THE POKÉMON ENCYCLOPAEDIA

THE DEFINITIVE SCIENTIFIC GUIDE TO POKÉMON ANATOMY, BEHAVIOUR, ECOLOGY, AND EVOLUTION

This Pokémon Encyclopaedia describes the intricacies of Pokémon biology from a scientific perspective. Accompanied by descriptive graphics, this guide is equivalent to a comprehensive Pokédex. A Pokédex is an electronic device that identifies Pokémon: wild, trained, and otherwise. These devices provide photographs and information about all known Pokémon species: their behaviour, habitat, anatomy, and various statistics.

Pokédexes, or Pokédices, are expensive machines distributed only to promising trainers who encounter a wide variety of Pokémon, including potentially undiscovered species. Scientists distribute Pokédexes with hopes to broaden the horizon of current Pokémon understanding.

For this volume, the utmost of attention has been dedicated towards including recent research and ensuring up-to-date scientific validity. The material is organised into encyclopaedic format in order of relevance, logical progression, and Pokémon number (as opposed to alphabetic).

The Encyclopaedia begins with 'Introduction & Key Concepts', a section that illustrates and describes concepts, including:

- The science of Pokémon battling

- TMs and evolutionary stones

- Pokémon ecology

- Genetics of breeding

- Relatedness between species of the same evolutionary family

- Pokémon-human interactions

These chapters are a comprehensive guide to the terms and concepts underpinning the rest of the Encyclopaedia. In this sample, only half of these sections are attached.

The second half of the Encyclopaedia, 'Pokémon Types', describes the science and diversity of all 18 Pokémon types/elements, with illustrated examples. Since this is just a sample, only three types are featured: electric, psychic, and rock.

The final section, 'Pokémon Entries', details the physiology, behaviour, and ecology of the first three native Pokémon of the Unova region: Snivy, Servine, and Serperior.

This book lays down the foundations of Pokémon biology with the hopes of inciting a scientific passion within the reader, so that she or he may apply that knowledge and enthusiasm towards the other wonderful domains of life.

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Introduction

"This world is widely inhabited by creatures known as Pokémon...

We humans live alongside Pokémon as friends.

At times we play together,

and at other times we work together.

Some people use their Pokémon

to battle and develop closer bonds with them.

What do I do?

I conduct research so that we may

learn more about Pokémon…

Now, go on, leap into the world of Pokémon!"

Professor Rowan

Pokémon are creatures similar to other types of life such as fungi, plants, **protists**, and single- and multi-celled animals. As long as 1.5 billion years ago, a group of single-celled creatures branched off the tree of life to form the group which would eventually become Pokémon.

Since the Pokémon lineage split from the other groups of life, many Pokémon species have developed characteristics similar to those of plants, animals, and fungi. Most Pokémon occupy a similar life history to animals, in that they hatch from eggs, develop, consume resources, reproduce, and die.

Pokémon have a number of relationships with humans, they serve as pets, work partners, companions, protectors, and food. Alike plants which have chloroplasts, **specialised organelles** that allow them to photosynthesise and survive, different groups of Pokémon also have unique organelles and adaptations.

Although many Pokémon species appear animal-like, these organelles and adaptations make Pokémon a distinct group in their own right. Pokémon also possess advanced mental capacities that allow them to understand human languages and communicate between different species.

Most Pokémon reach **discrete** stages in their life cycle and undergo an evolutionary metamorphosis similar to that of some insect families such as butterflies and moths, or like some back-boned animals such as frogs. This metamorphosis or 'evolution' (see, 'Evolutionary Family') includes a radical change in the Pokémon's appearance, personality, and **physiology**.

After metamorphosis, the later stages in a Pokémon's life cycle are classed as different types of species. Although it is still the same individual passing through these various stages, each step has a separate common and species name.

Collected together, all of the stages (or species) an individual will pass through in its lifetime are referred to as the evolutionary family or line. If this system were also applied to animals, we would refer to larvae (maggots), pupae, and flies as different species. Terms such as species, evolution, and evolutionary family have distinctly different meanings from those used to discuss other organisms like plants or animals (see, 'Species Concept').

Eighteen elemental types define each Pokémon species (see, 'Pokémon Types'): Normal, Fire, Water, Electric, Grass, Psychic, Fighting, Poison, Ground, Flying, Dragon, Bug, Rock, Ghost, Ice, Steel, Dark, and Fairy. All Pokémon species are associated with either one or two of the eighteen elemental types.

Each species' type(/s) often reflects the habitat under which that particular species evolved. Depending on their characteristics, some species are specialised for particular tasks and thus cooperate with humans, e.g. Water and Ground-typed Pokémon are commonly part of firefighting services, and Dark-typed Pokémon with malicious predispositions are likely to integrate with crime syndicates (see, 'Pokémon-human interactions').

Pokémon hunt, defend themselves, and attract mates with an extremely diverse set of actions termed 'moves'. Each move is classified as belonging to one of the eighteen elemental types listed above. A given Pokémon species may be affiliated with either one or two types, however, a move may belong to only a single type. The combative effectiveness of a move (of a particular type) against a Pokémon (of a given type combination) is governed by a complex set of interactions, comparable to scissors, paper, rock (see, '**Pokémon Types**').

In each Pokémon region, natives approaching adolescence begin a journey with Pokémon as a development of character as well as a display of maturity. For this tradition known as Pokémon training, particular evolutionary families, known as 'starter Pokémon', have been **selectively bred** to produce optimum initial partners (**Figure 1**).

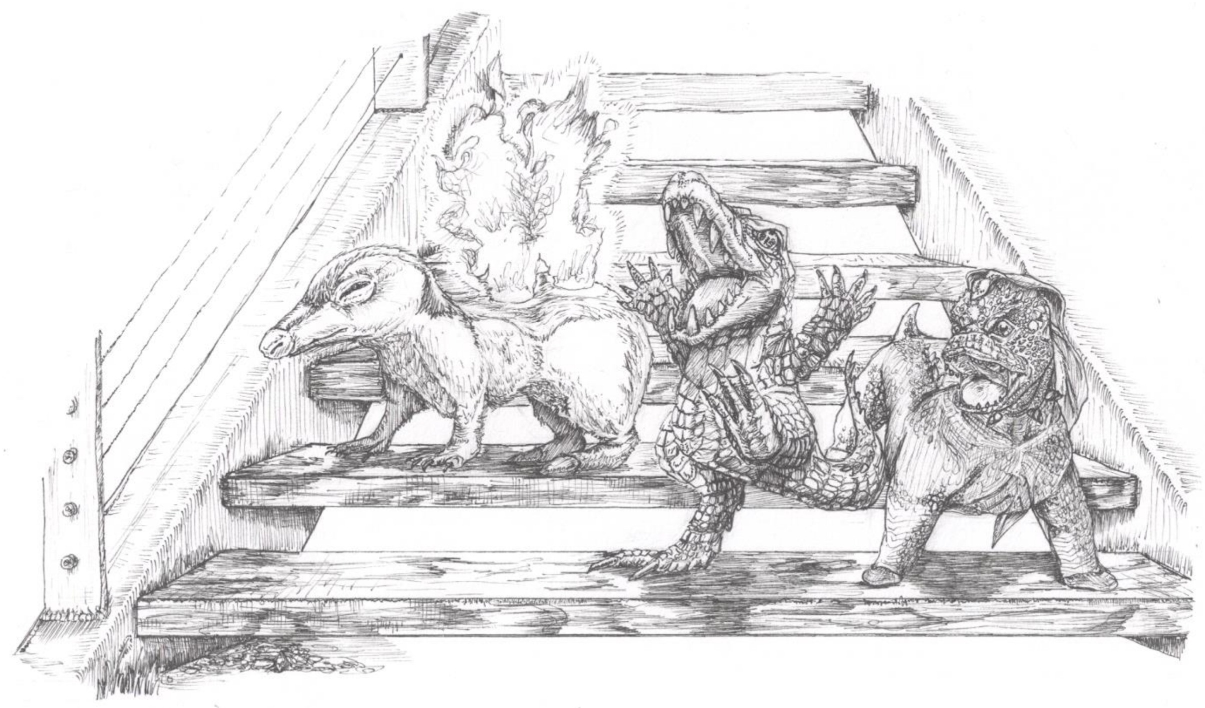

Figure 1: Starter Pokémon from the Johto region standing on a laboratory staircase. From left to right; Cyndaquil (*Dorsovulcan timere*), Totodile (*Daknosuchus familiaris*), and Chikorita (*Herbsuavis acrophyllus*). *Daknosuchus familiaris* is a basic Water-type starter, *H. acrophyllus*, a Grass-type starter and, *D. timere*, the Fire-type starter using the Ember technique.

Pokémon trainers travel around their native region, meeting wild Pokémon and other Pokémon trainers. With the assistance of the trainers' starter Pokémon, new wild Pokémon are captured to assist in the trainers' travels around the region. These newly caught Pokémon can act as companions and accompany the trainer on their travels; the team of Pokémon accompanying a trainer cannot exceed 6 members at any one time.

A trainer and his/her team of Pokémon gain experience through sparring with wild Pokémon as well as the Pokémon team of other trainers. The experience gained by the trainer and their team is tested periodically at special venues known as Pokémon Gyms. There are generally 8 to 12 certified gyms in each region. Upon victory at a given Pokémon gym, the Trainer and his/her team are awarded a badge specific to that location.

Trainers who have proved themselves by collecting 8 unique gym badges are ultimately tested at the elite level of the Pokémon League. Funding for the Pokémon journey, including the Gyms and Pokémon league, is heavily subsidised by the government in each region. The character-building value of Pokémon training has been noted in the low levels of teen crime and success of accredited Pokémon trainers and their Pokémon teams in these regions.

Scientists study many aspects of Pokémon biology including: breeding, ecology, interactions with humans, diversity, and evolutionary origins (see, 'Evolution'). Some species of Pokémon have only a single known individual composing the species, these individuals are presumably very long-lived, the last member of the species, or else **parthenogenic** – these individuals are known as 'legendary Pokémon'. Similar to many other groups of organisms, the prevalence of particular species varies; some species are highly common, some rare, and some 'legendary' (see, 'Ecology') (**Figure 2**).

Figure 2: Thundurus, *Brontotheron anthropoid*, a species with one known member (legendary Pokémon) Discharging wildly into the surroundings. This Pokémon is Flying/Electric-typed and is not known to evolve; it travels over the Unova region following and generating electrical storms. *Brontotheron* and two other similar Pokémon species (*Anemotheron* and *Terratheron*) form the Kami trio: three extremely rare Pokémon that alter the landscape and weather systems of Unova.

There are hundreds of different species of Pokémon, and all are confined to a number of landmasses and archipelagos. Thus, **mobility** determines how common species are between these islands. Regions containing Pokémon have effectively had their native animal populations displaced. Although larger animals and Pokémon are often mutually exclusive, Pokémon are capable of coexisting with plants, fungi, bacteria, viruses, and smaller animals such as insects.

The landmass known as the Unova region was the last region composed of purely native Pokémon. Until recently, no native species had emigrated to neighbouring regions, and no exotic species had immigrated in from other locations. The Unova region contained over 150 **endemic** species. Within the last few decades, exotic species of Pokémon have been introduced to the Unova region thus removing the last known set of habitats composed of a profile of purely native species. The three-Pokémon family catalogued in the final chapter of this encyclopaedia is native to the Unova region.

Figure above: A stylised satellite image of the Unova region, the last region to contain purely native species of Pokémon.

Key Concepts

Evolutionary Family

Individual Pokémon grow smoothly over time and sometimes in big leaps – similar to amphibians, or moths and butterflies. That is, an individual larva hatches from an egg, grows, develops, and may, given particular environmental triggers, metamorphose into further stages of its lifecycle. However, Pokémon differ from animal species that metamorphose. If a Pokémon larva metamorphoses into successive stages, each of those stages in the life cycle is classified as a different species and is given a completely different name.

Each of the stages (species) that arise from a larval metamorphosis belong to the same 'evolutionary family' or 'evolutionary line'. Therefore, a Pokémon's evolutionary family is composed of the basic form (larva) and all of the potential stages that might come afterwards.

The number of species, or stages, composing an evolutionary family varies. The most common evolutionary line includes a 'base form' with one subsequent stage, as in the darumaka family (**Figure 3**). Darumaka is the larval stage of the family, the species that emerges from the egg. These individuals grow in size like a regular developing creature until a given point in their lifecycle whereupon they undergo a rapid transformation into the next stage of their lifecycle: Darmanitan.

Figure 3: An evolutionary family composed of two members. On the left, a base form or larva, Darumaka (*Pyrogrennian daruma*), with a single subsequent stage: Darmanitan (*Pyrogrennian morphopithecus*). A larval Darumaka ages and grows to a certain point before undergoing a sudden metamorphosis, irreversibly transforming into Darmanitan (shown on the right).

An evolutionary family may also be composed of a single base form with no subsequent stages (**Figure 4a**). These individuals do not 'evolve' or metamorphose, but hatch, reach maturity, and reproduce all within the same stage. This is comparable to some mammals like horses or bats (though, many mammals undergo adolescence which is a biological transformation of sorts).

