs in different ways. As a basis for understanding this concept, students know that different plants and animals inhabit different kinds of environments, and have external features that help them thrive in different kinds of places, that both plants and animals need water, animals need food, and plants need light, that animals eat plants or other animals for food and may also use plants or even other animals for shelter and nesting. **Students know that we can infer what animals eat from looking at the shapes of their teeth, and that roots are associated with the intake of water and soil nutrients and that green leaves are associated with making food from sunlight.**

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