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LEVEL 3
VOLUNTEER
HANDBOOK

TABLE OF CONTENTS

CH 1- LIVING AMBASSADORS

- ***What are Living Ambassadors?***
- ***Plants as Ambassadors***
- ***Animals as Ambassadors***
- ***Training & Certification***
- ***Zoonoses***
- ***Stress***
- ***Handling Guidelines***
- ***Forms & Records***
- ***Program Preparation***

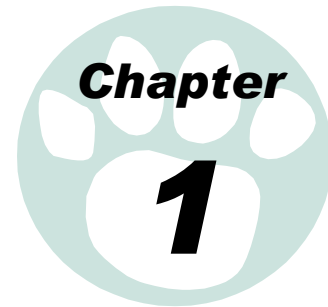
CH 2- ANIMALS

- ***Classification***
- ***Morphology***
- ***Ecology***
- ***The Invertebrates***
- ***The Vertebrates***
- ***Extremes & Oddities***

CH 3- PLANTS

- ***Classification***
- ***Morphology***
- ***Ecology***
- ***Extremes & Oddities***
- ***Role of Plants at Zoos***





Living Ambassadors

The stars of the show!

Living subjects are much more exciting to watch than dead ones. Living plants are appreciated for their vibrant colors, smells and textures. Living animals fascinate us as they move, eat, sleep, play, and socialize. People notice and connect with other living things. People want to experience them, learn more about them, and protect them. These living beings unknowingly become ambassadors for their kind - garnering attention, stimulating connection, creating empathy –demanding people care about their lives. They are the true stars of any program or experience, and have a huge impact on achieving our conservation education goals.

In this chapter, we will provide an overview of plants and animals as living ambassadors, and our guidelines for handling ambassadors for interpretation.

The Role

What is an Ambassador?

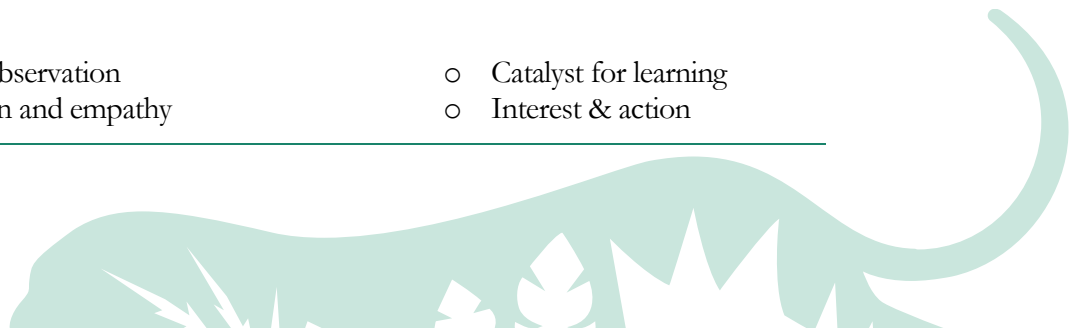
An ambassador is a species representative that interacts with people to increase their awareness, connection, and empathy for the species and to cultivate actions that will positively impact their survival in the wild. Living ambassadors can be any living material presented in an educational way, but are most often plants and animals.

It is important to remember that the use of live animals and plants is a privilege that carries with it serious responsibilities, and there are advantages and concerns of using them.

Advantages

The primary advantage of using living material is the opportunity to make a personal connection between the visitor and the Ambassador Animal. This personal connection is frequently cited as the reason that people become interested in conservation of a species and the preservation of wild places. There are also physical and behavioral adaptations that can only be seen on a living plant or animal.

- Advantages
 - Personal observation
 - Connection and empathy
 - Catalyst for learning
 - Interest & action



Concerns

Using living material is not without ethical challenges. We must care for the physical health of plants and animals when they are used in public interactions. Less obvious perhaps, but no less important is that we are careful not to cause undue stress or emotional trauma. We also must make sure that our animals (or plants) do not cause harm to our visitors.

- Concerns
 - Physical health
 - Emotional health
 - Quality of life
 - Safety

Plants as Ambassadors

As a botanic garden, we showcase a diversity of both native and exotic plants for all to enjoy. Plants form the foundation of our Zoo's natural atmosphere for guests, and the natural habitats for our animals. We want them to catch people's attention with their colorful flowers and interesting growth habits, and entice them to investigate their textures and smells. We hope they will increase people's awareness and appreciation for them, and inspire them to plant at home or save natural wild areas.

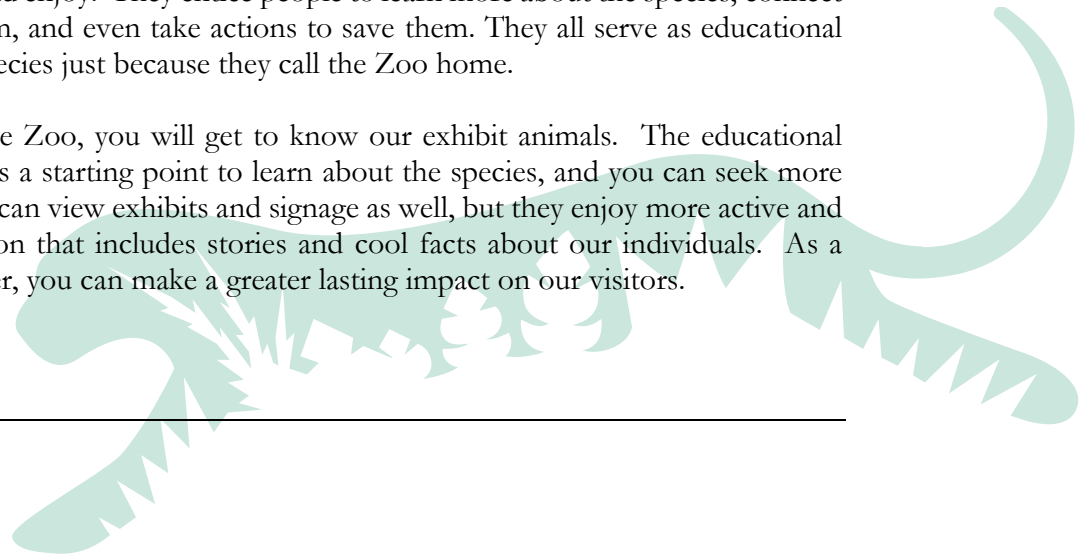
The plants at the Zoo are living ambassadors for their kind, and that helps save not animals and ecosystems too. Plant communities form the foundation of the food chain, determine biomes and grow habitats, and protect environmental quality of our land, air, and water. When we save plants in their wild habitats, we also save animal species and ecosystems.

Get to know plants, and use them as a feature in your interpretative activities at the Zoo. Many of our plant species are labeled where exhibited on grounds...in Amazonia, in the Family Garden, and along the paths. You can learn a lot by volunteering in our greenhouses and at our annual Bloomin' Zoo plant sale. And there are many SW Indiana Master Gardeners regularly working on grounds and in our Docent program that would be more than happy to share with you their passion for plants.

Animals as Ambassadors

All animals at the Zoo are living ambassadors for their kind. They are on display for the public to observe, appreciate, and enjoy. They entice people to learn more about the species, connect with and care about them, and even take actions to save them. They all serve as educational ambassadors for their species just because they call the Zoo home.

As you spend time at the Zoo, you will get to know our exhibit animals. The educational signage on each exhibit is a starting point to learn about the species, and you can seek more detail online. Our guests can view exhibits and signage as well, but they enjoy more active and personalized interpretation that includes stories and cool facts about our individuals. As a knowledgeable interpreter, you can make a greater lasting impact on our visitors.



Ambassador Animals

Ambassador Animal (AA) is a term used to specify a select subpopulation of the animals at the Zoo. AAs are more easily handled and transported, and amenable to training so they can serve in educational programs and experiences. They allow experiences that are close and personal, and they often have a lasting impact on our guests. They are the true stars of any program or interaction!

But not all animals are fit for this role. Good AAs have certain characteristics:

- Safe for educators to handle
- Can travel to program locations
- Have a good temperament
- Are cooperative for training
- Tolerate interacting with people
- Exemplify conservation messages

AAs are considered a separate collection from the exhibit animals. AAs have more exposure to people and germs, so they are housed separately as a precaution to protect the health of the exhibit animal collection. These animals are most often housed behind the scenes, reserved for specific interpretive moments with the public.

Fact Sheets

Our AA collection regularly changes, and it can be hard to stay in the know about every species. So, we offer a quick reference on all of our ambassador animals to prepare you for interpretive activities. These fact sheets are two-page summaries that give highlights about each species - taxonomy, conservation status, physical characteristics, ecology, plus special notes about our individuals.

Fact sheets can be found on our website under Volunteer Resources. They are written by knowledgeable volunteers using reputable sources. They are not the end-all, and we always welcome proofreading and updating.



Common Name: Blue-tongue skink
Scientific Name: *Tiliqua scincoides*

IUCN Red list Status: not listed
AZA Conservation Program: none

Class: Reptilia
Order: Squamata
Family: Scincidae
Genus: *Tiliqua*

Habitat: Open woodlands, semi-desert, tropical or agricultural areas in south and east Australia. This species is able to adapt well to different temperatures.

Threats in the Wild: Major predators of blue-tongues are large predatory birds and large snakes. Larger mammals such as Tasmanian Devils and Dingoes are also known to eat blue-tongues.

Physical Characteristics: Blue tongue skinks have a stout body with relatively small limbs and a thick, short tail. They have a broad, blunt triangular head. The tail is shorter than the body and generally tapers evenly to a point. Their legs are small and weak with small calves. Although this might indicate they are slow and easy to catch, they are surprisingly swift and able to move their bodies over the ground and into cover with great agility. Their body length is usually between 16 and 20 inches. The Blue tongue's color varies from silvery-gray to black. They have overlapping scales that are usually smooth and contain small plates of bone. Like other lizards, the roof of the mouth contains a Jacobson's organ. The tongue picks up odorous particles from the air or surface of objects and brings it to the organ for identification. The colorful blue tongue is used in a dramatic fashion to startle, distract, and ward off predators. When startled, a blue-tongue skink will usually stand its ground, hissing loudly, puffing up its body, and opening its mouth to show the blue tongue. If the threat does not go away, the skink may hiss and flatten out its body, making it look bigger.

Reproduction: Breeding season occurs once a year. Males seek out females and trail them. The male will bite and hold the female prior to and during mating. Females give birth 3 - 5 months later. Blue-tongue skinks are ovoviviparous; they carry shell-less membrane-enclosed "egg" sacs internally, which rupture and "hatch" as the sacs are expelled from the mother's body. Even though the young skinks are born live, as developing embryos they derive their sustenance from the yolks of their sacs. Females give birth to 6 - 15 young in a litter. Newly





Fact Sheet - Reptilia- Blue-tongue skink
 Last Updated: April 2020

Handling Animals

Interpreting ambassador animals is one of the most enjoyable activities at the Zoo, and one of the highest volunteer privileges. However, handling these animals comes with great responsibility. We must be not only knowledgeable about and skilled with the animal, but also observant and sensitive to the animal’s needs. At all times, we must ensure their safety and welfare.



You will need to train on procedures for proper handling, transportation, and use of the animals. You will also need to study each species’ life histories, and get to know them as individuals before you can interpret them to others.

Training & Certification

We classify our ambassador animals into several levels, according to how much experience and skill is needed to handle them. Level 3 includes novice level animals, and Levels 4 & 5 include progressively more advanced animals. Animals may change levels as their training progresses to make the animals easier and safer to handle.

Below are the current AAs organized by their level. The chart provides a quick reference to their names, birthdates, gender, location, and use qualifiers. It is available for reference on our website as well as in the DC common area.