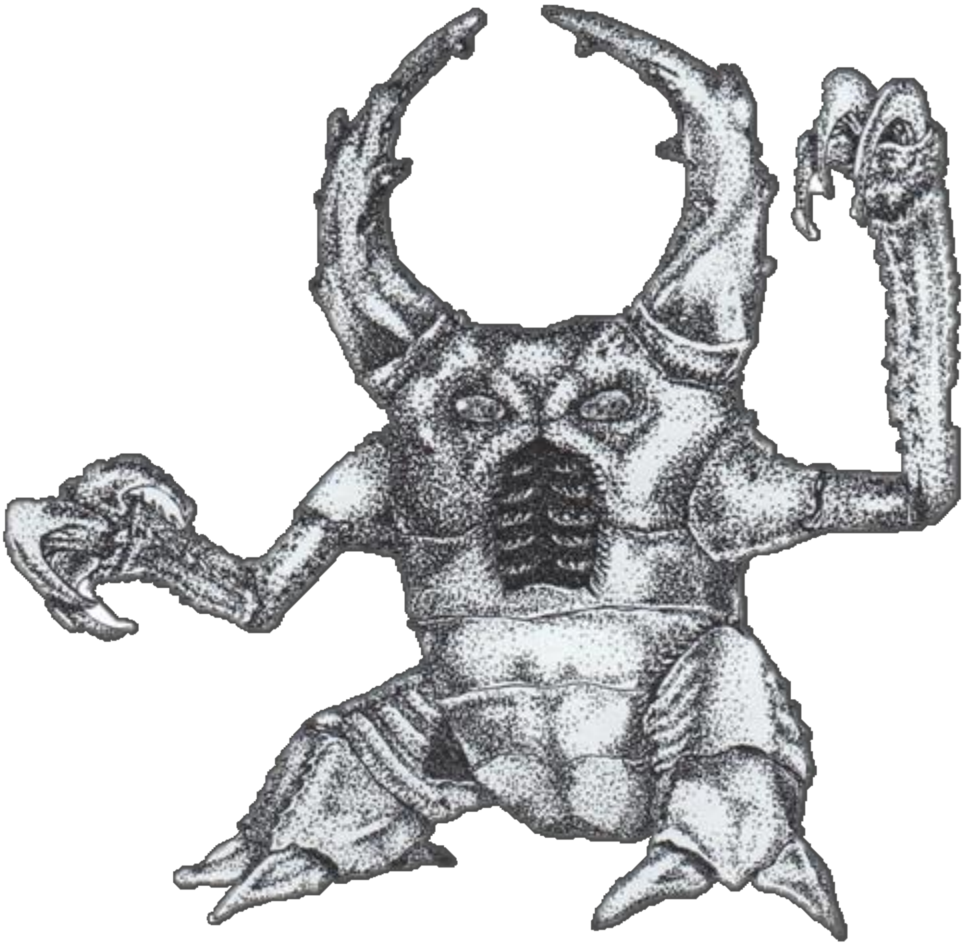

Figure 4a: Pinsir (*Dermoscutus dinognath*), an evolutionary family with a single basic form and no subsequent evolutionary stages.

As mentioned, the first stage of an evolutionary family emerges from the egg. This stage is known as the larva, or the base form. Almost every base form (larva) and subsequent stage of a Pokémon family is capable of reproduction. In the animal kingdom, a larva is almost always unable to reproduce – an individual needs to reach the adult stage before it is capable of producing offspring.

In humans, this transition is known as adolescence. Since Pokémon can reproduce from the outset of their lifecycle – there is no biological need for an individual to reach the final stage of adulthood. This is a phenomenon known as **neoteny**. Similarly in the animal kingdom, axolotls (Amphibia: Ambystomatidae) are the larval stage of salamanders and are capable of reproduction without reaching adulthood. For Pokémon, two individuals from any stage of an evolutionary family can be paired; the resulting offspring will be the base form of that family (**Table 1**).

Table 1: Compatibility of Pokémon from different species and egg groups (in brackets): maternal input across columns; paternal input down rows. Hyphens denote reproductive incompatibility. When Pokémon from different groups reproduce, the resulting offspring will be from the family of the mother. Note: Oddish is the larva of Vileplume, and Snivy is the larva of Serperior.

	Vileplume♀ (grass)	**Serperior♀** (grass/field)	**Pinsir♀** (bug)
Oddish♂ (grass)	Oddish	Snivy	-
Snivy♂ (grass/field)	Oddish	Snivy	-
Pinsir♂ (bug)	-	-	Pinsir

Each species/individual of an evolutionary line is related to one another not only through a lifetime, but also through history. Each successive stage of a Pokémon's family not only represents the transition through an individual's lifecycle, but also the transition through the species' evolutionary history. This is a tricky concept, but an important one.

The entire family line of a Pokémon, from birth to final stage, represents a historical evolutionary line, a series of 'chronospecies'. A well-known example of a chronospecies series is the oft-depicted 'ascent of man' illustration.

This illustration represents human evolution in a walking brigade of figures with modern man on the far right and a chimp-like ape on the far left. In between these two characters are various transitional ape-men. Heading up the line is the modern human (*Homo sapiens sapiens*) around today, and trailing behind is all of its (extinct) chronospecies or direct ancestors.

This concept is important for Pokémon and non-Pokémon biology and will be elaborated on further in the chapter 'Evolution'.

Species Concept

The term '**species**' in a Pokémon context has a different definition to the commonly accepted biological term for non-Pokémon. The word 'species' used to group non-Pokémon is sometimes defined as a group of individuals which can interbreed with one another and produce offspring that are themselves capable of reproducing. This definition, though imperfect, has two parts: 1) two individuals can interbreed, and 2) the resulting offspring is also capable of breeding.

Within the animal kingdom, an instance where the first part occurs but not the second is the pairing of a male donkey and a female horse. Donkeys and horses belong to different species which can interbreed, however, the resulting offspring is a mule, a unique individual which itself is infertile. The offspring of such pairings, (like mules) are called hybrids.

The primary difference between the definition of a Pokémon 'species' and a non-Pokémon 'species', is that an individual Pokémon is able to produce reproductively fertile offspring with members of the same species (**conspecifics**) as well as with members from other species of Pokémon (**heterospecifics**). Almost all Pokémon are capable of extreme **hybridisation** with other groups of organisms.

For non-Pokémon species, populations of individuals can sometimes become isolated from each other for long periods of time. This can happen when many plant seeds germinate in a new location, or when a flock of birds migrate to a new and isolated breeding spot. Over many generations, these isolated groups may evolve notably different characteristics from their original source population. We sometimes refer to these different populations as being different 'sub-species', but all a part of the same original species. This isolation occurs for Pokémon too, but instead of the term 'sub-species', members from these different populations are called different 'forms' of the same Pokémon species.

The degree of difference between groups, the point at which scientists label different groups as separate sub-species or as separate forms is entirely arbitrary. Further, if populations of Pokémon or non-Pokémon are isolated for enough generations, this may lead to an entirely new species. Different sub-species become different species; different forms, different species. This process is known as ‘**speciation**’, one of the forces that has led to the modern day diversity of creatures such as Pokémon.

Where a species name or ‘title’ normally determines which creatures can successfully breed together, a Pokémon’s egg group plays this role. Egg groups govern the reproductive compatibility between different groups of Pokémon, i.e. their ability to produce fertile offspring (see ‘Egg Group’). The degree of genetic exchange between two different species also varies depending on the evolutionary relatedness of the two Pokémon involved in the pairing (see ‘Genetic Transmission’).

Nomenclature

The common name for each Pokémon species is generally denoted with uppercase lettering, e.g. ‘Sewaddle’. Whilst the entire evolutionary family is punctuated in lowercase: ‘sewaddle family’. As well as the common name, each species also has a binomial (two-name) title.

Every species, Pokémon and non-Pokémon alike, have two names, a genus name and a species name. The genus name has a capital letter, while the species name has only a lowercase, e.g. *Homo sapiens* (Latin for ‘wise man’).

Different Pokémon species of the same evolutionary family share the same genus name, but have unique species names. For example, Darumaka (*Pyrogrennian daruma*) and Darmanitan (*Pyrogrennian morphopithecus*) share the genus name: *Pyrogrennian*, but have individual species names: ‘*daruma*’ and ‘*morphopithecus*’ respectively.

Binomial names are commonly composed of Latin and Greek, however can also come from other sources. ‘*Pyrogrennian*’, the genus name for the darumaka family, is a portmanteau composed of the Ancient Greek word for fire: ‘Pyr’ coupled with the Old English word ‘grennian’, meaning ‘to bare one’s teeth’.

Egg Group

Each species of Pokémon may be classed as belonging to a particular egg group. Egg groups determine which varieties of Pokémon are capable of producing fertile offspring. The **genomes** of Pokémon from each egg group have a unique number of **chromosomes** associated with them, thus preventing successful fertilisation between Pokémon from different egg groups.

Similar to the different elemental ‘types’, a particular Pokémon species may belong to either one or two different egg groups. Since each egg group has a different number of chromosomes associated with it, Pokémon belonging to two egg groups have asymmetric genomes. This is comparable to the asymmetry between the X and Y chromosomes of men.

Radical examples of hybridisation are possible with the genetic exchange arrangement between Pokémon. This may partly explain some of the similarities in characteristics between completely unrelated Pokémon species, species that are distantly **diverged**.

The offspring of Pokémon from two different species, within the same egg group, is determined by the maternal sex chromosomes – all offspring will therefore be in the same evolutionary family as the mother (**Table 1**).

Evolution (Pokémon and Darwinian)

Most Pokémon metamorphose at one or two points in a single lifetime. This drastic transformation between forms is called 'evolution', a term distinct from the process of Darwinian natural selection. This section will first describe what happens when a Pokémon metamorphoses. The following section will describe the theory of how and why the process of Pokémon metamorphosis evolved in the first place.

What to expect when you're evolving

In weeks prior to evolutionary metamorphosis, Pokémon will begin changing their behaviour and consuming the resources required for their instantaneous evolution. It has been observed that particularly **sentient** Pokémon may be unwilling to undergo evolution.

The sometimes-drastic change during evolution results in a change in personality, behaviour and sometimes degradation of memories and prior knowledge. These changes arise from alterations in body chemistry (hormones and neurotransmitters), brain morphology and many other aspects of the Pokémon's physiology. A trainer may find this process unfavourable for their particular Pokémon; the trainer can naturally stop or delay evolution (metamorphosis) with the use of naturally occurring minerals.

If a Pokémon and trainer decide to follow through with evolution, it is a rapid process. Evolution almost always occurs when the individual is exposed to a trigger. The trigger may be extreme emotional or physical hardship, or it might be a particular time of year.

When exposed to this trigger, the individual rapidly transforms, simultaneously using up all of its stored nutrients in an explosion of growth. Over an evolutionary metamorphosis, a Pokémon might grow metres. Though a Pokémon's external appearance can change drastically, its inner organs do not change so much.

The evolution of Pokémon evolution

This unique evolutionary metamorphosis is an extreme example of '**ontogeny** recapitulating **phylogeny**', a biological phenomenon that is also observed in other forms of life such as plants and animals.

The field of science that studies this phenomenon is known as 'evolutionary developmental biology' or more simply '**evo-devo**'. The observation that a creature's life cycle can sometimes be a fast-forward summary of that species' evolutionary history is summed up in the technical term: Ontogeny recapitulating phylogeny.

'Ontogeny' describes the growth and development of an organism from a single cell at conception to maturity/adult form. 'Phylogeny' is the evolutionary history of a given species through geological time (and its relatedness to other species). Evo-devo therefore, is the field that studies this biological process.

Some non-Pokémon examples of ontogeny recapitulating phylogeny are described further on below.

Before citing some non-Pokémon examples, the basics of evo-devo and evolution must first be described.

Ontogeny

Every individual of every creature whether plant, Pokémon, animal, or fungus, is mostly composed of cells. All of these individuals, including humans, begin life as a single cell, a cell which contains all of the information needed to create that being. That information is in the form of a chemical known as DNA. From this single cell, DNA causes a series of chemical reactions to occur, eventually leading to that single cell multiplying. Depending on the species, that cell will multiply into many millions or billions of cells; each time a cell multiplies it will also multiply the DNA within. Coupled with influences from the environment, the DNA will constantly orchestrate the process to result in a fully developed individual. Even after this point, DNA must continue working to repair the individual and eventually make new cells to go towards making offspring for the next generation. This process, from single cell to mature individual is called ontogeny.

Phylogeny

Overtime, a single species may evolve into a wholly different state, or may branch off into a number of different species (speciation). The process by which this occurs is as follows: within a given species, every individual is genetically different and therefore a unique being (excluding twins/clones). Natural and sexual selection in the environment determines which of these individuals produces more or less offspring, and therefore, which unique combination of DNA gets into the next generation.

Individuals that reproduce ineffectively or not at all will not pass on their DNA to the next generation and will fade away through time. However, the successful individuals copy their successful DNA to their offspring which go on, multiplying into the future. Down through the generations, mutations alter various chemical details of DNA resulting in slightly different individuals – which, if more successful – will multiply and become more common in the population.

If the species stays together in a single population, over many hundreds or thousands of generations, this group may have changed much from its ancestors. The population may have shifted into an unrecognisable state of its former self – this new population could be called a new species. Though this new species is distinct from the original one, all of the individuals are descendants from that original group.

This gradual transformation of an entire group – a single branch changing over its length – might be represented by the recent history of the Dodo (*Raphus cucullatus*). The exact ancestry of Dodos is not known, however, it is known that the ancestors of the Dodo were flying birds related to pigeons. At some point in the past, these animals settled on the island of Mauritius near Madagascar. Over time, this ancient population of birds had pressures from environmental factors that ensured better reproduction and survival of some individuals, but not others. Between each generation was a filter, through which only birds with the right criteria could pass. The criteria may have included, instead of spending precious food resources on building wings and flight muscles, which are useless – spend them on creating larger, healthier eggs. After many generations exposed to these pressures, the population no longer resembled a flock of pigeons, but a large herd of flightless creatures: the Dodos. This form of evolution is known as ‘anagenesis’.

Alternatively, as described with ‘subspecies’ or ‘forms’, a species may be divided into many different populations. This is commonly the case: humans are grouped together in unique populations; one species of bird may be grouped into many different flocks, insects in many swarms. Shellos, the Sea Slug Pokémon, is divided into two unique populations in the East and West Seas on either side of the Sinnoh mountain range. If these populations of individuals are reproductively isolated, i.e. they are unable to interbreed – then each population will have a distinct gene pool. Each gene pool will be subjected to different influences of natural selection and may therefore acquire unique characteristics. Given enough time, these may be classed as separate subspecies, and given still more time – unique species.

This way, over time, one original species isolated in many populations may eventually give rise to many unique species. One spectacular example of this ‘species branching’ is the major group of mammals in Australia: the marsupials. Genetic evidence suggests that all 159 marsupial species in Australia are descendants from one species of marsupial ancestor that entered Australia fifty thousand, thousand years ago (50 MYA). The splitting of one species into many can be represented by a tree branch. The shared base of two forking branches represents an ancestral species, while each of the forks represents two new and unique species which have descended from that shared ancestor. This form of evolution, from one species to many, is known as ‘cladogenesis’.

The evolutionary history of a population, a group of populations, or a species is known as a ‘phylogeny’. Phylogenies are often represented as a branching tree. A single branch which changes but does not fork is anagenesis. While a single branch which forks into two or more unique twigs is cladogenesis.

Ontogeny: a recap of phylogeny

‘Ontogeny recapitulating phylogeny’ simply means, as a creature grows over its lifetime (ontogeny), it demonstrates characteristics of its species as that species developed through history (phylogeny). This occurs for the following reasons: every individual, including every human, has mutations in their DNA which were absent in their parents.

Recent research suggests that you have 60 mutations that weren’t present in either of your parents.

These mutations, or genetic changes, contribute to the evolution of a species by 1) helping to pass on those changes to offspring or 2) by destroying the individual that possesses them. Since DNA is involved in building an individual, changes in its structure can affect how that embryo develops. Furthermore, genetic changes can influence the embryo at any stage of development, from single cell to maturity. Mutations that alter a young embryo are more lethal than those that alter a more developed individual. This is because changes earlier on will likely have larger, deadlier effects down the line. This means that mutations that positively contribute to an individual’s survival will probably occur later on in the creature's development. These helpful genetic mutations become more and more common in the gene pool and contribute to that species' evolution.

Since young embryos are fixed, and older ones are free to mutate - this lays down a pattern in development/ontogeny. A single-celled embryo develops; the DNA that orchestrates this early process is ancient, remaining unchanged for eons. Further on in development, DNA instructs the embryo to form a tail, a mutation that initially occurred hundreds of millions of years ago. Further on still, DNA instructs the creation of hair, a mutation that first occurred more recent again.

Creatures retain their ancient library of mutations in their DNA. And as they are growing, they can retrace the steps of these mutations. This is how ontogeny recapitulates phylogeny. This recapping process plays out smoothly in plants and animals, but in radical leaps for Pokémon. Together, these concepts unite to explain Pokémon metamorphosis, Pokémon evolution.

As a Pokémon develops it recaps its evolutionary history just like other creatures. But since Pokémon grow and metamorphose in leaps (evolving), each of the stages in the family represents a stage in the Pokémon's evolutionary past. Each member of a Pokémon's evolutionary line – from basic stage to most mature stage – represents phases of the species at particular moments in the past. This theory is based off of genetic and fossil evidence. The basic fossil pattern observed for Pokémon evolution has recent layers of earth, called **strata**, containing all stages of the evolutionary family, including larvae through to the final stage.

Using the two-membered cubchoo family as an example – recent layers of earth show the bones of the basic stage of the family: Cubchoo, as well as the bones of the final stage of the family: Beartic.

By digging deeper into the earth, through ancient layers and going back through time to the Eocene, roughly 40 million years ago (MYA), the fossil assortment changes. The only fossils present are the basic form of the family: Cubchoo, but none of the final stage, Beartic (**Figure 5**).

This suggests that the final stage, Beartic, had not evolved yet, and Cubchoo was the most mature stage of the lifecycle. Then, over the ensuing 40 million years under intense selection pressure, the Cubchoo species was forced to evolve new characteristics. This resulted in the fierce, modern day adults of this family: Beartic (**Figure 6**). The less effective Cubchoo are now restricted to early on in the development as larvae, and must metamorphose before reaching the final stage as a mature Beartic. These fossil observations suggest that the early, larval stages of modern evolutionary families, such as Cubchoo, are **primitive** species, while the later stages of the family have a more recent evolutionary history.

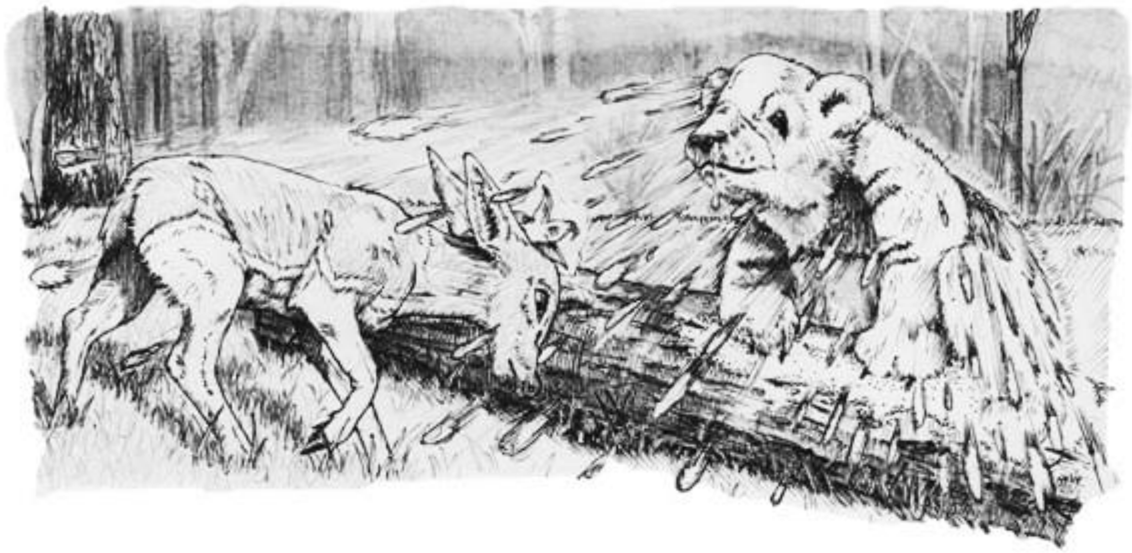

Figure 5: ~40 million years ago. A battle between two adult (final) forms – these two individuals are at the final stage of their lifecycles and would not metamorphose any further. The Ice-typed carnivorous Pokémon Cubchoo (*Arctos rhinoblenn*) hunting a Normal/Grass-typed prey species: Deerling (*Condiresignum herbfawnia*). The Deerling is defending itself with the Energy Ball technique; the predatory *A. rhinoblenn* is subduing the prey with Icy Wind. Adaptive turn-for-turn style battling gets abandoned in life and death interactions, both Pokémon use any technique necessary to survive.

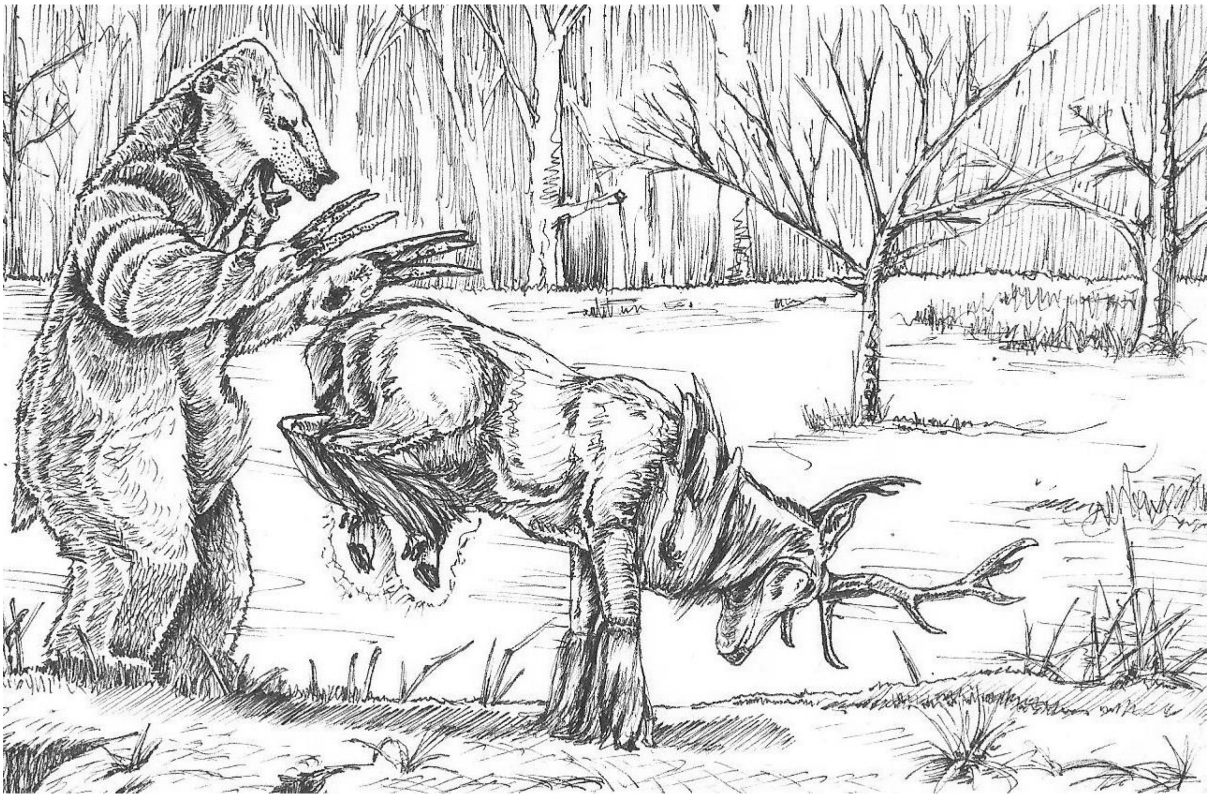

Figure 6: Modern day. A battle between two adult (final) forms, Beartic (*Arctos daspletus*) and Sawsbuck (*Condiresignum sawsbuckii*). These fully developed Pokémon species represent ~40 million years of fierce competition, resulting in radically more powerful individuals than the ancient Cubchoo/Deerling ancestors. These Pokémon species only naturally encounter one another during winter. Beartic is defending itself from a powerful and effective Fighting-typed move: Double Kick.

This is how Pokémon growth and metamorphosis recaps their evolutionary past, and this is why we rather confusingly call Pokémon metamorphosis: 'Evolution'.

An analogous, but considerably less radical example of this process can be seen in the lifecycle of all animals. Animal life began a few billion years ago as single-celled creatures similar to amoebas or algae. Over vast periods of time, these cells eventually developed a mutation which allowed them to multiply, but remain together – thus forming the first multi-celled animals. These multi-celled animals eventually evolved to give rise to all of the diversity we see today. Now, when every modern day animal begins its life, it recapitulates the state of its ancestors – as a single cell at conception. This single cell goes on to multiply into a multi-celled animal, just like its ancestors did in the past.

A non-Pokémon example of metamorphosis representing evolutionary history may be seen in amphibians. Amphibians are creatures that often spend the first part of the life in water, and the second part of the life on land. Amphibians are modern day animals, but they evolved from ancient fish such as *Tiktaalik* 370 million years ago. Amphibians recap this evolution in their lifecycle. Frogs and toads begin life as fish-like larvae in water, metamorphose, and adopt a four-legged life on land. The larvae **express** the primitive characteristics of fish (gills, aquatic life, tail used for swimming etc.) and then metamorphose and express the newer or more recently **derived** amphibian form, i.e. lung usage and loss of tail, the animals is then capable of land and water existence in adulthood (**Figure 7**).