MPZ Ambassador Animals List by Level						
Class	Common Name	Names/Gender	Birthdate	Use Info.	Touch	Location
Level 3						
Mammalia	Guinea Pig	*Alto*, Nick, Morris (M)	(A) 2013/(N,M,R) 2015	Alto - *Geriatric*	Yes	DC Barn
Reptilia	Blue Tongued Skink	Oliver (M)	2010		Yes	Reptile Room
Reptilia	Kenyan Sand Boa	Naya (F)	2000	*Geriatric*	Yes	Reptile Room
Reptilia	*Baja Rosy Boa*	*Arnold* (M)	1995	*Geriatric*	Yes	Reptile Room
Reptilia	African/Brown House Snake	Nyoka (M)	2007		Yes	Reptile Room
Reptilia	*Yellow-Margined Box Turtle*	*Drumstick* (M)	1988	*Geriatric*	Yes	Reptile Room or Barn
Reptilia	Egyptian Tortoise	Ra & Xerces (M)	2007		Yes	Reptile Room
Amphibia	Argentine Horned Frog	Goblin (Unknown)	2007	in training	No	Reptile Room
Reptile	Inland Bearded Dragon	Spyro (F)		in training	Yes	Reptile Room
Level 4						
Invertebrates	Madagascar Hissing Cockroach	(M)(M)	Various		No	Reptile Room
Invertebrates	Rose Hair Tarantula	Morgana (F)	2019		No	Reptile Room
Mammalia	Chinchilla	Emil (M) and Esteban (M)	(Emil) 2017/ (Esteban) 2019	in training	Yes	Dc Barn
Mammalia	*Madagascar Hedgehog Tenrec*	*Nugget* (M) *Rey*, *Phasma* (F)	(N) 2007/(R,P) 2008	*Geriatric*	Yes	DC Jewel Box
Reptilia	Mexican Pine Snake	Armando (M)	2005-2007		Yes	Reptile Room
Reptilia	*Prehensile Tailed Skink*	*Oscar* (M)	2002	*Geriatric*	Yes	Reptile Room
Level 5						
Hoofstock:						
Mammalia	San Clemente Island Goat	Sunny (M) & Bonnie (F)	(M)2012/(F)2013	Onsite only	Yes	DC Barn
Mammalia	Donkey (African Wild Ass)	Sunshine & *Jill* (F)	(S)2003/(J)1996	Jill-*Geriatric* Onsite only	Yes	CEF Contact Area
Mammalia	Miniature Horse	Clarence (M)	2000	Onsite only	Yes	CEF Contact Area
Herpetiles:						
Reptilia	Dumeril's Boa	Dremel (M)	1994	future AA - not moved yet	Yes	Reptile Room
Raptors:						
Aves	Barred Owl	Echo (F)	2019		No	Outdoor Mews
Aves	Eurasian Eagle Owl	Rava (F)	2019		No	Outdoor Mews
Aves	American Kestrel	Phoebe (F)	2016		No	DC Barn
Level L						
Aves	Blue & Gold Macaw	Gandy (M) & Crackers (F)	(M)1989/(F)1985	Onsite only	No	Amazonia
Aves	Scarlet Macaw	Lorojo (F)	(F)1988	Onsite only	No	Children's Forest
Last edited: August 2021						

Certification

We train and certify Docents to handle animals by level. Each level requires its own certification class, and levels must be completed in order. Certification classes are offered once per year, and have prerequisites to attend.

Certification in any level requires you to...

- Attend class
- Read the level volunteer handbook
- Read applicable AA fact sheets
- Practice handling the animals with mentors
- Take a handling test with a mentor
- Take the certification test

You will be trained on all animals in a level for certification on the level. However, you are not required to handle all of the animals in it if you choose not to. For example, some people draw the line at handling snakes or spiders, but want to handle the other animals in that level.

That is perfectly acceptable. Your normal Docent activities can include only the animals you want to work with. You should still be familiar with all animals in the level.



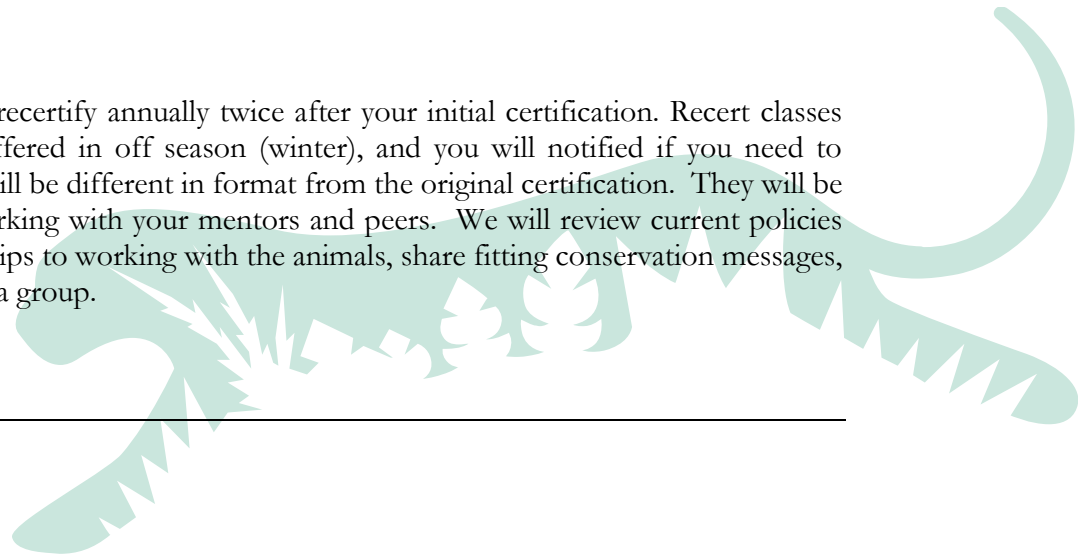
To stay active in the level of certification, volunteers are expected to serve at least 40 hours and do several interpretive activities each year. Refer to the volunteer program structure chart in chapter 4 for more details on requirements to qualify for trainings and stay active at each level.

What if we get a new ambassador?

There will be times when we get a new ambassador animal. We will go through a process to incorporate the animal into a level. We first allow the animal to quarantine and get acclimated to its new habitat. Then we assign a small team of veteran Docents to habituate the animal to handling and start its training i.e. crate training. We will classify the animal into a training level once we know the animal and its temperament better. Once the animal is ready to be handled by more people, we will offer special certification classes for those at that level to train with the veteran Docent team. The animal will then be added to the normal certification classes.

Recertification

You will be required to recertify annually twice after your initial certification. Recert classes for each level will be offered in off season (winter), and you will be notified if you need to recertify. These classes will be different in format from the original certification. They will be a hands-on refresher working with your mentors and peers. We will review current policies and procedures, discuss tips to working with the animals, share fitting conservation messages, and practice handling as a group.



Beyond the two recerts, you will need no further training as long as you stay active and fluent on handling. For those animals that you do work with, you must stay practiced on handling at all times. If at any time you feel rusty, or decide to work with an animal you haven't in a while, you can ask a veteran Docent to mentor you or you can audit a recertification class. **This is an honor system. We trust that you will not handle an animal that you are not practiced and competent handling without asking for a training refresher.**

Evaluation Rubric

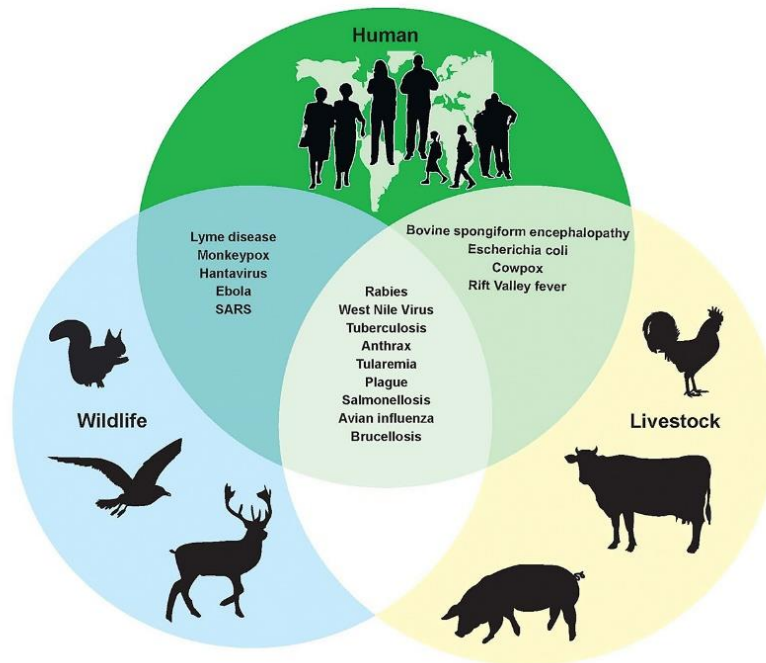
To train and certify a volunteer on a level, we use an evaluation tool called a rubric. A staff or volunteer mentor will evaluate your knowledge and skill during your training, and sign off on your certification status. It is meant to give you detailed feedback that you can use to grow your skills, and document your progress towards certification. This will become part of your volunteer file.



Level 3 Animal Handling Evaluation	Session 1					Session 2					Session 3					Session 4 (Testing)					Recert 1			Recert 2						
	Date:					Date:					Date:					Date:					Date:			Date:						
	Comfort / Confidence	Attitude	Removal	Presentation	Return	Comfort / Confidence	Attitude	Removal	Presentation	Return	Comfort / Confidence	Attitude	Removal	Presentation	Return	Comfort / Confidence	Attitude	Removal	Presentation	Return	Total points for each animal / 24	Comfort / Confidence	Attitude	Handling	Total points for each animal / 12	Comfort / Confidence	Attitude	Handling	Total points for each animal / 12	
Rosy Boa																														
Brown House Snake																														
Kenyan Sand Boa																														
Bearded Dragon																														
Blue Tongue Skink																														
Egyptian Tortoise																														
Box Turtle																														
Guinea Pig																														
Horned Frog																														
Animals not intending to handle after mentoring:	Comments:					Comments:					Comments:					Comments:					Comments:			Comments:						
																											Quiz Score		L3 Cert	
MENTOR:	Printed:					Printed:					Printed:					Printed:					Printed:			Printed:						
	Signed:					Signed:					Signed:					Signed:					Signed:			Signed:						
EDUCATION CURATOR:	This is to certify that all facets of Level 3 Training & Certification have been met, and Docent is entitled to full status of Level 3 Docent Ambassador.										Signed:					Signed:					Signed:			Signed:						
											Dated:										Pass = 75% or 18/24 points for each animal in session			Pass = 75% or 9/12 points for each animal in Recert			Pass = 75% or 9/12 points for each animal in Recert			

Zoonoses

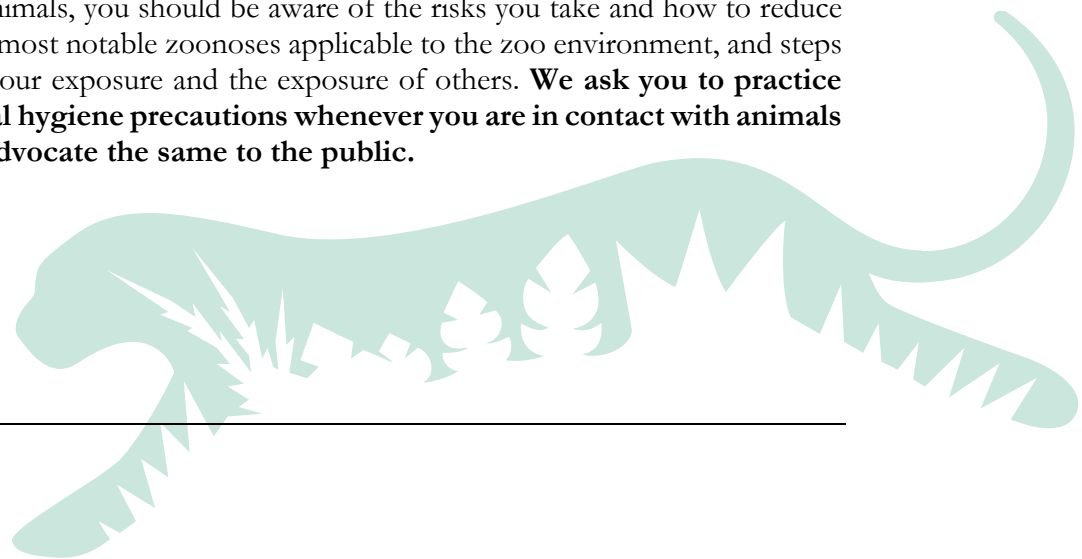
Before you begin to handle animals, you should know what you are getting into. Contact with animals presents the possibility of exposure to pathogens (organisms that cause disease) they carry. Zoonotic diseases are those that can be passed from animal to humans, or vice versa. Salmonella, Lyme disease, rabies, plague, and covid-19 are some of the most publicized zoonoses, and there are many more. A number of viral, bacterial, fungal, or parasitic organisms are known cause zoonoses.



www.halenessme2018.wordpress.com

While we strive to keep our animal population as healthy as possible, we cannot constantly guarantee they are free of pathogens or disease. Even healthy animals can carry pathogens, which if given the proper environment, can cause disease in animals or people. The risk of disease transmission from mammals to humans is greater since they are very physiologically similar. The potential for disease transmission is greatest between primates and people, since they are most closely related.