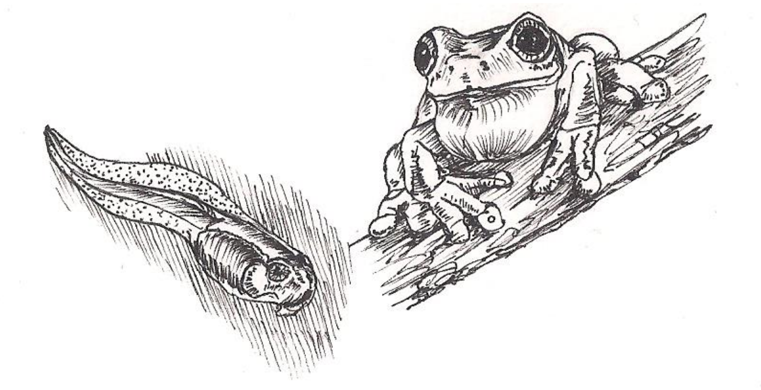

Figure 7: *Litoria xanthomera*, an Australian species of amphibian. The larval tadpole stage of frogs and toads is aquatic and fish-like, characteristics that may have stuck since their ancestors had them ~370 million years ago. The adult stage of this animal is capable of terrestrial life, however still recapitulates the 'primitive' fish-like larval form.

The genes required to produce the fishy characteristics may be **vestigial** – present since the Devonian era when fish represented the mature, adult stage of the life cycle. Amphibians' gradual emergence onto land from fish **ancestors** (also in the Devonian era) favoured those larval fish characteristics (gills and tail) each generation, thus retaining them in the current lifecycle of amphibians.

More examples of this phenomenon abound. Developing dolphin and whale embryos grow hair inside the womb just as their land-based ancestors would have done. Further through development, these lose this hair just like their modern day brethren. Also, adult humans and other apes have lost their tails. But since we come from a long line of tailed animals, we too grow tails as embryos. In fact, when we're developing in the womb, we have long tails which are eventually absorbed and stunted later on in development. Our stunted tail forms the base of our spine known as the ‘coccyx’ or ‘tail bone’.

Emergence of a pre-evolution

The biological process of expressing various ‘snapshots’ of the species’ evolutionary history within the lifetime, likely indicates this to be either a neutral or advantageous trait. The same assumption could be made of Pokémon.

If the trait is advantageous, the phenomenon might allow a Pokémon family to evolve more or less stages in its family line to cope with an ever changing environment.

The advantage of the ‘ontogeny recapitulating phylogeny’ phenomenon may work as follows - a Pokémon, e.g. Pinsir, whose larval form is detrimental to the species’ survival is suppressed to the egg stage of development, emerging only once metamorphosis occurs, as the adult Pinsir. Conditions change such that a mutant Pinsir emerging from the egg earlier in **embryogenesis** is able to collect food and increase the likelihood of survival and reproduction for the adult individual.

Such early emerging mutants may therefore be positively selected for, as they spend smaller amounts of time gestating within the egg and can exploit the environment in their larval form. Mutants that emerged with an ancestral (larval) physiology and behaviour distinct from the adult Pinsir have an advantage over other Pinsir individuals that are born in the environment that emerge only in the adult stage.

This successful mutation (of early emergence) may compound over evolutionary time, reaching a stage such that evolutionary metamorphosis occurs outside the egg at a given point in the larval Pinsirs' (termed a different name) lifecycle. This individual which is comparable to an external, fully functional embryo will thus be termed a distinct species (by future Pokémon taxonomists), or 'pre-evolution' and will largely express the physiology and behaviour of a Pinsir ancestor, matching a species in the fossil record.

There are many Pokémon families with newly discovered pre-evolutions that only emerge upon specific environmental stimuli.

Furthermore, from this theoretical model, it could be predicted that there are Pokémon species in a **transitional** state and potentially in the process of generating a new species and life stage to the beginning of the lifecycle. Members of the Pokémon species Kangaskhan (*Phascophora tyrannos*) often carry an offspring that is physiologically distinct from the parent however does not undergo discrete evolution or metamorphosis. The distinct form of the juvenile may represent an ancient Kangaskhan **morphology** and may therefore be in a transitional state between a sole evolutionary family, and a two-membered evolutionary family.

Suppression of a pre-evolution

Alternatively, if retaining and expressing **ancestral characteristics** is not advantageous, but is an unavoidable genetic trait of Pokémon, then it could be predicted that there are many cases where the phenomenon of evo-devo is harmful or 'detrimental' to the species.

Hypothetically, if there were a Pokémon species that had larvae that disadvantaged the survival or reproductive chances of the adults – then natural selection might **suppress** the larva to 'within-egg development'. The larvae might metamorphose while still in the egg, and then emerge as an adult, thus not hindering the success of that individual.

Indeed, data suggest that Pokémon with only one stage in their family spend more time as an egg before hatching. Pokémon that have only a base form, such as the beetle-like Pinsir, might represent this process. If Pinsir larvae were a hindrance, the Pinsir species could theoretically benefit from expressing only the adult stage of development. Therefore, the larval form might be expressed during development within the egg; it may then metamorphose within the egg and then hatch as a mature Pinsir (**Figure 4b**).

Figure 4b: A theoretical embryo of Pinsir. It is hypothesised that many species of Pokémon have a larva that is expressed in the egg, but then metamorphoses before hatching. This is likely due to the environment not favouring individuals that hatch in an immature state. Hypothetically, environmental conditions might change to favour larvae hatching earlier on in development. Then over evolutionary time, the larvae of these

individuals might assume a distinct stage at the beginning of the evolutionary family. This is one theory for how 'pre-evolutions' or 'Baby Pokémon' might evolve, see 'Emergence of a pre-evolution'.

Emergence of an additional stage

The previous section outlined the conditions under which a particular evolutionary family may generate another 'stage'/species at the *beginning* of the life cycle. The evolutionary process by which successive stages are generated at the *end* of an evolutionary family is much simpler and intuitive.

All organisms must continually adapt to survive in their given habitat; species that fail to mutate and change in a changing environment go extinct. For an individual Pokémon, the final stage, or most derived form, is both the stage in which the individual lives out most of its life, as well as the stage that reproduction is most likely to occur in.

Final-stage individuals must compete most fiercely for mates and territory and thus are subject to intense **sexual selection** pressures. Adults that out-compete rivals at the same life cycle stage can secure mates and perpetuate the genes that led to mate acquisition. In this way, evolution can manipulate the final stage of an evolutionary family by accumulating beneficial mutations throughout successive generations.

During these times of intense selection, which can be called 'pressure periods', individuals experience extreme changes in their physical and emotional state. This might be compared to the vibrant colour changes that occur in male birds during mating season. As well as colour changes, individual's immunities might also become compromised.

During pressure periods, the change from 'typical' adult state to 'mating season' adult state is often caused by a trigger, sometimes environmental (day length) and sometimes internal (hormonal). It is during pressure periods that natural and sexual selection can weed out inferior mature Pokémon from those most fit.

Initially, there will be little noticeable difference between an individual before and after such periods. But over many thousands of generations of selection, the transition of an individual before and after a pressure period could be great, a metamorphosis even.

Instead of being a yearly transformation (such as with some male birds) this metamorphosis would be permanent, an additional stage of maturity.

Suppression of an additional stage

Occasionally, evolutionary families have 'lost' or suppressed the final stage of the family. This is most obvious in Pokémon families that evolve only with a very specific trigger such as an evolutionary stone (see 'Technical Machines (TMs) and Evolutionary Stones').

The loss or suppression of a final stage can occur when the trigger required for metamorphosis is consistently absent, thus the evolutionary family never reaches completion.

This also occurs in the animal kingdom. As mentioned, axolotls are larval salamanders that eat, reproduce and reach adulthood in their larval state. The final stage of their lifecycle can only be reached once axolotls are exposed to high levels of ingested iodine (element), or particular hormones. If these triggers are never encountered – axolotls do not reach their final stage of maturity.

The necessary ‘evolution or metamorphosis trigger’ for many Pokémon families includes: inorganic minerals, other inorganic and organic items, particular moves, electromagnetic radiation, symbioses with other Pokémon, and hormones. If an immature Pokémon is not exposed to these influences, they will not reach full evolutionary maturity.

Relationship between stages

Species composing the early stages of evolutionary families possess distinct anatomical differences and often use different sets of resources (food, shelter) to avoid competition with the adult stages of the group. Many scientific spheres study and compare the behavioural and anatomical differences between base form (larval) Pokémon and final form (adult) Pokémon.

Pokémon Types

Electric

It is thought that animals evolved electricity generation to communicate with others and to locate prey, similar to echolocation. Nerve cells and muscle cells, such as those in the heart, naturally generate electrical impulses. Electricity producing animals co-opted these forces for their own means. In some electric animals, their **electrocytes** (cells specialised to create electricity) are modified from muscle cells. In other species, electrocytes are actually modified nerve cells. Electrical discharges generated by both animals and Pokémon are species-specific, i.e. each species has a distinctly different electrical current. This fact lends credence to the notion of electric generation evolving for the purpose of species specific communication.

A nervous centre in the brain controls the simultaneous firing of the electrocytes of Electric Pokémon. This can be stimulated consciously by the Pokémon and also at the request of the trainer.

Electric Pokémon, like Fire Pokémon, have an extremely high metabolic rate, that is – the rate at which they generate heat from food. Organisms with a high metabolic rate require large amounts of food to facilitate their energy requirements. On average, species of Electric Pokémon have a higher speed and special attack statistic owing to their highly specialised electricity-generating muscles.

Many powerful Electric species generate positively charged leader channels high into the atmosphere leading to frequent lightning incidences. Such species have evolved mechanisms to withstand and store atmospheric lightning strikes. Lightning and other electrical phenomena are often utilised by these Pokémon to shock and fry opposing Pokémon (**Figure 17**).

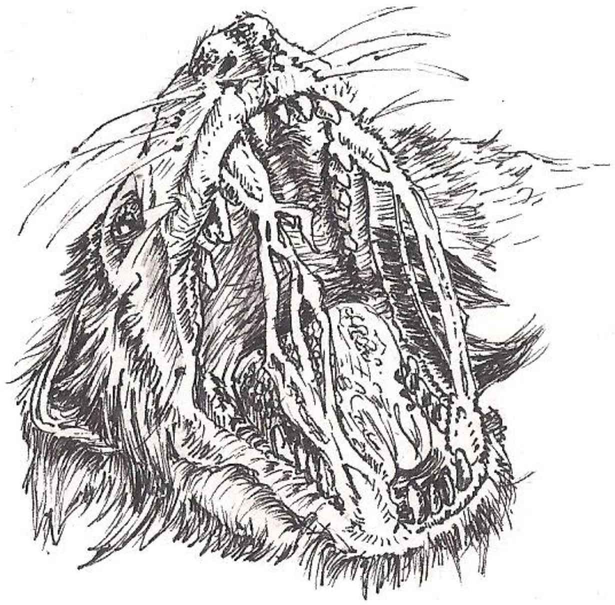

Figure 17: Thunder Fang, an Electric-typed move, being performed by a Luxray (*Intimidare xray*), an Electric-typed Pokémon. This move would benefit from the same type attack bonus (STAB) due to the shared typing of the technique and user.

Flying and Water-typed Pokémon are especially vulnerable to Electric moves due to no-ground contact and the highly conductive properties of water, respectively.

Electric-typed attacks are:

Highly effective against Water & Flying-typed Pokémon

Ineffective against Dragon, Electric, & Grass-typed Pokémon

Useless against Ground-typed Pokémon

Electric-typed Pokémon are:

Resistant to Electric, Flying, & Steel-typed attacks

Vulnerable to Ground-typed attacks

Psychic

Psychic Pokémon are able to intercept and interpret the electric signals of other individual's neurons (brain cells). Neurons are used to transmit information around and between parts of the body (including the brain). They also bring about movement and 'consciousness'.

Psychic Pokémon hijack this closed system for offensive and defensive purposes. This is analogous to the electricity generated by fish, which is then detected by nearby sharks. Fish generate the electricity each time their muscles contract. Sharks use specialised organs to detect these electric fields to hone in on these fish.

The electrical firing of our brains, our brain waves, is perceptible to Psychic-typed Pokémon. This neuronal energy can be manipulated in a variety of forms.

The production of electricity generates magnetic fields – psychic Pokémon utilise this phenomenon to levitate Pokémon or other objects by repelling them against the fields generated by Earth.

A large proportion of human decision making occurs unconsciously several seconds before the manifestation of conscious thought. Electrical activity in the frontopolar cortex of both Pokémon and human brains can be intercepted by Psychic-typed Pokémon allowing them to consciously pre-empt decisions before they are made. Psychic Pokémon can read brain activity so fluently it can give the outward appearance that these Pokémon can travel through time to apprehend the actions of their opponents.

As well as intercepting neuronal firing, psychic Pokémon can also stimulate the involuntary firing of neurons, projecting thoughts and other imagery into the minds of others. Psychic Pokémon may send an individual into powerful long lasting delusions.

Though psychic Pokémon are skilled mind readers, they are unable to accurately read the neuronal firing of Bug and Ghost-typed Pokémon due to the diffuse central nervous system of these species.

Evidence suggests that psychic Pokémon developed extremely high neuron densities due to ancient mutations in the ASP encoding gene. As such, psychic Pokémon are viewed as being an especially intelligent type of Pokémon.