When interacting with animals, you should be aware of the risks you take and how to reduce your risk. Below are the most notable zoonoses applicable to the zoo environment, and steps you can take to reduce your exposure and the exposure of others. **We ask you to practice common sense personal hygiene precautions whenever you are in contact with animals or their exhibits, and advocate the same to the public.**



Zoonoses Precautions:

PPE – Where appropriate and necessary, use personal protection equipment (PPE) such as face masks, gloves, and eye protection.

Wash Hands - Wash your hands well with soap before and after touching any animal. Encourage guests to do the same. Use hand sanitizer until a hand washing area is available.

Clean Injuries - If you are bitten or scratched by an animal, report the injury to Zoo staff, wash the wound well, and consult your physician for medical attention.

Avoid Contamination – Keep food and drink out of animal areas. Do not kiss animals or put hands or objects in your mouth or eyes. Caution children and parents to avoid the same.

Refrain if Ill - If you are not feeling well and may have a contagious disease (e.g., respiratory infection, stomach bug), please refrain from working near or handling animals.

Stay Current on Vaccinations - MPZ requires that all staff and volunteers entering a primate or felid area have current vaccination and proven antibodies for tuberculosis (TB). All must also wear a mask in these animal areas to reduce their exposure to covid-19.

Report Irregularities - If you notice irregular behavior or appearance with any of the Zoo's animals, please report it to one of the keepers or managers. It could be a sign of illness.

Zoonoses:

Listed below are zoonoses and their routes of transmission and species involved. They are listed by the type of agent: viral, bacterial, fungal, or parasitic. If you want to learn more about symptoms or treatments, you can do further research online.

Bacterial Disease	Transmission	Species Involved
Tetanus <i>Clostridium tetani</i>	Direct contact with infected soil or fecal matter, associated with a wound	Potentially all animals can be carriers-more common in herbivores.
<i>Yersinia sp</i>	Fecal-oral ingestion	Mammal, avian, reptile
<i>Listeria sp.</i>	Direct contact, contaminated food, water, soil	Mammal, Avian, Fish, Crustaceans
Leptospirosis	Direct contact with contaminated urine, or reproductive fluids	Mammal-more common in wildlife, domestic farm animals
<i>Escherichia coli</i>	Fecal-oral ingestion	Mammal, avian
<i>Salmonellosis sp.</i>	Fecal-oral ingestion	Reptile, amphibian, mammal, avian, crustacean
<i>Psittacosis</i>	Aerosol transmission of infected feces	Avian
<i>Bordetellosis</i>	Aerosol exposure, direct contact with saliva	Mammal (Mainly Guinea pigs and rabbits)
TB (<i>Mycobacterium sp</i>)	Aerosol or ingestion	Mammal, Avian
<i>Campylobacteriosis</i>	Fecal-oral	Mammal, Avian
Tularemia	Direct contact, aerosol, oral, fomites	Mammal, Avian, Reptile, Fish

Source: 10th edition Merck Veterinary Manual.

Viral Disease	Transmission	Species Involved
Rabies	Direct contact with saliva from infected individual	Mammal
COVID-19	Aerosol, Direct contact	Mammal
Contagious ecthyma "Orf" Pox Virus	Direct contact with broken skin	Mammal-goat, sheep, wild ungulates.
Vesicular stomatitis	Direct contact, vector (insects)	Mammal-goat, sheep, wild ungulates, rodents, swine,
Foot and Mouth disease	Direct contact, vectors (insects)	Mammal (goat,sheep,horses, swine, rodents, camelids)
Hanta Virus	Direct contact, aerosol	Rodents
West Nile Virus <i>Flavivirus</i>	Vector (Mosquito), Direct contact with infected tissues	Mammal, Avian, possible reptile/amphibian
Fungal Disease	Transmission	Species involved
Ringworm	Direct contact, fomites	Mammal
Aspergillosis	Environmental exposure to infectious fungal spores, can affect humans and animals.	Avian, Mammal
Blastomycosis, Histoplasmosis	Environmental exposure to infectious fungal spores-mainly moist soil, can affect humans and animals.	Mammal
Cryptococcosis	Aerosal (inhalation), direct contact	Fecal matter, environmental exposure more vs. direct animal exposure. Avian and Mammals may harbor/be affected.
Parasitic Agent	Transmission	Species involved
Cryptosporidiosis	Fecal-oral, inhalation, ingestion contaminated food/water	Mammal
Giardiasis	Fecal-oral	Mammal
<i>Toxoplasmosis gondii</i>	Ingestion of oocysts	Mammal-feline
Mange	Direct contact, fomites (mite)	Mammal
Rickettsial disease (Rocky Mt. Spotted Fever, Lyme Dz)	Vector (ticks)	Mammal
Intestinal parasites (round/ tape/ hookworms)	Fecal-oral, direct with open wound	Mammal, avian, reptile, amphibian
<i>Baylisascaris procyonis</i> or <i>columnaris</i>	Fecal-oral, ingestion of contaminated soil or water	Raccoons and skunks

Stress

As we all know, stress doesn't feel good and can be detrimental to our physical, emotional, and mental well-being. Animals feel stress too, and human caregivers are important advocates for their health and well-being. All kinds of stress can be harmful and debilitating to an animal, and can lead to illness or even death. Our animal handling guidelines are an attempt to minimize stress.

Stressors can be either acute or chronic. Acute stressors are one time, "unpleasant surprises," like a dropped crate or spike in temperature during an outdoor program. Chronic stressors are those that may seem minor at the time they occur, but happen continuously, such as crowded living quarters, frequent mishandling, or exposing an animal to large crowds of people which is not psychologically ready for it. Physical and psychological stressors (Table 1) can be either acute or chronic depending on their severity and frequency of occurrence.

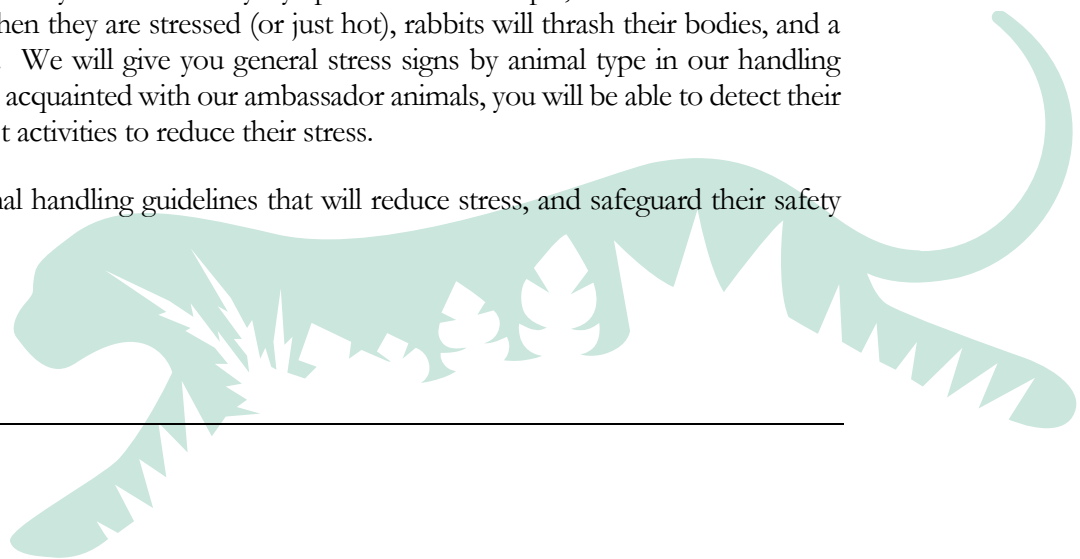
Table 1: Physical Stressors		Psychological Stressors
Sights & Sounds	Changes in position	Fear
Surprising contact (Unexpected touches)	Abnormal stretching of muscles or tendons	Crowding
Odors (perfumes, etc)	Excessive thirst or hunger	Loneliness
Tastes	Oxygen deprivation	Anger
Sudden light changes	Change in temperature	

Docents should watch for signs of stress in our ambassador animals, particularly when using them in interpretation, and adjust activities accordingly to reduce their stress. A general list of stress symptoms are provided in Table 2 below.

Table 2: Signs of Stress				
Piloerection	Vocalizations	Teeth grinding	Pupils dilated	Kicking
Fluffing feathers	Showing teeth	Urination	Self-mutilation	Shivering
Depression (too easy to handle)	Drinking (excessive)	Sphincter muscles contract (pooping)	Color changes (flushing, or going pale)	Panting/open mouth breathing
Sexual activity	Change in fecal matter (diarrhea)	Posture changes	Aggression (exaggerated)	Over-eating/ not-eating

The signs of stress exhibited by an animal vary by species. For example, we know barred owls "pant" (gular fluttering) when they are stressed (or just hot), rabbits will thrash their bodies, and a tarantula may throw hairs. We will give you general stress signs by animal type in our handling guidelines. As you become acquainted with our ambassador animals, you will be able to detect their stress symptoms and adjust activities to reduce their stress.

Next, we will outline animal handling guidelines that will reduce stress, and safeguard their safety and well-being.



General Handling Guidelines

Guidelines for All Ambassador Animal Use

1. Docents should wear their uniform and name tag for any animal handling activity.
2. Be cognizant of ALL Zoo, Docent, and animal related policies.
3. Docents must have appropriate training and experience to handle.
4. Notify staff or keeper before going into any animal area. Notify Curators via email the day before for animals kept in keeper areas. Notify keepers upon arrival with a radio.
5. Docents should never enter an area they aren't authorized to enter.
6. Only approved "animal ambassadors" should be used.
7. Follow proper procedures for animal use, crating, transport, and handling.
8. Docents must pair up with another qualified Docent or staff to take some animals out.
9. Never leave an animal unattended.
10. The public is never permitted to hold or control an animal.
11. Animals should always be handled so that their safety and comfort are maximized and the possibility of injury is minimized.
12. The public should follow the "two-finger rule" when they are given the opportunity to touch an animal and should "pet" in the direction of the fur or scales (head to tail).
13. Sanitary hand washing or sanitizing should be followed after touching an animal. The public should always be advised, especially those with young children under 5.
14. Handlers should avoid sudden movements and should at all times remain calm.
15. Handlers should avoid feeding animals in a public setting, and should not feed any food item not prescribed and provided by the Zoo commissary or staff.
16. If any injuries or unusual behaviors are observed, please notify a keeper or staff member. If neither available, call for an Animal Curator or veterinary staff member.
17. Always keep personal comments, messages, and behavior professional and credible.

Guidelines Specific to Reptiles & Amphibian Use

1. Handling order should be: amphibians (before sanitizer), then reptiles, then mammals.
2. Sanitizer should be used between each reptile to avoid spreading germs between reptiles and to avoid inadvertent hand-to-mouth contact by children. Turtles in particular can carry salmonella bacteria that can make a child sick.
3. Snakes must not be draped around the necks of people, both to avoid the appearance of animals used as jewelry and the increased danger of a bite to the face.
4. Amphibian skin is highly absorbent, and should be handled with pre-moistened hands free of soap, sanitizer or lotion. Use only dechlorinated water "Amphibians only".

Guidelines Specific to Perch-Using Animals (birds, prehensile-tailed skink)

1. These animals should never be allowed to climb on the handler's body.
 2. For most of these animals, handlers should use a stick perch of sufficient length to ensure that the animal is not able to climb on the handler. Animals should not be permitted to wander off of approved perches. Return the animal to the perch using a stick. If it will not remain, then put the animal back into its container or exhibit.
 3. For raptors, handlers should use a leather glove or a raptor-safe perch. Raptors can leave a perch it is tethered to and they can re-perch themselves.
 4. Perches should be in a location that does not permit the public's contact
-

Guidelines Specific to Animal Handling and Transport:

❖ Frequency

- Animals may be handled for up to 60 minutes at a time on a case-by-case basis. Some animals will tolerate 30-60 minute sessions (SC goats, PT skink, boa, etc.) and some will only tolerate 15-30 minutes (AH frog, some snakes, etc). Know the animal, and observe for stress indicators. Adjust your session time accordingly.
- Animals can be used up to 4 sessions per day. Animal must be returned to its enclosure or carrier for equal and isolated rest between sessions.
- Geriatric animals may be handled only every other day. Geriatric status will be designated by Animal Curators, Veterinarian and Education Curator.
- Animals must not be away for > 4 hours without special arrangements.

❖ Temperature

- Animals may be handled for programs, enrichment, or training when the environmental temperature is above 15°F and below 96°F.
- Amphibians, reptiles, and invertebrates can only be handled in environments with an ambient temperature of 60°F or higher, and should be transported in insulated containers when the temperature is below 60°F or above 85°F. (Coolers are tested and will hold a constant temperature for 5-10 min. while in transport outdoors in winter. Heat packs can be added for extended periods of transport. Follow instructions for heating packs to appropriate warm – not hot - temperature.)
- Mammal carriers should be covered with a blanket when the temperature < 45°F.
- Birds housed in outdoor winter enclosures need time to adjust to warmer indoor temperatures. When the outdoor temperature is below 30°F, crate the animal and set it in a slightly warmer, sheltered location for 30-60 min. to provide a more gradual temperature change, and do the same for the return.
- Exceptions to temperature guidelines can be made on a case by case basis by the Education or Animal Curators.

❖ Transport

- The Ambassador Animal Use Checklist must be completed for all animal uses.
 - Handlers must have an outreach kit before leaving or going across zoo grounds.
 - Grab an Education Dept radio before going across zoo grounds with an animal.
 - Animals should be individually transported unless from the same home enclosure. Transport in clean, appropriate and secure carriers. Ensure that the container shuts securely, has ample substrate for stable footing, and cover to reduce stimulus.
 - Care should be taken to ensure minimal movement when carrying animals in transport crates. Be cognizant of how much you swing, lift, or move your arms when you walk.
 - Transport carriers should be cleaned before storing, following guidelines.
 - Water should be provided for an animal if it is off-site for longer than two hours.
 - In cold or hot weather, the vehicle must be cooled or warmed before transporting.
 - Animals should not be exposed to loud noises or uncontrolled crowds. All containers should be kept isolated from human disturbance by covering with a blanket or locating behind a door or curtain until it is time to get the animal out.
 - It is important to be aware of predator/prey relationships. Visual access between such animals should be avoided in order to reduce stress.
-

Species-Specific Handling Guidelines

➤ AMPHIBIANS

- **Touch:** NO TOUCH animal. MOIST & CLEAN hands required.
- **Handlers:** 1 minimum
- **Equipment:** Glove is preferred but NOT required. Nitrile glove, ensure outreach kit spray bottles are emptied and filled with treated water labeled for “Amphibians only” before departing.
- **Transport:** Provide an enclosed, moist environment using moist paper towels, mulch, moss, or similar substrate & treated water. Provide a hide.
- **Concerns:** Avoid direct sunlight and keep moist. The handler’s hands should be clean of soap or lotion, and sprayed moist with treated water before contact, and a moist environment must be maintained. Misting bottles of treated water should be available for use with amphibians.

➤ INVERTEBRATES

- **Touch:** NO TOUCH animal.
- **Handlers:** 1 minimum
- **Equipment:** sand or small hidey places for some
- **Transport:** Provide appropriate substrate for the animal to feel hidden / secure, placed in a plastic aquarium, shallow tub or insulated cooler to maintain specified temperatures. Provide a hide.
- **Concerns:** Handle with care. Handle tarantula slowly to avoid startling and aggravating. Hairs can prick skin and cause irritation. Wash hands after handling. Signs of stress include shedding and quick movements. DO NOT hold tarantula more than a few inches away from a solid surface, because if she is dropped to the ground she will burst and die. A small clear container is recommended to show or walk around with invertebrates.

➤ SMALL SNAKES

- **Touch:** Touch animal. Two fingered touch, mood considered.
- **Handlers:** 1 minimum
- **Equipment:** snake bag
- **Transport:** Pillowcase tied securely with a knot and placed in a shallow tub or insulated cooler to maintain specified temperatures.
- **Concerns:** Do not use 24-48 hours after feeding, depending on the size of the food. Snakes should not be wrapped around your neck or body, but they can be draped over your lap or arm. Signs of stress include hissing, biting or excessive movement. Snakes opaque (i.e. preparing to shed) should not be handled. Long periods of time i.e. several hours in an enclosed cooler will be okay – sufficient oxygen in the space.



➤ LARGE BOA CONSTRICTOR

- **Touch:** Touch animal. Two fingered touch, snake mood considered.
- **Handlers:** 2 minimum
- **Equipment:** snake bag
- **Transport:** King-sized pillowcase or cotton laundry bag tied securely with a knot and placed in a tub or insulated cooler to maintain temperatures.
- **Concerns:** Do not use 24-48 hours after feeding, depending on the size of the food. Snakes should not be wrapped around your neck or body, but they can be draped over your lap or arms. Large boas must be handled by two animal handlers for safety. Signs of stress include hissing, biting, excessive movement and/or inflation of throat area. Snakes opaque (i.e. preparing to shed) should not be handled. Long periods of time in enclosed cooler is okay.

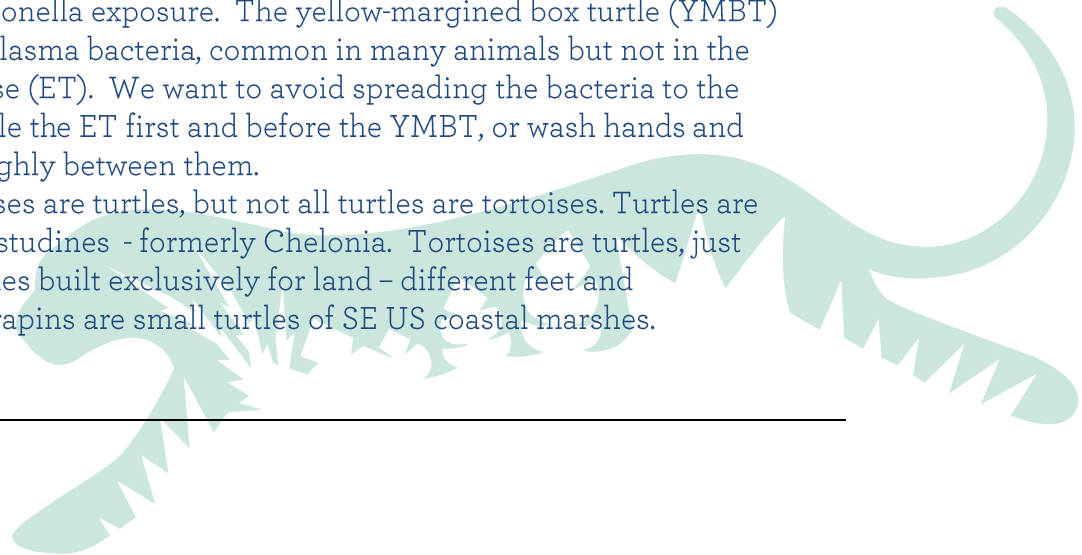


➤ SMALL LIZARDS

- **Touch:** Touch animal. Two fingered touch, animal mood considered.
- **Handlers:** 1 minimum
- **Equipment:** tree branch perch
- **Transport:** Provide ample mulch, cloth, carpet, or paper substrate for secure footing in a tub or insulated cooler to maintain temperatures.
- **Concerns:** Signs of stress include excessive struggling or lethargy. Lizards may poop while you are handling. Be prepared with paper towels.

➤ TURTLES

- **Touch:** Touch animal. Two fingered touch. Ensure hand washing.
- **Handlers:** 1 minimum
- **Equipment:** sanitizer!
- **Transport:** Plastic aquarium, tub, or insulated cooler to maintain specified temps, lined with torn newspaper or similar substrate.
- **Concerns:** Signs of stress include prolonged periods pulled into shell. Parents of children < 5 yrs should be advised of hand washing / sanitizing and risk of salmonella exposure. The yellow-margined box turtle (YMBT) carries a mycoplasma bacteria, common in many animals but not in the Egyptian tortoise (ET). We want to avoid spreading the bacteria to the ET. Either handle the ET first and before the YMBT, or wash hands and surfaces thoroughly between them.
- **Note:** All tortoises are turtles, but not all turtles are tortoises. Turtles are in the Order Testudines - formerly Chelonia. Tortoises are turtles, just specialized turtles built exclusively for land - different feet and vegetarian. Terrapins are small turtles of SE US coastal marshes.



➤ TENRECS

- **Touch:** Touch animal, but only away from head and mood willing.
- **Handler:** 1 minimum
- **Equipment:** Glove NOT required
- **Transport:** Plastic aquarium, tub, or insulated container with shavings and shredded paper. Provide a hide.
- **Concerns:** Handle outdoors only if the temperature is between 60° and 80°F. Cover carrier with a towel to reduce visual stimulus during transport if temperatures allow. Signs of stress include hissing, drooling, vomiting and defecating. This animal can bite. Use a bite resistant glove.

➤ CHINCHILLAS

- **Touch:** Touch animal. Two fingered touch, animal mood considered.
- **Handlers:** 1 minimum
- **Equipment:** portable animal yard, preferably with cover
- **Transport:** Medium or large pet carrier with substrate. Cover carrier with a towel to reduce visual stimulus during transport if temperatures allow. Keep animals dry!
- **Concerns:** Signs of stress: barking and whistling, spraying urine, baring teeth, hiss and spit. Signs of overheating: red ears, warm body, drooling, lethargy, heavy breathing. When grabbed, they “fur slip” - shed patches of fur to escape. Do not grab tails or hold upright to protect delicate spine. Pick up around the chest, support their hind legs, and hold close to your body. Watch for their jumps of up to 6’!