These ASP mutations have resulted in a costly brain to body ratio with huge energy requirements for the brain. This means that bearing such a costly brain must have dramatic benefits for other aspects of these Pokémon’s fitness.

The neuronal firing of psychic Pokémon occurs in undulating waves of intensity. The brains of psychic Pokémon almost always modulate between intense gamma wave concentration and the hypnosis-like state of alpha wave activity.

The cerebral discharge of psychic Pokémon can be concentrated to produce a manifested pulse of energy; this is often used in an offensive manner. Psychic attacks can commonly leave the foe in a severe state of confusion, potentially resulting in self-inflicted harm. Powerful psychic Pokémon are able to alter a foe's perception of reality and create powerful imagery and altered states, the process by which some psychic Pokémon teleport is currently under experimental investigation.

Psychic Pokémon rely primarily on their central nervous system to perform daily activities, they therefore require large amounts of glucose to fuel their mental expenditure. In-between mental activity, Psychic-typed Pokémon can often be found meditating or sleeping.

Many non-offensive Psychic moves affect the user’s state by upping their production of hormones. Through meditation, psychic Pokémon can drastically improve their condition.

Psychic Pokémon have evolved *esp*-ecially powerful special attacks and special defences, as opposed to physical attacks. Most Psychic attacks involve discharges of mental energy; these often strike the opponent and cause aberrant stimulation to a foe's nervous system. Psychic waves often result in alterations to the nerves themselves even inducing changes in the **threshold potentials** required to perpetuate neuronal firing.

Some Pokémon species demonstrate radical physiological reactions when attacked by Psychic energy. It is theorised that the neurons of Poison Pokémon that have evolved adaptations to avoid self-intoxication are disrupted by this intense mental energy. The Pokémon are thus rendered vulnerable to the effects of their own toxins. Similarly, the dense concentration of muscle fibres and electrical firing of a Fighting Pokémon nervous system are especially susceptible to the harmful nerve impulses elicited by Psychic attacks.

Psychic-typed attacks are:

Highly effective against Fighting & Poison-typed Pokémon

Ineffective against Psychic & Steel-typed Pokémon

Useless against Dark-typed Pokémon

Psychic-typed Pokémon are:

Resistant to Fighting & Psychic-typed attacks

Vulnerable to Bug, Dark, and Ghost-typed attacks

Rock

Rock Pokémon are highly defensive organisms that are either composed of inorganic minerals or have incorporated inorganic minerals into their hides. These Pokémon can withstand many assaults but are vulnerable to many types of attacks.

Different species of Rock-typed Pokémon have unique mechanisms by which their inorganic structures develop. The crystalline bodies of some species have characteristics of minerals that formed over vast periods of time. Other species or bodily structures have the makeup of **extrusive** rock, rock that has cooled quickly and not initiated crystal formation.

The rocky bodies of some Pokémon species are generated by sedimentary processes, like those that create mud- or sandstone. The bodies of some Rock/Ground-typed Pokémon are made of many layers of compressed earth, forming mudstone armour (**Figure 20**).

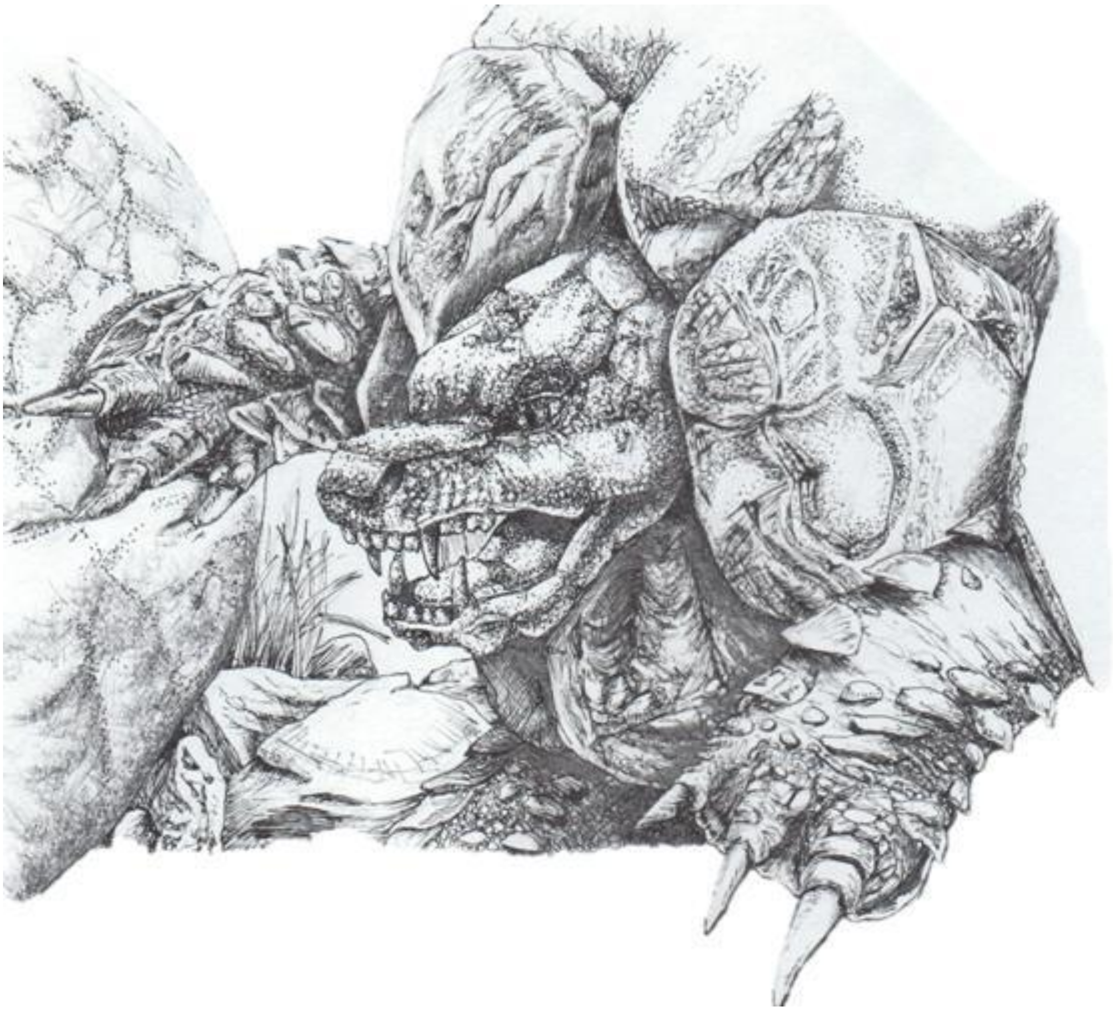

Figure 20: Golem, (*Petrosoma gedynam*), the final stage of the *Petrosoma*, Rock/Ground-type family. This rarely spotted Pokémon species thrives in mountain habitats, using their boulder-like body to camouflage against the scenery. The body of *P. gedynam* is composed of mud-stone which is shed, and compressed many times over its lifespan.

Rock-typed Pokémon are extremely physical, using their bulk to attack. All but two of the Rock-typed attacks are classed as physical, generally utilising the Pokémon's body as a weapon or generating projectile rock products.

Some Rock attacks utilise various physical properties of the Pokémon's rocky body. Some species use their body to focus light waves through successive compounding crystalline structures to generate offensive LASER-like techniques.

Fossil Pokémon

With modern science, the fossilised DNA of some extinct Pokémon has been recovered and used to reanimate some 21 different species. These reanimated individuals function as living ones, and as such, have been reintroduced into their former habitats and environmental niches.

Due to unavoidable processes, the initial cell cultures used to reanimate the fossilised Pokémon became contaminated with the genetic material from rock-eating bacteria.

Plasmids (circular DNA) from these bacteria were subsequently integrated into the embryonic tissue of each sample. These contaminations led to all 21 resurrected species becoming at least part Rock-type, though some of these prehistoric Pokémon would likely have been Rock-typed in the past.

Rock-typed attacks are super effective against intuitively vulnerable species including fast but commonly fragile Flying species as well as Bug, Ice and Fire-typed Pokémon.

Rock-typed attacks are:

Highly effective against Bug, Fire, Flying, & Ice-typed Pokémon

Ineffective against Fighting, Ground, & Steel-typed Pokémon

Useless against nothing

Rock-typed Pokémon are:

Resistant to Fire, Flying, Normal, & Poison-typed attacks

Vulnerable to Fighting, Grass, Ground, Steel, & Water-typed attacks

Pokédex Entries

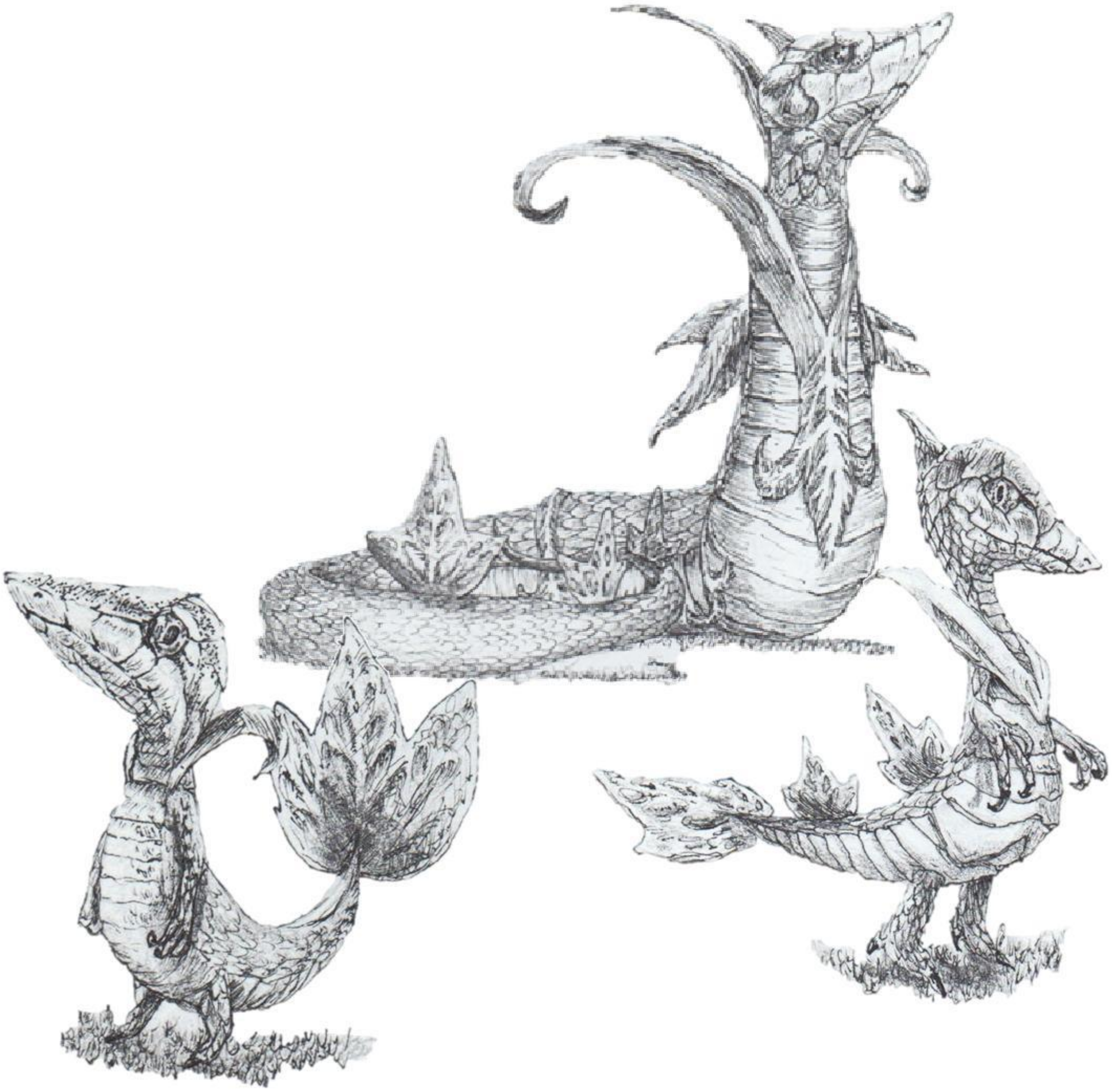

Figure 24: One of three starter families (Grass-type), the snivy family, *Ophioregalis*. Snivy (*Ophioregalis phyllus*), Servine (*Ophioregalis principus*), and Serperior (*Ophioregalis intimidatus*).

Snivy, Servine, and Serperior #1 – 3

The snivy evolutionary family consists of three members: Snivy (*Ophioregalis phyllus*), Servine (*O. principus*), and Serperior (*O. intimidatus*) (**Figure 24**). All three species are carnivorous ambush predators. *Ophioregalis* are **ectothermic**, or 'cold-blooded' grass Pokémon that require energy from the Sun to facilitate normal metabolism. All three species are capable of supporting their diet with photosynthetic material. *Ophioregalis phyllus* is one of three starter Pokémon in the Unova region, and as such is an ideal Pokémon for beginner trainers.

Habitat and Ecology

Many populations of *O. phyllus* are bred by humans in special raising facilities for the purpose of Pokémon training. Domesticated Snivy are more placid than their wild relatives, however, still share most of the same attributes.