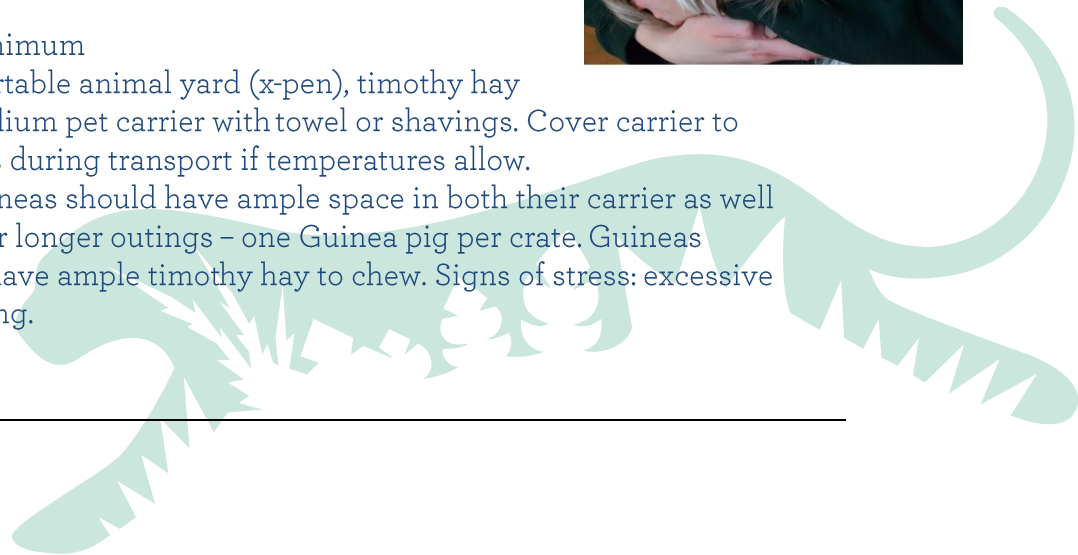
➤ RABBITS

- **Touch:** Touch animal. Two fingered touch, animal mood considered.
- **Handlers:** 1 minimum
- **Equipment:** portable animal yard, hay
- **Transport:** Medium or large pet carrier with carpet square and /or towel. Cover carrier to reduce stimulus.
- **Concerns:** Signs of stress: kicking and/or panting.



➤ GUINEA PIGS

- **Touch:** Touch animal. Two fingered touch, animal mood considered.
- **Handlers:** 1 minimum
- **Equipment:** portable animal yard (x-pen), timothy hay
- **Transport:** Medium pet carrier with towel or shavings. Cover carrier to reduce stimulus during transport if temperatures allow.
- **Concerns:** Guineas should have ample space in both their carrier as well as an “x-pen” for longer outings – one Guinea pig per crate. Guineas should always have ample timothy hay to chew. Signs of stress: excessive kicking & panting.



➤ SAN CLEMENTE GOATS

- **Touch:** Touch animal. Two fingered touch, animal mood considered.
- **Handlers:** 2 minimum
- **Equipment:** halter and lead rope or leash required, treats, pooper scooper
- **Transport:** On grounds use only Walk goats in pairs only using halter and leash. Two handlers are required total to walk both SC goats.
- **Concerns:** Signs of stress include kicking, head butting, and/or panting.

➤ MINIATURE HORSE

- **Touch:** Touch animal. Two fingered touch, animal mood considered.
- **Handlers:** 2 minimum
- **Equipment:** halter and lead rope required
- **Transport:** On grounds use only. Walk horse using halter and leash. Two handlers are required to walk the horse - one in front & one in back.
- **Concerns:** Signs of stress include kicking, biting.

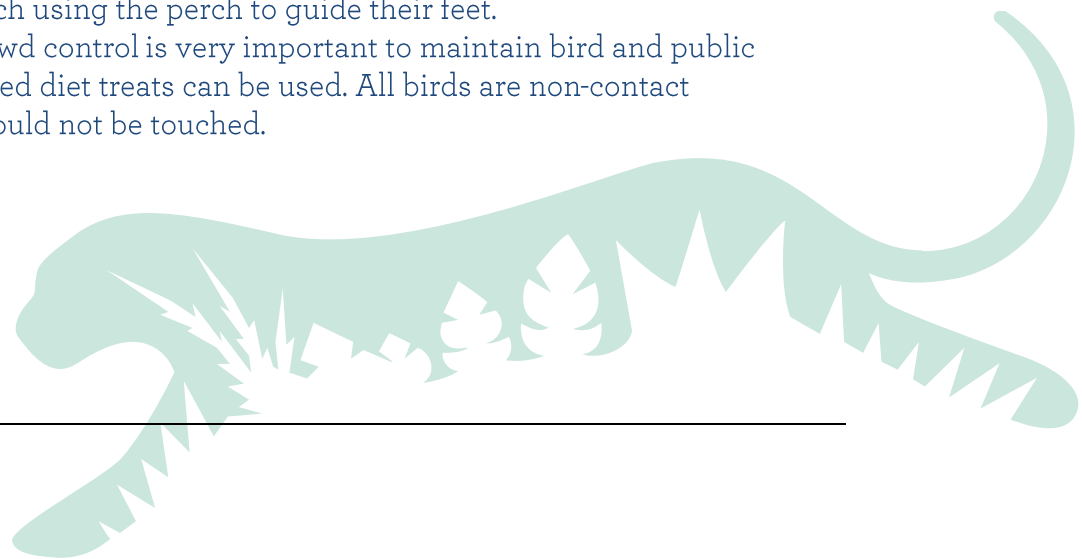


➤ DONKEYS

- **Touch:** Touch animal. Two fingered touch, animal mood considered.
- **Handlers:** 2 minimum
- **Equipment:** halter and lead rope required
- **Transport:** On grounds use only. Walk donkeys in pairs only, using halter and leash. Two handlers are required total to walk both donkeys.
- **Concerns:** Signs of stress include kicking, biting.

➤ MACAWS

- **Touch:** NO TOUCH animal.
- **Handlers:** 2 minimum
- **Equipment:** tree branch perches, treats
- **Transport:** On grounds use only. Two handlers are required each session. Macaws should only be handled using perches and should never be on your person. If macaws leave their perches, work quickly to return them to the perch using the perch to guide their feet.
- **Concerns:** Crowd control is very important to maintain bird and public safety. Prescribed diet treats can be used. All birds are non-contact animals and should not be touched.



➤ RAPTORS

- **Touch:** NO TOUCH animal.
- **Handlers:** 1
- **Equipment:** Leather gauntlet (glove) and leash required, floor protection
- **Transport:** Birds are handled only on a gloved hand. Retrieval and crating of the birds will be done by a limited number of staff and docents. Birds can be walked short distances from their mew (enclosure) on the glove, always using a leash on jesses for safety. For programs, crossing the zoo, or going off grounds, use a giant hood (carrying crate) to increase security and reduce stress of wait times and transports. Ensure perch is solid for secure footing during travel. Use paper on the bottom. Lock door with a carabiner. Leave leash outside the door and tie onto hood handle. Place giant hood in a vehicle with perch parallel to the car front to back so the bird has secure footing during travel.
- **Concerns:** Birds of prey should be given their daily meal at time of retrieval from their mew to encourage cooperation. Other treats are not necessary. Birds mute (poop) a lot, mostly at the beginning of handling. Be prepared with floor coverings and paper towels. Allow an assistant to clean up or do it after the bird has been hooded, instead of trying to do so with a bird on the glove. Signs of stress include looking around quickly, wings drooping, panting or “gular fluttering” (in owls) and bating (flying off the glove). Reducing visual stimulus and sudden movements is the main way to reduce stress. All birds are non-contact animals and should not be touched by guests.
- **Note:** All raptors are birds of prey, but not all birds of prey are raptors. Vultures are birds of prey but not raptors because they don't seize and kill their prey.



Records & Forms

We track everything! We keep data on the frequency animals are used and why, the programs conducted, and the people reached. We also use tools to ensure animals are handled and returned properly, and to communicate their whereabouts. We ask you to use several forms and procedures for these purposes.


Sign Out

When you get an animal out of its enclosure, you will sign the animal out on a dry erase board or checklist that hangs on the wall so that at a glance all keepers, staff, and other volunteers knows it whereabouts. This is important to avoid panic!

Activity Log

We also ask you to sign the animal in and out on paper each time it is used. For this, we use the AA Activity Log (right). This is for long-term record keeping to track when an animal was used and for what purpose. It is also for short-term communication so everyone knows each animal's latest activities to guide when it is eligible for use again. These are kept in a binder in the DC common area.

Ambassador Animal Activity Log							
Year:		Animal:					
Date	Staff /Vol. Name(s)	Destination (circle two)	Purpose (circle one)	Time Out	Time In	# of people	Special Concerns or Comments
		ON / OFF Grounds	Roaming Program Event				
		INside / OUTside	Enrichment Training Other				
		ON / OFF Grounds	Roaming Program Event				



Evansville's
Maker Park
Zoo
Of Indiana's Capital

DATE: _____ DOCENT(s): _____

CHECKLIST for Ambassador Animal Use

Complete one checklist for all Docents and animals per use / program / event

Prepare:

- Review animal use, handling, & touching policies and procedures.
- Check weather conditions and temperatures range is appropriate.
- If traveling in a vehicle, grab the key and warm or cool to temp.
- If staying on grounds and leaving DC, grab a radio from Education.
- Grab outreach kit and supplies specific to animals traveling.
- Let a staff member know you are going into an animal area.

OUTREACH KIT

- Hand sanitizer
- Disinfectant spray
- Paper towels
- Water & water bottle / dish
- Thermometer
- Trash bag
- First aid kit
- Phone & emergency numbers
- Optional Zoo radio on grounds

Retrieve:

- Check the sign-out binder to see when the animal was used last.
- Sign animal(s) "OUT" in the book and on white board on door /barn.
- If exhibit animal, place a sign noting an animal is out on a program.
- Ensure carrier will maintain temperature specifications.
- Take out animal(s), close enclosure door, & put in a transport carrier.

Return:

- Return animal(s) back to home enclosure and secure the doors.
- Sign animal(s) "IN" in the book and clear the white board.
- Notify staff of issues or concerns, if any.

Finish:

- Clean and put away all carriers and supplies.
- Return radio and van key, make sure van has fuel.
- Wash your hands thoroughly.
- Ensure the checklist is complete.

ANIMALS IN USE:

	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>

OUT IN:

	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>

DOCENT RESPONSIBLE: _____

1345 Maker Park Drive
Evansville, Indiana 47730-8206
812-435-6143
makerparkzoo.com

Use Checklist

Each time you prepare to take an animal out for interpretation, we ask that you use the AA Use Checklist (left). This helps ensure consistent preparation for programming, and ensures that all animals checked out are also safely returned. We want to be sure all animals are accounted for and returned to their home enclosures! This is a reusable laminated form that hangs on the AA room door.

Note the "Outreach Kit" in the box on the top of the form. There are several of these kits that are ready to grab. They should be taken with animals anywhere away from DC, whether on or off grounds.

Next we will go over program preparation.

Program Preparation

We offer many formal and informal educational programs, including interpretation stations, school or scout programs, and booths at events. Live animals are often the star, helping us draw attention and deliver messages with impact. However, we must always be cognizant of the program audience and environment to make sure the animals are well suited and their welfare protected.

There are many steps to take to get everyone and everything program ready. Below is a general list of steps to take, but the best way to learn the steps is by shadowing veteran Docent mentors.

Before the Program

- Communicate with the other docents who are doing the program with you. Traditionally, the lead Docent initiates this process.
- Discuss logistics of getting to and from the program, sequence of the program, and which animals and/or biofacts you want to take.
- Study for the program delivery -lesson plans, talking points, or interpretation binders...