Wild *Ophioregalis* are found in the tropical regions of Unova, preferring dense rainforests that allow them to camouflage and hunt efficiently. The prey size of *Ophioregalis* changes proportionally with the organism as it grows. *Ophioregalis phyllus* consume insects, some Bug-typed Pokémon, and Pokémon eggs, effectively moderating populations of Pokémon in the ecosystem.

The second stage of the family, *O. principus*, are mesopredators able to consume small to medium-sized Pokémon, such as Patrat and Woobat.

The final evolution, *O. intimidatus*, is an apex predator and the largest carnivore in the Unova region. Due to their size and capacity to swallow large prey, Serperior are predators to a large proportion of Pokémon species that share their habitat. The oldest record of the *Ophioregalis* family is an *O. phyllus* skeleton dating back to ~110 MYA.

Evolution, Life History, Physiology, and Behaviour

Studying the behavioural and physiological changes that occur over the life history of *Ophioregalis* reveals insights into the evolution of the family.

In the earliest stage of the *Ophioregalis* lifecycle, Snivy (**Figure 25**) rely on small or slow moving prey. Prey capture generally only occurs on the initial strike as immature *O. phyllus* are inefficient pursuers of fleeing prey.

Figure 25: One of three starter Pokémon, Snivy (*Ophioregalis phyllus*). The larval, or base form of the *Ophioregalis* evolutionary family. Note the

apical tail-leaf used for photosynthesis, and camouflage. Vines protrude from scales at the base of the neck.

Snivy (*Ophioregalis phyllus*)

As well as carnivory, Snivy grow partly from the photosynthetic sugars they gain from the leafy structure on their tail.

As individual *O. phyllus* grow and mature, they become more efficient hunters, selecting shrubs and foliage that complement their natural colouration.

Snivy hatch with vine-like structures that lie sub-dermally to the collar scales. As these Pokémon grow, the 'vines' are reinforced and develop into powerful offensive weapons. Experienced Snivy are adept users of their vines, using them to snare prey and manipulate their environment. These experienced individuals exhibit a cool, calm, and intelligent disposition.

Mature Snivy often have vivid yellow collar scales, which likely have a role in mate selection. In weeks prior to evolution, *O. phyllus* spend large amounts of time sunbathing in order to up regulate photosynthesis. The carbon compounds derived from this period are required to generate healthy dorsal leaves in the next stage of the organism's lifecycle.

Servine (*Ophioregalis principus*)

Servine, *O. principus* (**Figure 26**), is the evolved form of Snivy; morphologically, this species is very similar to the previous stage.

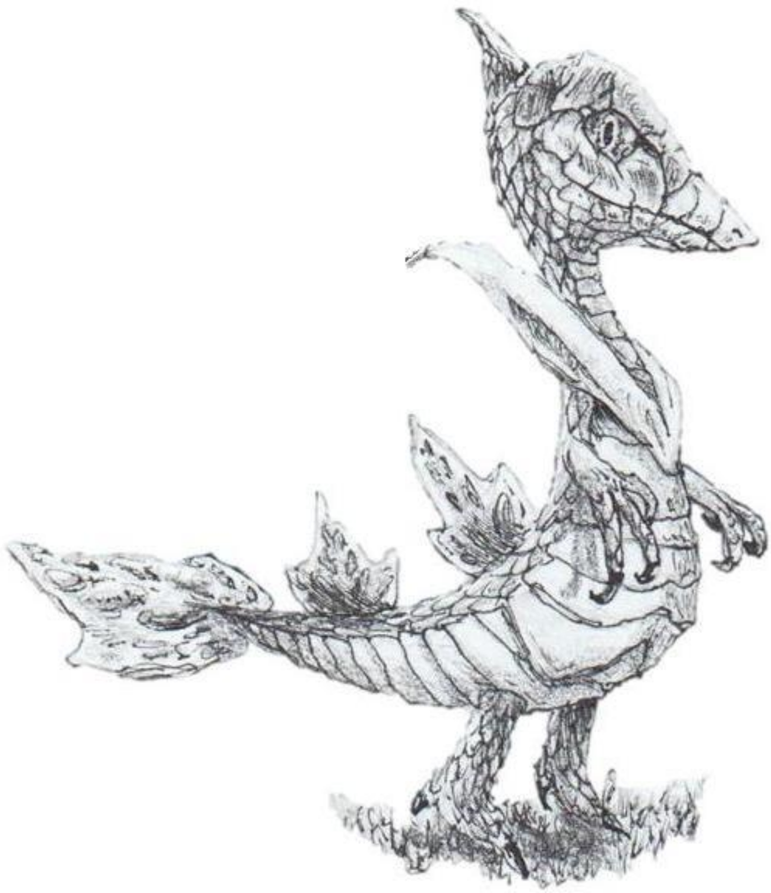

Figure 26: The second stage of the *Ophioregalis* line, Servine (*O. principus*). Ornate collar scales at the base of the neck, used for display to the opposite sex. Dorsal leaves increase the photosynthetic output of this species; forelimbs have been reduced to 'hands' protruding from the side of the organism.

Post metamorphosis, the forelimbs of *Ophioregalis* are notable reduced from arms, to three muscular digits protruding from the **pectoral girdle**. The reduction of forelimbs allows *O. principus* to pursue fast prey through the undergrowth of the jungle, allowing the predator to penetrate smaller dens and crevices without the obstruction of arms.

The reduction of arms between evolutionary stages is an archetypal example of evolutionary development. Primitive *Ophioregalis* whose genomes produced smaller arms must have been positively selected for for their capacity to capture larger volumes of prey. Over evolutionary time, this resulted in the complete loss of arms in *O. principus*.

Servine travel rapidly over fallen foliage by slithering on their **ventral** surface, using their hind legs to propel them forward. *Ophioregalis* are reproductively active prior to evolution, however mating primarily occurs during the second, and final, stage of the lifecycle.

Healthy well fed individuals tend to produce more impressive, ornate collar scales than sick or immature individuals. It is likely that sexual selection has favoured *Ophioregalis* that are capable of producing these ornate scales, demonstrating skill at capturing prey. The collar scale surface increases the amount of sunlight striking and thus warming *Ophioregalis*.

Over 80% of individuals from this species are male, thus there is heavy competition for females. This skewed sex ratio may have arisen as an extreme refining force to produce the most efficient and striking *Ophioregalis*, weeding out suboptimal individuals. Evolution has thus favoured elaborate, vibrant scales that capture the attention of the opposite sex.

Although capable of pursuing prey, Servine are more skilled at ambushing prey. When hunting, *O. principus* camouflage themselves amongst foliage, and when prey is within striking distance, they burst out and stun the prey with their agility. At this stage in their lifecycle *Ophioregalis* are efficient at using their vines to capture and subdue prey for consumption.

Serperior (*Ophioregalis intimidatus*)

The final stage of the snivy family is Serperior, *O. intimidatus* (**Figure 27**). These organisms have a powerful and regal demeanour. They are highly skilled and confident predators.

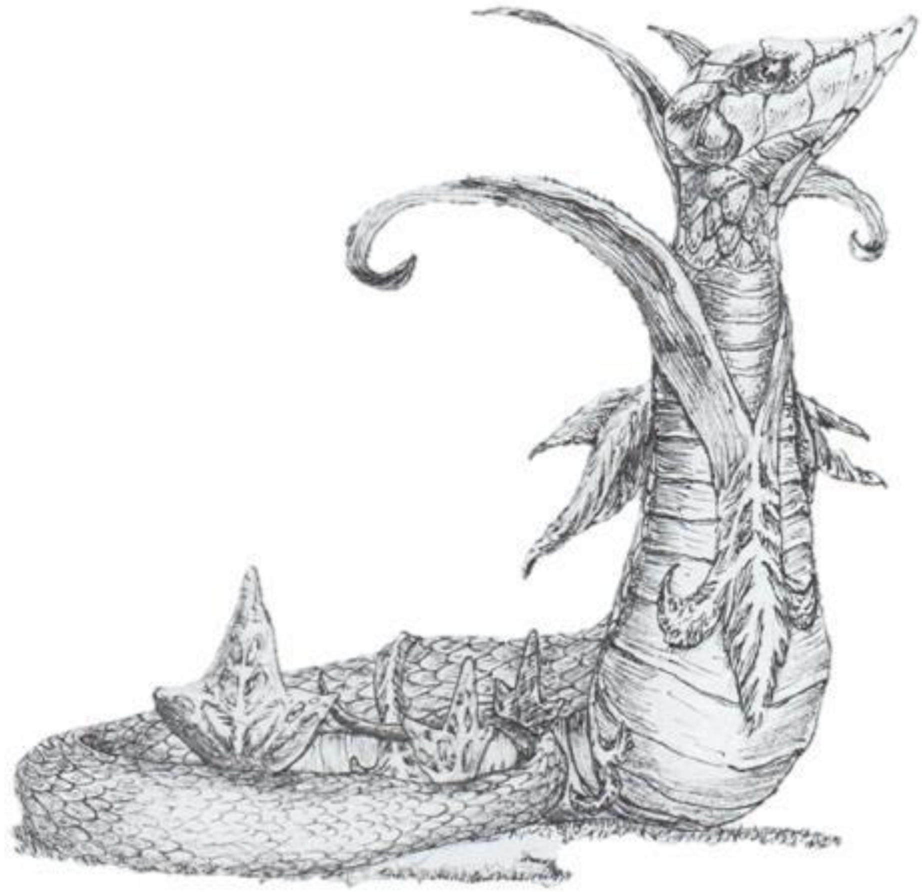

Figure 27: The final stage of the snivy family, Serperior (*Ophioregalis intimidatus*) in a characteristically regal stance. Elaborate scale modifications give the appearance of foliage, aiding camouflage and prey capture. Forelimbs have been reduced to two-digit leafy appendages.

Fully grown Serperior are generally between 3 and 4 metres (~11 feet) long, however some individuals have been found to grow up to 6 metres (~20 feet). The ornamental scales, and other aspects of *O. intimidatus* morphology, have evolved to resemble their habitat; their leaf-like forelimbs have become extremely modified for camouflage.

Various ornate scales over the body of Serperior resemble the tropical vines and shrubs that they use to disguise their body whilst ambushing prey.

Ophioregalis intimidatus have an extremely high prey capture rate. If an *O. intimidatus* is detected whilst in stealth mode it will strike an intimidating pose; commonly, the overwhelming shock of this manoeuvre causes the prey to freeze.

Although selectively bred to be optimum companions, Serperior that belong to inept Pokémon trainers will often intimidate their trainer by striking this stance, inducing temporary paralysis. The intense glare of this Pokémon has influenced human folklore; many fables allude to the paralysis inducing glare of *O. intimidatus*. The characteristic leer of Serperior also influenced taxonomists in the naming of this species.

In battle, this Pokémon has a number of moves that leech energy from their opponent; parasitic vines, tendrils, and seeds are implanted in the opponent, transporting nutrients back to *O. intimidatus*. These Pokémon can also whip sharp projectile leaves from the ends of their tails. Experienced individuals are able to generate fierce storms of razor leaves.

The fangs of Serperior are recessed at the back of their upper jaw; these are rarely displayed to their opponent. *Ophioregalis intimidatus* rarely dedicate themselves completely to battle, experienced individuals often hold back until they register an opponent as equivalent in skill and power. When battling a worthy opponent, Serperior demonstrate their full potential.

Ability and Other Data

Overgrow

When the health or energy available to battle is limiting, the ferocity of Grass-typed moves increases, allowing *Ophioregalis* to triumph over the opponent.

Egg group – Field and Grass

Members of the *Ophioregalis* family are:

Resistant to Ground, Water, Grass, & Electric-typed moves

Vulnerable to Flying, Poison, Bug, Fire, and Ice-typed moves

Immune against nothing

Glossary

Organism – an individual form of life, such as a plant, animal, bacterium, protist, or fungus; a body made up of organs, organelles, or other parts that work together to carry on the various processes of life (http://www.thefreedictionary.com/organism)

Protist – any of a large variety of usually one-celled organisms belonging to the kingdom Protista (or Protoctista). Protists are eukaryotes and live in water or in watery tissues of organisms. Some protists resemble plants in that they produce their own food by photosynthesis, while others resemble animals in consuming organic matter for food (http://www.thefreedictionary.com/protist)

Specialisation – to develop so as to become adapted to a specific function or environment; undergo specialisation (http://www.thefreedictionary.com/specialized)

Organelle – a differentiated structure within a cell, such as a mitochondrion, vacuole, or chloroplast, that performs a specific function (http://www.thefreedictionary.com/organelle)

Physiological – being in accord with or characteristic of the normal functioning of a living organism (http://medical-dictionary.thefreedictionary.com/physiological)

Discrete – consisting of distinct or separate parts (http://www.thefreedictionary.com/discrete)

Vertebrate – a member of the subphylum Vertebrata, a primary division of the phylum Chordata that includes the fishes, amphibians, reptiles, birds, and mammals, all of which are characterized by a segmented spinal column and a distinct well-differentiated head (http://www.thefreedictionary.com/vertebrate)

Selective breeding – [artificial selection] the intentional breeding of organisms with desirable trait in an attempt to produce offspring with similar desirable characteristics or with improved traits (http://www.biology-online.org/dictionary/Selective_Breeding)

Parthenogenesis – a form of reproduction in which an unfertilized egg develops into a new individual, occurring commonly among insects and certain other arthropods (http://www.thefreedictionary.com/Parthenogenetic)

Mobility – the ability to move physically (http://www.thefreedictionary.com/mobility)

Endemic – native to or confined to a certain region (http://www.thefreedictionary.com/endemic)

Eukaryote – a domain of organisms having cells each with a distinct nucleus within which the genetic material is contained. Eukaryotes include protists, fungi, plants, and animals (http://www.thefreedictionary.com/eukaryote)

Neoteny – retention of juvenile characteristics in the adults of a species, as among certain amphibians. The attainment of sexual maturity by an organism still in its larval stage (http://www.thefreedictionary.com/neoteny)

Clade – a group of organisms considered as having evolved from a common ancestor (http://www.thefreedictionary.com/clade).
A group of organisms (usually species) that are more closely related to each other than any other group, implying a shared most recent common ancestor (http://www.biology-online.org/dictionary/Clade)

Species – group of organisms whose members are capable of interbreeding and producing fertile offspring

Conspecific – refers to individuals of the same species

Heterospecific – refers to individuals belonging to different species

Hybridisation – the act of mixing different species or varieties of animals or plants and thus to produce hybrids (http://www.thefreedictionary.com/hybridisation)

Nomenclature – the procedure of assigning names to the kinds and groups of organisms listed in a taxonomic classification (http://www.thefreedictionary.com/nomenclature)

Genome – the genome is the entirety of an organism's hereditary information (en.wikipedia.org/wiki/Genome)

Chromosome – a structure found in the cells of most living organisms, chromosomes are composed of DNA and carry the genetic information that codes for an organism. May be differentiated into two groups: autosomal and sex

Evolutionary divergence – the accumulation of differences between groups which can lead to the formation of new species (en.wikipedia.org/wiki/Divergence_(biology))

Ontogeny – the origin and the development of an organism from the fertilized egg to its mature form (en.wikipedia.org/wiki/Ontogeny)

Phylogeny – the sequence of events involved in the evolutionary development of a species or taxonomic group of organisms (wordnetweb.princeton.edu/perl/webwn)

Evolutionary Development – evolutionary developmental biology (evolution of development or informally, evo-devo) is a field of biology that compares the developmental processes of different organisms to determine the ancestral relationship between them, and to discover how developmental processes evolved. It addresses the origin and evolution of embryonic development; how modifications of development and developmental processes lead to the production of novel features, such as the evolution of feathers (http://en.wikipedia.org/wiki/Evolutionary_developmental_biology)

Stratum – (plural; strata) a bed or layer of sedimentary rock having approximately the same composition throughout (http://www.thefreedictionary.com/stratum)

Primitive – [ancestral] a descriptive term often used in the field of evolution to describe particular species or traits that are characteristic of an older evolutionary scale of development relative to more recent developments (en.wikipedia.org/wiki/Primitive_(phylogenetics)

Express – to cause (itself) to produce an effect or a phenotype. To manifest the effects of (a gene) (http://www.thefreedictionary.com/express)

Derived – features or traits considered more advanced than their associated primitive form, often unique to a species

Vestigial – having attained a simple structure and reduced size and function during the evolution of the species, e.g. the vestigial pelvic girdle of a snake (http://www.thefreedictionary.com/vestigial)

Ancestors – the actual or hypothetical organism or stock from which later kinds evolved (http://www.thefreedictionary.com/ancestor)

Ancestral – of, relating to, or evolved from an ancestor or ancestors (http://www.thefreedictionary.com/ancestral)

Embryogenesis – the development and growth of an embryo (http://www.thefreedictionary.com/embryogenesis)

Transitional fossil – fossils that show intermediate characteristics are called transitional fossils — they have characteristics that are intermediate in nature to organisms that existed both prior to it and after it. There are many examples of transitional fossils in the fossil record, including large-scale transitions such as from reptiles to birds… (http://atheism.about.com/od/-aboutevolution/a/TransitionalFossilsEvolution.htm)

Morphology – the form and structure of an organism or one of its parts (http://www.thefreedictionary.com/morphology)

Sexual selection – Sexual selection is a type of natural selection that affects the traits that influence an individual's ability to attain or choose a mate, instead of the traits that influence an individual's ability to survive. Sexual selection is thought to be responsible for the evolution of many elaborate morphological features, such as long plumes in birds, courtship displays, and bright colours (http://animals.about.com/od/s/g/sexualselection.htm)

Sentient – having sense perception; conscious (http://www.thefreedictionary.com/sentient)

Extant – still in existence; not destroyed, lost, or extinct (http://www.thefreedictionary.com/extant)

Gene expression – the full use of the information in a gene via transcription and translation leading to production of a protein and hence the appearance of the phenotype determined by that gene.Gene expression is assumed to be controlled at various points in the sequence leading to protein synthesis and this control is thought to be the major determinant of cellular differentiation in eukaryotes (http://www.biology-online.org/dictionary/Expressed_gene)

DNA – nucleic acid that contains the genetic instructions used in the development and functioning of all known living organisms (en.wikipedia.org/wiki/DNA)

Plasmid – a plasmid is a DNA molecule that is separate from, and can replicate independently of, the chromosomal DNA (http://en.wikipedia.org/wiki/Plasmid)

Sex linked – characteristics that are determined by genes carried on the sex chromosome (wordnetweb.princeton.edu/perl/webwn)

Gametes – a cell that fuses with another gamete during fertilization (conception) in organisms that reproduce sexually (en.wikipedia.org/wiki/Gametes)

Syngamy – the fusion of gametes to produce a new organism (en.wikipedia.org/wiki/Syngamy)

Horizontal gene transfer – horizontal gene transfer or transposition refers to the transfer of genetic material between organisms other than vertical gene transfer. Vertical transfer occurs when there is gene exchange from the parental generation to the offspring. Horizontal gene transfer is then a mechanism of gene exchange that happens independently of reproduction. Horizontal gene transfer is the primary reason for bacterial antibiotic resistance and in the evolution of bacteria that can degrade novel compounds such as human-created pesticides. This horizontal gene transfer often involves plasmids (http://en.wikipedia.org/wiki/Horizontal_gene_transfer)

Adaptive radiation – the diversification of several new species from a recent ancestral source, each adapted to utilize or occupy a vacant adaptive zone (http://www.biology-online.org/dictionary/Adaptive_Radiation)

Biome – a major regional or global biotic community, such as a grassland or desert, characterized chiefly by the dominant forms of plant life and the prevailing climate (http://www.thefreedictionary.com/biome)

Abiotic – nonliving, as in abiotic factor, which is a nonliving physical and chemical attribute of a system, for example light, temperature, wind patterns, rocks, soil, pH, pressure, etc. in an environment (http://www.biology-online.org/dictionary/Abiotic)

Speciation – the formation of new species as a result of geographic, physiological, anatomical, or behavioural factors that prevent previously interbreeding populations from breeding with each other (http://dictionary.reference.com/browse/speciation)

Invertebrate – any animal lacking a backbone, including all species not classified as vertebrates (http://www.thefreedictionary.com/invertebrate)

Terrestrial – living or growing on land; not aquatic (http://www.thefreedictionary.com/terrestrial)

Convergent evolution – a kind of evolution wherein organisms evolve structures that have similar (analogous) structures or functions in spite of their evolutionary ancestors being very dissimilar or unrelated (http://www.biology-online.org/dictionary/Convergent_evolution)

Ecosystem function – the interactions between organisms and the physical environment, such as nutrient cycling, soil development, water budgeting, and flammability (http://www.biology-online.org/dictionary/Ecosystem_function)

Mesopredator – a medium-sized predator which often increases in abundance when larger predators are eliminated; raccoons, skunks, snakes, cats, and foxes are mesopredators (http://en.wiktionary.org/wiki/mesopredator)

Kleptoparasitism – a form of parasitism in which parasite steals items such as food or nest materials from other host individuals (http://animals.about.com/od/k/g/kleptoparasitis.htm)

Selection – placing organisms under conditions where the growth of those with a particular genotype will be favoured (http://www.biology-online.org/dictionary/Selection)

Assortative mating – assortative mating is a non-random mating pattern where individuals with similar genotypes and/or phenotypes mate with one another more frequently than what would be expected under a random mating pattern (http://en.wikipedia.org/wiki/Assortative_mating)

Suppression – the restoration (or partial restoration) of a wild-type phenotype by a second mutation (http://en.mimi.hu/biology/suppression.html)

Parsimony – adoption of the simplest assumption in the formulation of a theory or in the interpretation of data, especially in accordance with the rule of Ockham's razor

Epigenetic factor – epigenetics refers to modifications in gene expression that are controlled by heritable but potentially reversible changes in DNA methylation and/or chromatin structure (http://en.mimi.hu/biology/epigenetic.html)

Gene transcription – the process by which genetic information is copied from DNA to RNA, resulting in a specific protein formation (http://medical-dictionary.thefreedictionary.com/Gene+transcription)

Phenotype – the observable physical or biochemical characteristics of an organism, as determined by both genetic makeup and environmental influences (http://www.thefreedictionary.com/phenotype)

Genotype – the genetic makeup, as distinguished from the physical appearance, of an organism or a group of organisms (http://www.thefreedictionary.com/genotype)

Transcription factor – a protein that controls when genes are switched on or off (whether genes are transcribed or not). Transcription factors bind to regulatory regions in the genome and help control gene expression

Symbiosis – a close, prolonged association between two or more different organisms of different species that may, but does not necessarily, benefit each member (http://www.thefreedictionary.com/symbiotic)

Antigen – any of the various substances that when recognized as non-self by the adaptive immune system triggers an immune response, stimulating the production of an antibody that specifically reacts with it (http://www.biology-online.org/dictionary/Antigen)

Allele – any of the possible forms in which a gene for a specific trait can occur. In almost all animal cells, two alleles for each gene are inherited, one from each parent. Paired alleles (one on each of two paired chromosomes) that are the same are called **homozygous**, and those that are different are called **heterozygous**. In heterozygous pairings, one allele is usually dominant, and the other recessive. Complex traits such as height and longevity are usually caused by the interactions of numerous pairs of alleles, while simple traits such as eye colour may be caused by just one pair (http://www.thefreedictionary.com/allele)

Detriment – damage, harm, or loss (http://www.thefreedictionary.com/Damage%20harm%20or%20loss)

Pathogenic – capable of causing disease (http://www.thefreedictionary.com/pathogenic)

Spread – a measure of the extent to which the values of a variable, in either a sample or a population, are spread out (http://www.answers.com/topic/measure-of-spread)

Dimorphism – having two different distinct forms of individuals within the same species or two different distinct forms of parts within the same organism (http://www.biology-online.org/dictionary/Dimorphism). Differences in appearance between the males and females of a species (http://dictionary.reverso.net/english-definition/sexual%20dimorphism)

Homozygous – of, or pertaining to an individual (or a condition in a cell or an organism) containing two copies of the same allele for a particular trait located at similar positions (loci) on paired chromosomes (http://www.biology-online.org/dictionary/Homozygous)

Mutualism – a symbiotic relationship between individuals of different species in which both individuals benefit from the association (http://www.biology-online.org/dictionary/Mutualism)

Exocrine gland – an externally secreting gland, such as a salivary gland or sweat gland that releases its secretions directly or through a duct (http://www.thefreedictionary.com/exocrine+gland)

Melanocyte – a pigment bearing cell (http://medical-dictionary.thefreedictionary.com/melanocyte)

Speciose – rich in number of species (http://en.wiktionary.org/wiki/speciose)

Electric organ – a small group of modified muscle cells on the body of certain fishes, such as the electric eel, that gives an electric shock to any animal touching them (http://www.thefreedictionary.com/electric+organ)

Fitness – describes the ability to both survive and reproduce, and is equal to the average contribution to the gene pool of the next generation that is made by an average individual of the specified genotype or phenotype (http://en.wikipedia.org/wiki/Fitness_(biology)

Chloroplast – a plastid containing chlorophyll and other pigments, occurring in plants and algae that carry out photosynthesis (http://www.thefreedictionary.com/chloroplast)

Threshold potentials – the action potential threshold in a neuron is the point of depolarization at which the neuron fires, transmitting information to another neuron (http://www.chegg.com/homework-help/definitions/action-potential-threshold-13)

Acute – having a rapid onset and following a short but severe course (http://www.thefreedictionary.com/acute)

Habit – characteristic appearance, form, or manner of growth, especially of a plant or crystal (http://www.thefreedictionary.com/habit)

Exapted - the utilization of a structure or feature for a function other than that for which it was developed through natural selection (http://www.thefreedictionary.com/exapted)

Extrusive – derived from magma poured out or ejected at the earth's surface. Used of igneous rocks (http://www.thefreedictionary.com/extrusive)

Obligate mutualism – a type of mutualism in which the species involved are in close proximity and interdependent with one another in a way that one cannot survive without the other (http://www.biology-online.org/dictionary/Obligate_mutualism)

Ectothermic – of or relating to an organism that regulates its body temperature largely by exchanging heat with its surroundings; cold-blooded…having body temperature that varies with the environment (http://www.thefreedictionary.com/ectothermic)

Pectoral girdle – a bony or cartilaginous structure in vertebrates, attached to and supporting the forelimbs or anterior fins (http://www.thefreedictionary.com/pectoral+girdle)

Ventral – relating to the front part of the body; towards the belly (http://www.thefreedictionary.com/ventral)

Gallery

Figure 8: A grazing Nidorino (*Androcnidos cornu*) this species is an omnivorous, temperamental Poison/Ground-typed Pokémon. The final form of this family (*Androcnidos arche*) hunts smaller Pokémon species to supplement a largely plant-based diet.