Day of the Program

- Dress in Docent polo shirt, khakis, and appropriate shoes.
- Check forecast for outdoor programs to determine which animals are appropriate.
- Meet at the DC and get supplies together.
- Gather/prepare biofact & animal transport containers.
- Gather and sign out biofacts and ambassador animals.
- Sign them out on the Activity Logs.
- Use the Animal Use Checklist to ensure every step is done.
- Grab the outreach kit for animal use away from DC.



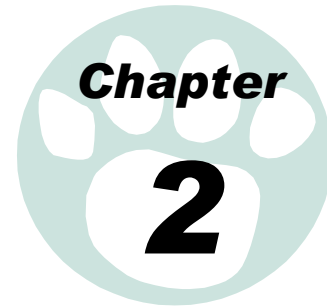
The Program

- Get to your designated program spot. If offsite, find and notify the contact person at the site (for example, at a school check in at the office).
- Check for safety issues. If indoors check for overhead fans, open windows, enough room for presentation. If outdoors check for shade, danger, alarming stimulus, seating.
- Greet the group and group leader, or families as they come around.
- Go over safety issues with each audience i.e. stay seated, calm voices, two finger petting
- Give presentation.

After the Program

- Return the biofacts and / or animals to their homes.
- Sign them in on the Activity Logs.
- Check the Animal Use Checklist to ensure all animals have been put away.
- Clean the crates & put away any other supplies.
- Record your hours on Volgistics

In the next chapters, we will give a high-level overview of the plant and animal kingdoms to better prepare you for interpreting them.



Animals

The incredible eating machines.

Animals come in all shapes and sizes, but one thing they have in common is a desire to eat. All animals eat. The style and substance of their diets spans the globe. Some animals only eat as infants. Some eat feces. Some eat their mates. Whether you drink blood or nectar, delight in rotting flesh, think there is nothing finer than a fresh ball of dung or prefer pizza and an ice-cold beer welcome to our kingdom, the Kingdom Animalia.

Introduction to Animalia

Animals range in size from no more than a few cells to organisms weighing many tons, such as the blue whale or giant squid.

The number of known animals on the planet is roughly 9 to 10 million species, but the exact number is not known.

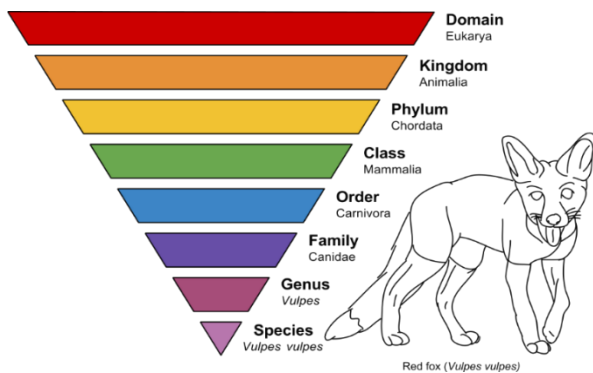
The animals that we all know best and love - fish, amphibians, reptiles, birds, and mammals – are vertebrates (those with a backbone) in Phylum Chordata. But they are by far outnumbered by the invertebrates. Just the species in Arthropoda outnumber all of the other animal phyla combined.

Animal Phyla		Species
Placozoa	<i>Trichoplax adhaerens</i>	1
Porifera	Sponges	8,000
Cnidaria	<i>Hydra, jellyfishes, corals, anemones</i>	11,000
Ctenophora	Comb jellies	100
Platyhelminthes	Flatworms	15,000
Nemertea	Ribbon worms	800
Nematoda	Roundworms, Pinworms, hookworms	20,000
Rotifera	Rotifers	1,800
Mollusca	Snails, slugs, clams, squids, octopuses	110,000
Annelida	Earthworms, leeches, polychaetes	15,000
Arthropoda	Crabs, lobsters, spiders, insects	1,000,000+
Echinodermata	Sea stars, sea urchins, sea cucumbers	6,000
Chordata	Tunicates, lancelets, vertebrates	2,100

Animal Classification

As we begin to discuss the Kingdom Animalia, we will use a lot of scientific names to describe groups of organisms. Remember that organisms, living or extinct, are named and classified based on their physical, developmental, and behavioral characteristics and their evolutionary relationship with other organisms. All species are given a two part universal and scientific name written in italics: *Genus Species*. For example, the common barred owl is *Strix varia*.

The Genus and species is the most specific name for an organism. But the organism is also part of larger, more inclusive groupings with other organisms, including Family, Order, Class, Phylum, and so on. All animals belong in the Kingdom Animalia (all animals) and the Domain Eukarya (all true-celled organisms).

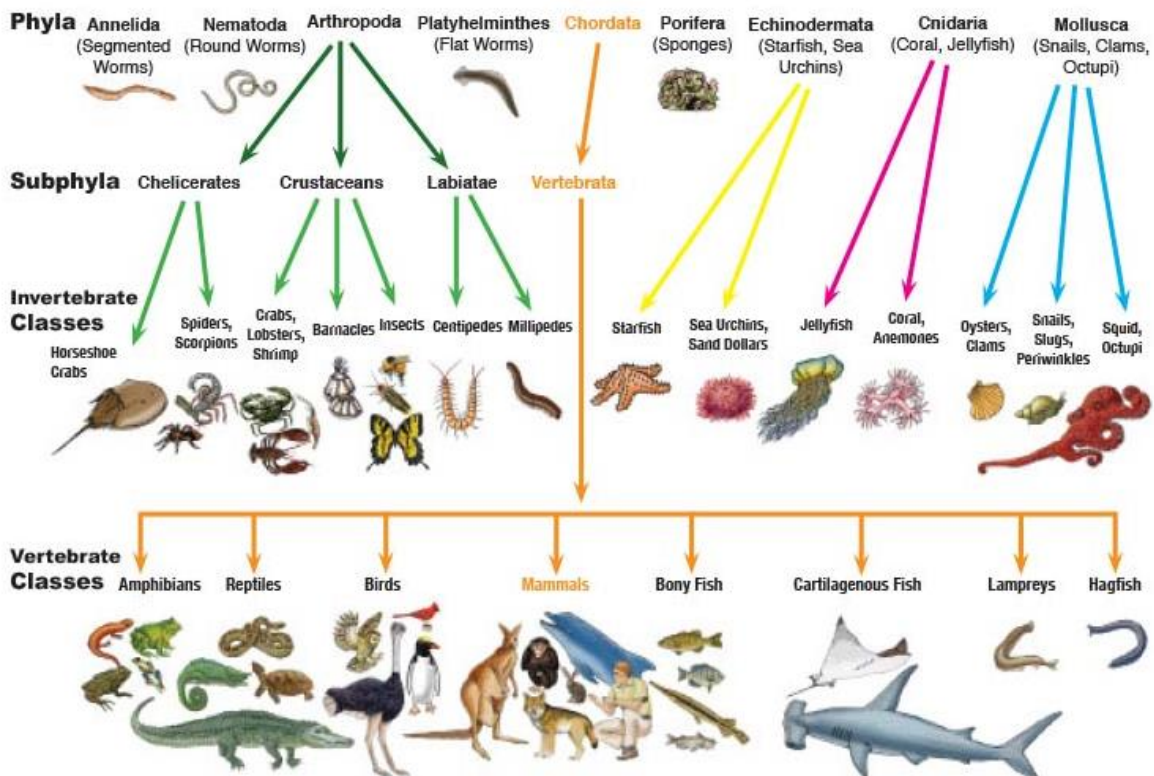


A good way to remember the order of the taxonomic levels is by creating or memorizing a memory aide for them, such as:

Do cents **K**now **P**retty **C**ool
Odd **F**acts and **G**ood **S**tores

<https://en.wikipedia.org/>

Animal Kingdom



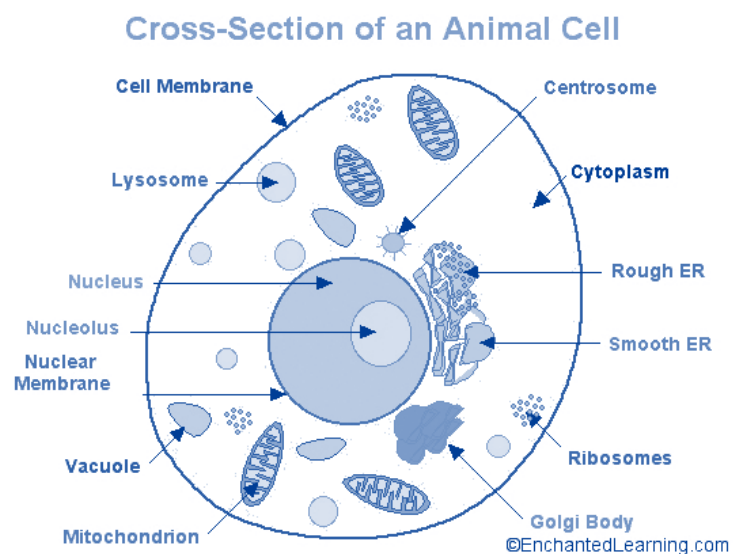
Animal Morphology

What makes animals... well, animals?

Source: <http://www.ucmp.berkeley.edu/phyla/metazoamm.html>

When you look across all animals and try to determine what features they all share, you may think of multicellularity. But multicellularity has been independently developed in at least seventeen different groups of organisms, including plants, fungi, and slime molds. If you think more deeply about the characters that all animals possess, you are left with small things at the cellular level. At the cellular level, animals begin to all look alike, but they can also resemble many other groups of organisms. If you separate out all of the things that only animals possess, what are you left with?

The short answer is: an extracellular matrix composed of four types of molecules: collagen, proteoglycans, adhesive glycoproteins, and integrin. These molecules are created inside, but exist outside, the cells of animals. They fill up the spaces between cells and serve as structural elements that allow cells to develop, live, and work together. The extracellular matrix also plays a key role in the development of animal cells, allowing them to differentiate into special types of cells and to become mobile. It appears that all animals share this complex system of cell development mediated by extracellular matrix, whereas all other multicellular organisms do not.



Animal cells are eukaryotic - meaning they have a nucleus and organelles that perform specialized function. They differ from plant cells in that they have no cell wall and are more flexible, irregular shape that provides less protection from bursting in some environments. They also have no central vacuole or plastids with photosynthetic pigments. There are others, but these are the major differences that are relevant for our depth of study.

Animal Ecology

Animals are heterotrophic.

All animals eat. Animals cannot manufacture their own food, and so must eat (consume) other organisms to obtain nourishment. One feature common to all animals is their ecological role as consumers. There are three basic categories of consumers:

- **Predator** - A predator devours other organisms, or parts of other organisms. This includes both carnivores, which eat other animals, herbivores, which eat plants, and omnivores, which eat both.

- ❶ **Detrivore** - Detrivores feed on dead organisms, or on organic nutrients in the soil or water. These organisms are vital to the food web because they recycle nutrients which would otherwise become unavailable. Earthworms and vultures are both examples of detrivores.
- ❷ **Parasite** - A parasite lives on or within another organism (the host), and obtains nourishment from the host without killing or swallowing it. These organisms range from ticks to tapeworms, and may be relatively harmless or may cause disease.

Many animals specialize in their roles as consumers; they may feed exclusively on one food or one kind of food. Certain bats, for instance, are frugivores, and eat only fruits. These specialists often play important roles in the lives of the species with which they interact. In the case of the fruit bats, the bats are crucial for dispersing the seeds contained within the fruits.

Arthropoda – The Dominant Invertebrates

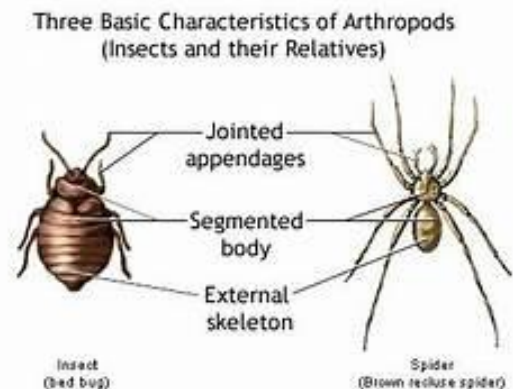
The REAL rulers of the earth.

Source: <http://www.ucmp.berkeley.edu/arthropoda/arthropoda.html>

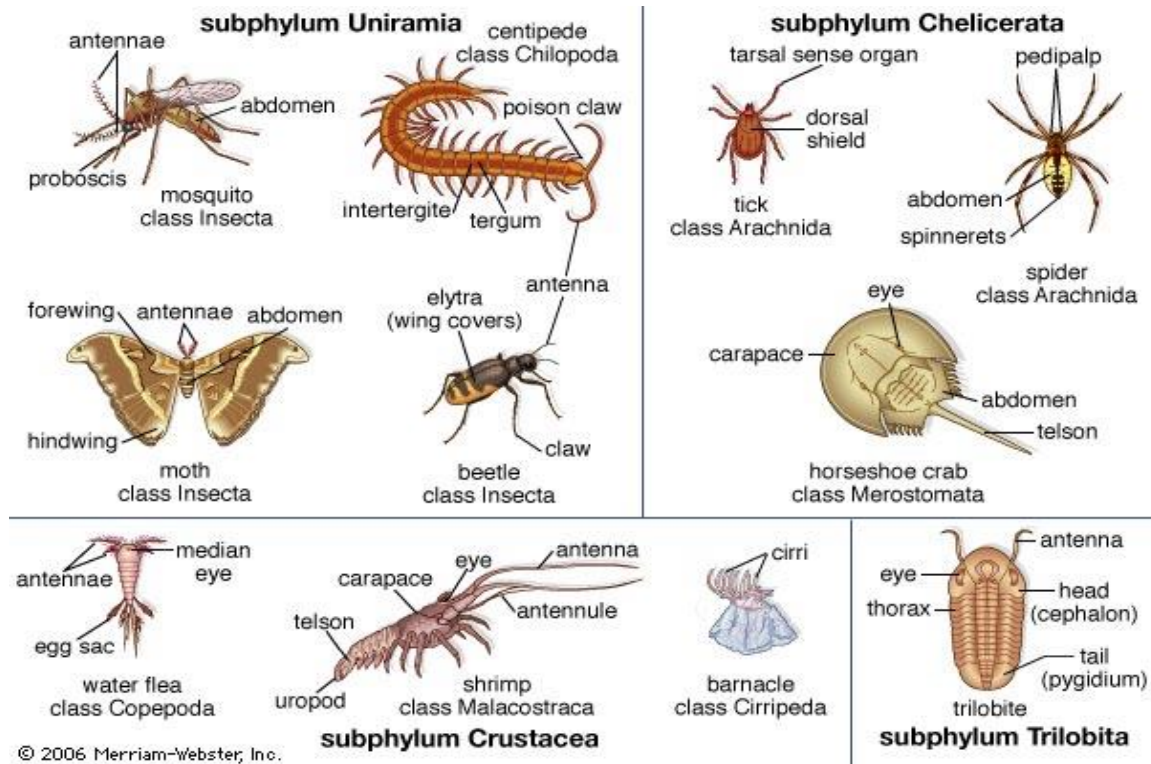
By nearly any measure, the most successful animals on the planet are the arthropods. They have conquered land, sea and air, and make up over three-fourths of all currently known living and fossil organisms, or over one million species in all. Since many arthropod species remain undocumented or undiscovered, especially in tropical rain forests, the true number of living arthropod species is probably in the tens of millions. One recent conservative estimate puts the number of arthropod species in tropical forests at 6 to 9 million species (Thomas, 1990).

Arthropods range in distribution from the deep sea to mountain peaks, in size from the king crab with its 12-foot arm span to microscopic insects and crustaceans, and in taste from chocolate covered ants to crawfish jambalaya and lobster Newburg. Despite this unbelievable diversity, the basic body plan of arthropods is fairly constant with an exoskeleton and segmented joints.

Arthropods have an exoskeleton of a tough compound called chitin. This outer shell provides the structure against which arthropod muscles pull, reduces water loss, and protects them from environmental dangers. To move inside such a rigid armor, the chitin is laid down in plates, with joints between them. This gives the arthropods their name, meaning “jointed feet.” Its distinctive jointed appendages may be modified in a number of ways to form antennae, mouthparts, and reproductive organs. Arthropods also have a hemocoel, an open body cavity in which blood flows and bathes the tissues and organs, and they generally lack blood vessels.



It is almost impossible to generalize about the ecology and life history of arthropods; they are simply too diverse. Arthropods first appeared in the sea. Most crustaceans are marine, but one crustacean group has successfully invaded the land, the Isopoda, a.k.a. "pillbugs" or "roly-polies." The vast majority of living arthropods belong to groups that are specialized for a land-dwelling existence. Arthropods are a clade (a group from a common ancestor) that have traditionally been divided into four subphyla: Trilobita, Chelicerata, Crustacea, and Uniramia.



Crustaceamorpha – Kings of the deep

The Crustaceamorpha includes lobsters, crabs, shrimp, pill bugs, krill, barnacles, water fleas, brine shrimp (sea monkeys), copepods, and more—many, many more. In fact, about 38,000 species have been described and named to date. There are many more that remain to be named, particularly in the deep sea. Crustaceans have an extremely wide variety of body shapes. In fact, body form is so varied throughout the crustacean groups that the only feature all crustaceans share is the possession of two pairs of antennae at some stage of their life cycle. Their colorful exoskeletons and active habits make them favorites to watch at aquariums and when scuba diving. A number of species are economically important to humans as sources of food, and many serve as the main source of food for many fish and whales.



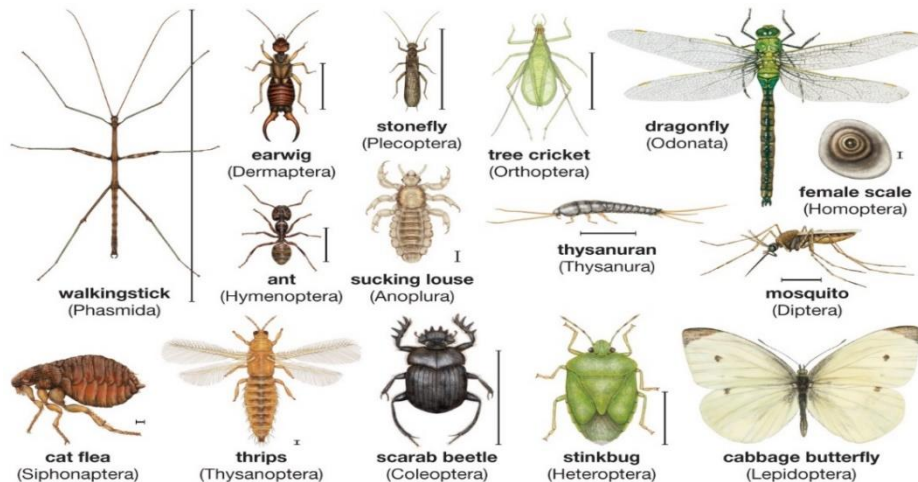
If you aren't yet convinced how important crustaceans are, think about this: Crustaceamorphs are the dominant arthropods, and very often the most numerically abundant type of animal in aquatic environments. They make up a significant portion of animal communities in all aquatic habitats, from the most extreme (glacial ice or temporary desert ponds) to the largest (deep ocean) and everywhere in between. When found on land crustaceans are either found in moist protected habitats like under logs or in leaf litter in cool forests, or they are encysted (enclosed in a tough protective capsule, nearly dried out, and dormant). The Crustaceamorphs are arguably the most well-known of the arthropods because of their contributions to aquatic, aerial, and terrestrial food webs.

It is possible to find a group of crustaceans that feeds in just about every way imaginable. There is even a great diversity of parasitic life history strategies used by various crustacean groups. And there's a lot to learn about non-parasitic crustacean feeding, mouthparts, and digestion. As crustaceans feed, they grow, and as they grow they must shed their exoskeleton and produce a larger one; this is called molting. Crustaceans molt as they grow throughout their lives but they molt most frequently during metamorphosis when they are changing from larvae to adults.

Uniramia – Approximately 75% of the world's animals

Uniramia is the largest major group of arthropods that includes insects, millipedes, centipedes, and their relatives. Most are terrestrial, but some are aquatic for part or all of their life cycles. They make up by far the most common and diverse major group of arthropods, and in fact make up over three-fourths of all known animal species on the planet -- and probably an even greater proportion of the total number of species, known and unknown.

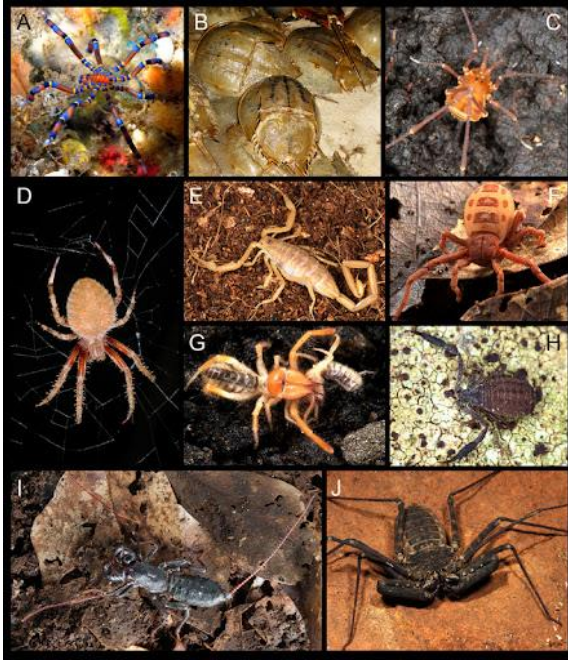
Insects are distinguished by having a body divided into head, thorax, and abdomen, with 11 segments on the abdomen, and three pairs of appendages on the thorax. Thus the Myriapoda, the centipedes, millipedes, and their kin, are not insects; they have many more appendages, and their bodies are not divided into thorax and abdomen. Neither are the Parainsecta (springtails and proturans) or Diplura (diplurans) true insects, for their numbers of abdominal segments vary. These two clades, together with the true insects, form the clade Hexapoda ("six-legged"). Insecta includes the Archaeognatha (jumping bristletails), Thysanura (silverfish or firebrats), Ephemeroptera (mayflies), Odonatoida (dragonflies and damselflies), and the many insect orders in the Neoptera, as well as other groups known only from fossils.



Cheliceramorpha – Terrestrial tough guys.

The Cheliceramorpha includes spiders and scorpions, mites and ticks, horseshoe crabs, daddy-longlegs, and extinct "sea-scorpions", to name a few. It is the second most prominent order of terrestrial arthropods, after the uniramians. Most of its marine representatives are extinct, but were prominent in the Paleozoic and included some fearsome predators. Chelicerates occupy a variety of roles in the ecology of marine systems and on land as well.

<http://www.sharmalabuw.org/chelicerate-phylogenomics.html>



While many spiders build webs, others do not, but instead ambush prey as it passes by. This is also the tactic used by scorpions, another group of chelicerate predators. The predatory habits of these critters helps to control insect populations in many parts of the world.