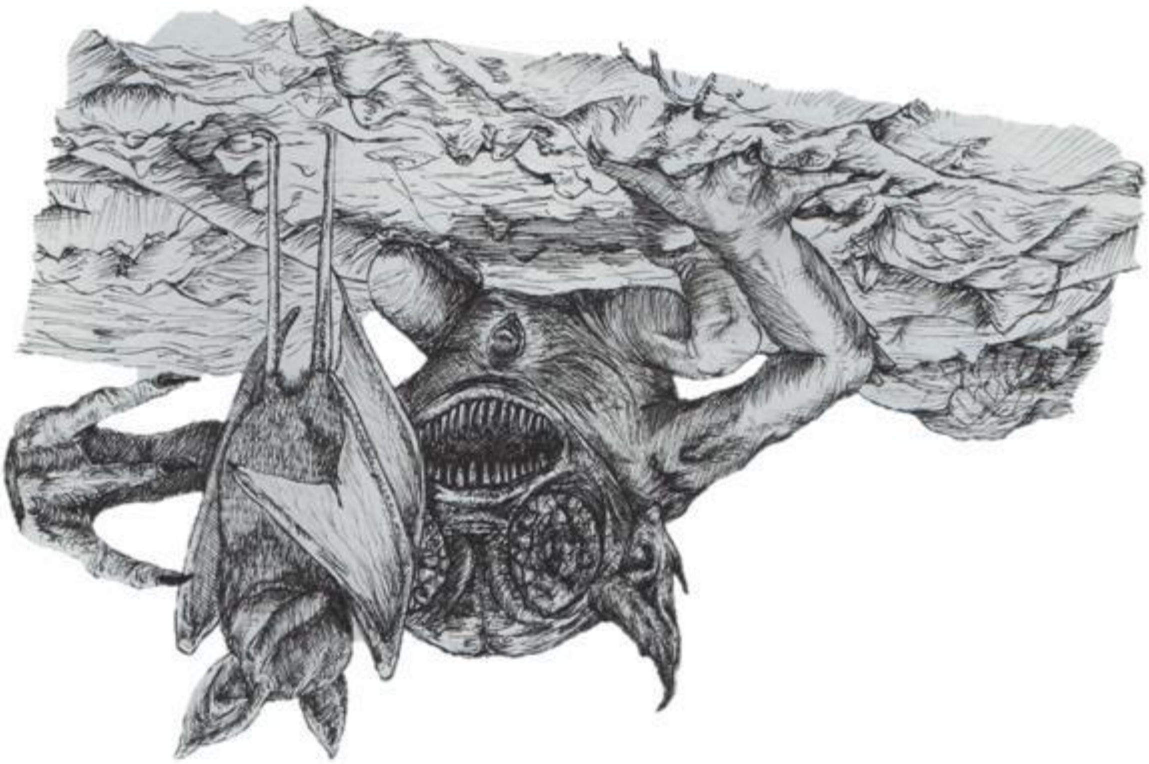

Figure 9: A cave ceiling with two cave-dwelling species. An opportunistic ambush predator, Sableye (*Phasmafusc gimmocculus*) stalking an extremely common Flying/Poison species: Zubat (*Haemophag anophthalmos*). Sableye, a Dark/Ghost species, ordinarily feeds on inorganic minerals however also has the digestive machinery to consume flesh. The *P. gimmocculus* is using a Faint Attack, and is about to consume the roosting Zubat.

Figure 10: Marine apex predator, Eelektross (*Electromorsus ferocis*), using Crush Claw to ambush a terrestrial omnivorous species, Simipour (*Hydrocercopes lax*). Simipour is a second stage Water-type Pokémon; primarily a fruitivore, this Pokémon occasionally supplements it's diet with protein from Pokémon prey. *Electromorsus ferocis*, is an Electric-type Pokémon and the final stage of the tynamo line (*Electromorsus*).

Figure 11: A Ground-typed Pokémon, Sandslash (*Loricatus temenochela*) locked in battle with a Poison-type, Ekans, (*Ophitoxis oophag*). Fierce battles such as this produced a pressure on species to evolve lethal offensives and heavy offences to stay alive. The Poison Sting attack of *O. oophag* being dodged by *L. temenochela.*

Figure 12: Three species of simian Pokémon that require an evolutionary stone before evolution occurs. Pokémon from Left to right: Fire-typed Pansear (*Pyrocercopes rostir*), Grass-typed Pansage (*Phytocercopes esculentum*), and Water-typed Panpour (*Hydrocercopes lymphocephali*). Stones from left to right: Fire Stone, Leaf Stone, and Water Stone. It is theorised that these three species came from a single simian ancestor, whose populations became isolated into three distinct habitats, wherein native minerals became a necessity for complete development.

Figure 13: Jellicent (*Nurarihyon morrigain*), a Ghost/Water-typed Pokémon species that is sexually dimorphic; the larval stage, *N. vampire*, also exhibits sexual dimorphism. Males are predominantly blue, whilst females are pink - each sex has unique appendages as well as other variations in morphology. These Ghost Pokémon live in the ocean, feeding off of weak animals in their territory; *N. morrigain* may actively sink ships to consume the sailors aboard.

Figure 14: Fighting Pokémon Sawk, *Caerulbellator karatensis*, launching a misaimed physical strike at the Bug Pokémon, Accelgor (*Molluscus tachytacitus*). Whilst dodging - *M. tachytacitus* exhibits a special STAB (same-type attack bonus) technique, Bug Buzz, to damage and potentially bewilder the opponent.

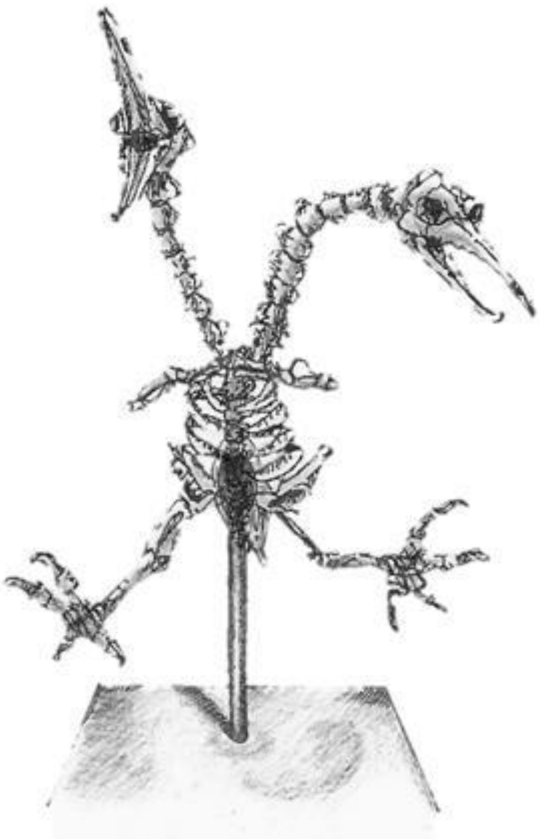

Figure 15: Museum display of extant avianoid, Doduo skeleton (*Polycephala tachyapteryx*); a Normal/Flying, dual typed species.

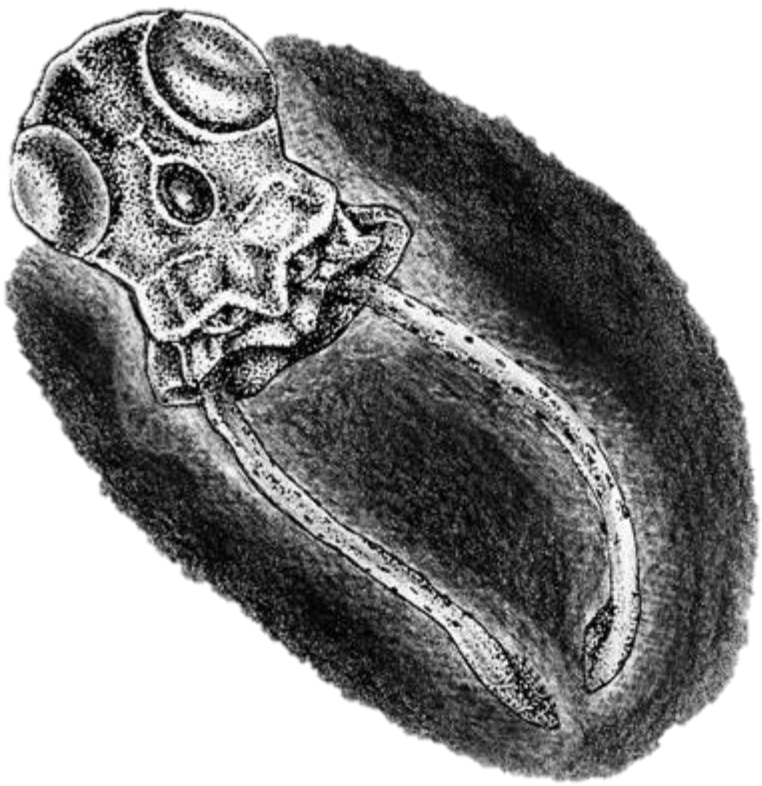

Figure 16: Tentacool (*Lymphosoma rhodotrabus*), a blue Water/Poison dual typed Pokémon species floating in the ocean. This is the basic stage of a two stage evolutionary line.

Figure 18: An Oddish (*Oddium wanderus*) planted in the soil during the day, photosynthesising. The cells of this Grass/Poison species produce carbon compounds during the night time whilst this Pokémon travels around above ground. This is the basic stage of a three stage evolutionary line (*Oddium*).

Figure 19: Stunfisk, (*Platyicthyes electropelos*) a Ground/Electric dual typed species. Members of this species sit at the bottom of shallow freshwater water bodies and camouflage with the sediment. *Platyicthyes* lie in wait for their prey to unknowingly step on them, after which they surge powerful electrical currents through the unsuspecting foe's body.

Figure 21: Duskull, (*Cyclopes requiem*), a Ghost-typed Pokémon, leeching the life of a depressed adult human. Ghost-typed Pokémon are relatively indiscriminate when selecting a host species, they do however, prefer parasitising physically or emotionally damaged individuals. *Cyclopes requiem* specialise in haunting and drawing energy from children.

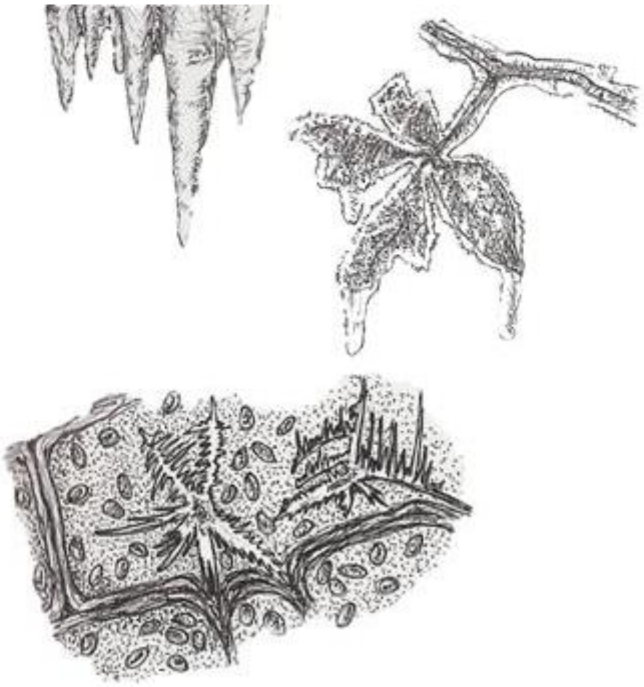

Figure 22: Clock-wise from top: (i) water sprayed by an Ice-typed Pokémon that has instantaneously been frozen to produce icicles. (ii) A macroscopic view of a frozen leaf; plant material can freeze solid purely in the presence of an Ice-typed Pokémon. (iii) A microscopic view of the internal cellular damage caused by the formation of ice crystals; Ice techniques are super effective against Grass Pokémon as vital functions are unable to be performed during periods of frost.

Figure 23: A gang of *Gladimalus*, Dark/Steel-typed Pokémon abusing a human in the city. Both members of the evolutionary line are pictured; the basic-stage smaller individuals, *Gladimalus mindinos*, take orders from the large, humanoid species, *G. apotemno*. The base form species, Pawniard, form packs and perfom malevolent acts at the commands of the final evolution, Bisharp. These Dark Pokémon compete mercilessly amongst themselves to ascend ranks and command more respect; this species has served as a productive study species for determining the evolutionary history of Dark-typed Pokémon.