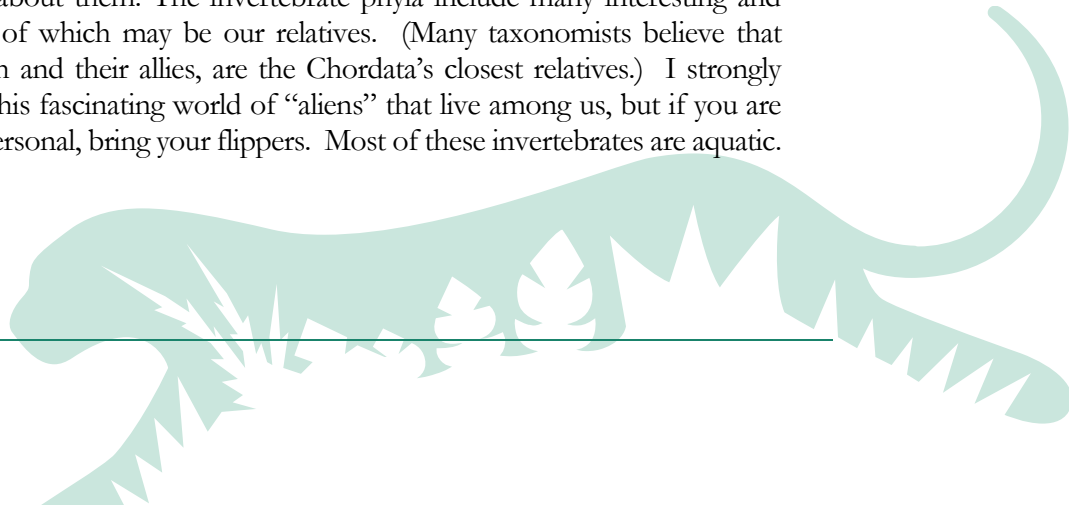
Some arachnid chelicerates are parasites, such as ticks and mites. They live upon the bodies of other animals and feed on the blood, skin, or hair. Some of these carry diseases, which they pass on to the host when they feed. Still other chelicerates are tiny organisms which feed on detritus, the bits of decaying matter that accumulate on and below the ground. The first terrestrial chelicerates are believed to have been detritus feeders.

Parental care is not common among the chelicerates, but some scorpions will carry their young on their backs for a time. In most cases, however, no such care is provided, and the young must fend for themselves from the time they hatch. Survival is then dependent on the fact that large numbers of eggs are produced at a time, and it is likely that at least a few will survive.

The Other Invertebrates

Where we give approximately 20% of all animal species the short straw.

It is ridiculous to treat the wide diversity and incredible numbers of non-Arthropod invertebrates as a small heading within this chapter - an insult which I will compound by not really telling you anything about them. The invertebrate phyla include many interesting and incredible creatures, some of which may be our relatives. (Many taxonomists believe that Echinodermata, the starfish and their allies, are the Chordata's closest relatives.) I strongly encourage you to explore this fascinating world of "aliens" that live among us, but if you are going to get up close and personal, bring your flippers. Most of these invertebrates are aquatic.



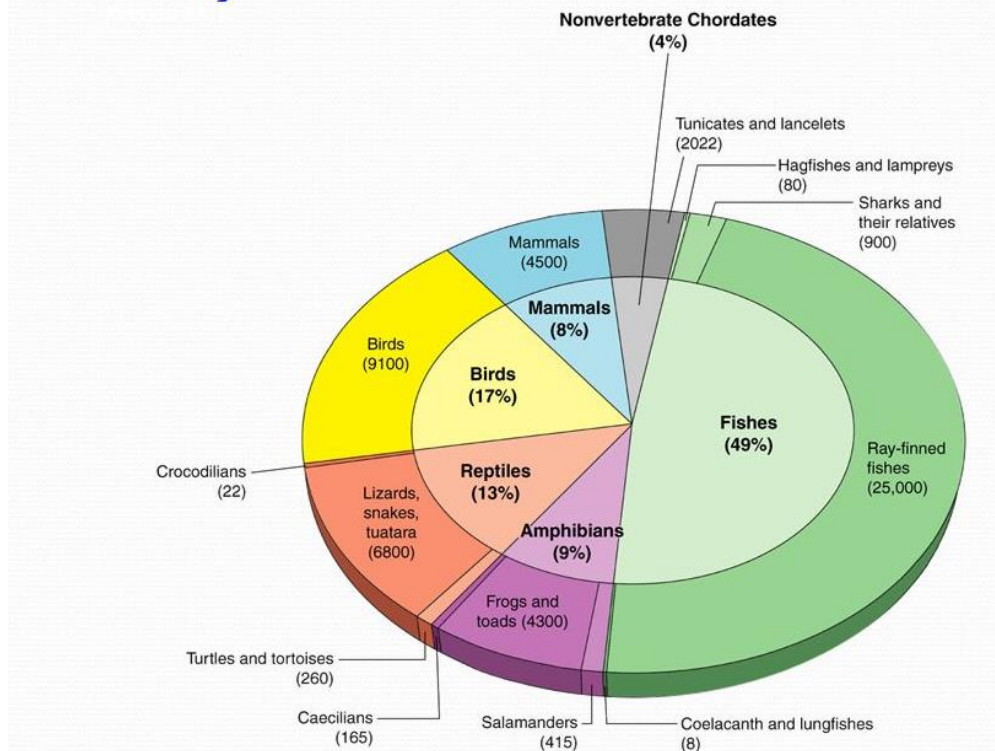
Chordata & the Vertebrates

From sea squirts to squirrels.

Source: <http://www.ucmp.berkeley.edu/chordata/chordata.html>

The Chordata is the animal phylum with which everyone is most intimately familiar, since it includes humans and other vertebrates. However, not all chordates are vertebrates.

Diversity of Chordates:



<https://slideplayer.com/slide/9397102/>

All chordates have the following features at some point in their life (in the case of humans and many other vertebrates, these features may only be present in the embryo):

- pharyngeal slits - a series of openings that connect the inside of the throat to the outside of the "neck". These are often, but not always, used as gills.
- dorsal nerve cord - a bundle of nerve fibers which runs down the "back". It connects the brain with the lateral muscles and other organs.
- notochord - cartilaginous rod running underneath, and supporting, the nerve cord.
- post-anal tail - an extension of the body past the anal opening.

While the Chordata share many developmental features, their life histories and ecology vary greatly. For this reason, the three subphyla, Urochordata, Cephalochordata, and Vertebrata, will be treated separately.

Urochordata - Commonly known as "sea squirts" or tunicates, these are a marine group. In most groups, the young tunicate, called a larva, resembles a tadpole and is able to swim freely by means of a tail. As it matures, the larva settles and metamorphoses into a sedentary adult -- losing its tail, its ability to move, and many of its chordate features -- and becomes a filter feeder. Reproduction may be asexual through budding, or sexual. In the latter case, the tunicate is hermaphroditic, possessing both sets of sex organs.



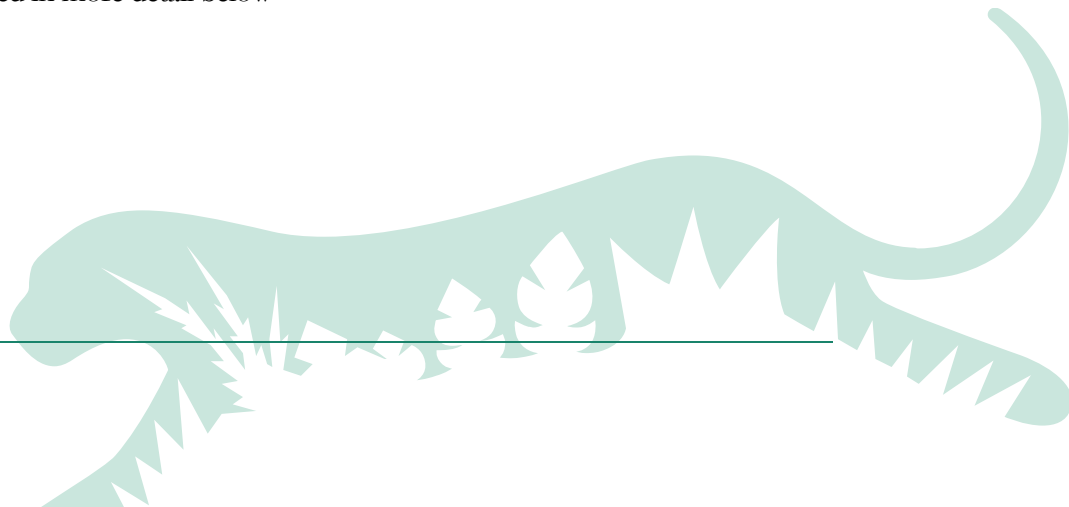
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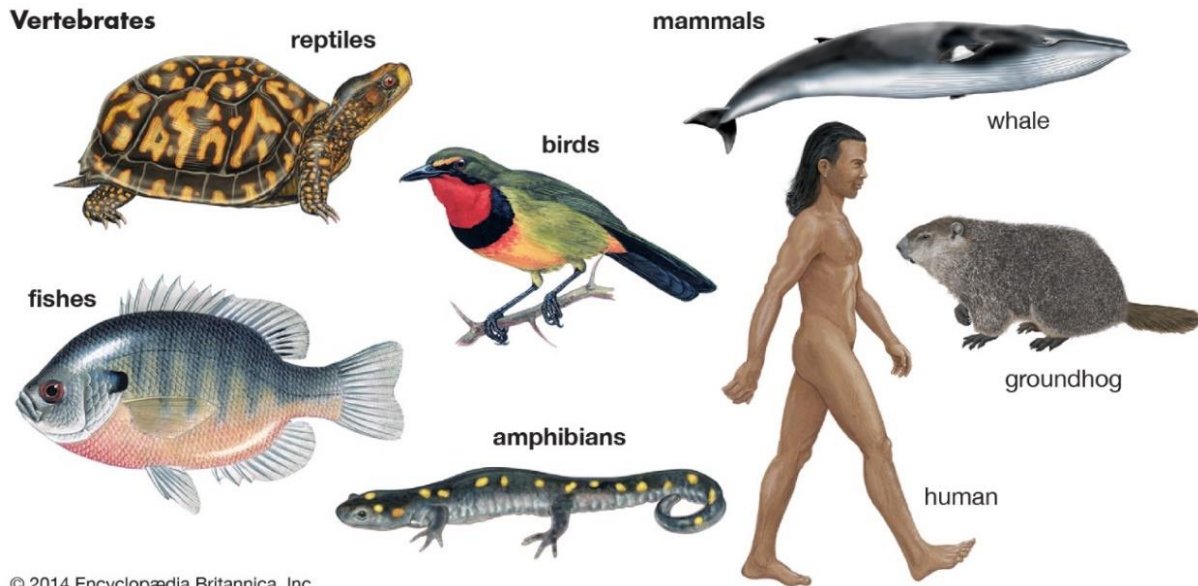
Cephalochordata - The lancelets are found in coastal waters of tropical and temperate regions. *Amphioxus* (*Branchiostoma*) is the more common member of the group, and has received the common name "lancelet" because of its short tapered body. While capable of swimming, the lancelet has no complex sense organs, and so it burrows into the sand of shallow waters where the currents bring food to its tentacles that bring food into its mouth. The sexes are separate in this group; the sex organs occurring in pairs along the body and producing gametes which are released into the water at maturity.



<https://www.faunafondness.com/amphioxus/>

Vertebrata - The vertebrates show affinities with other chordates but share some characters that make them unique. Some have argued that many of the characters that describe vertebrates have been derived from the same set of cells, the neural crest cells. These cells appear early in development, and only vertebrates have them. From neural crest cells are derived the skull and jawbones. The wonderful world of vertebrates and the vertebrate orders are explored in more detail below





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<https://www.britannica.com/animal/vertebrate>

Source: <http://www.ucmp.berkeley.edu/vertebrates/vertmm.html>

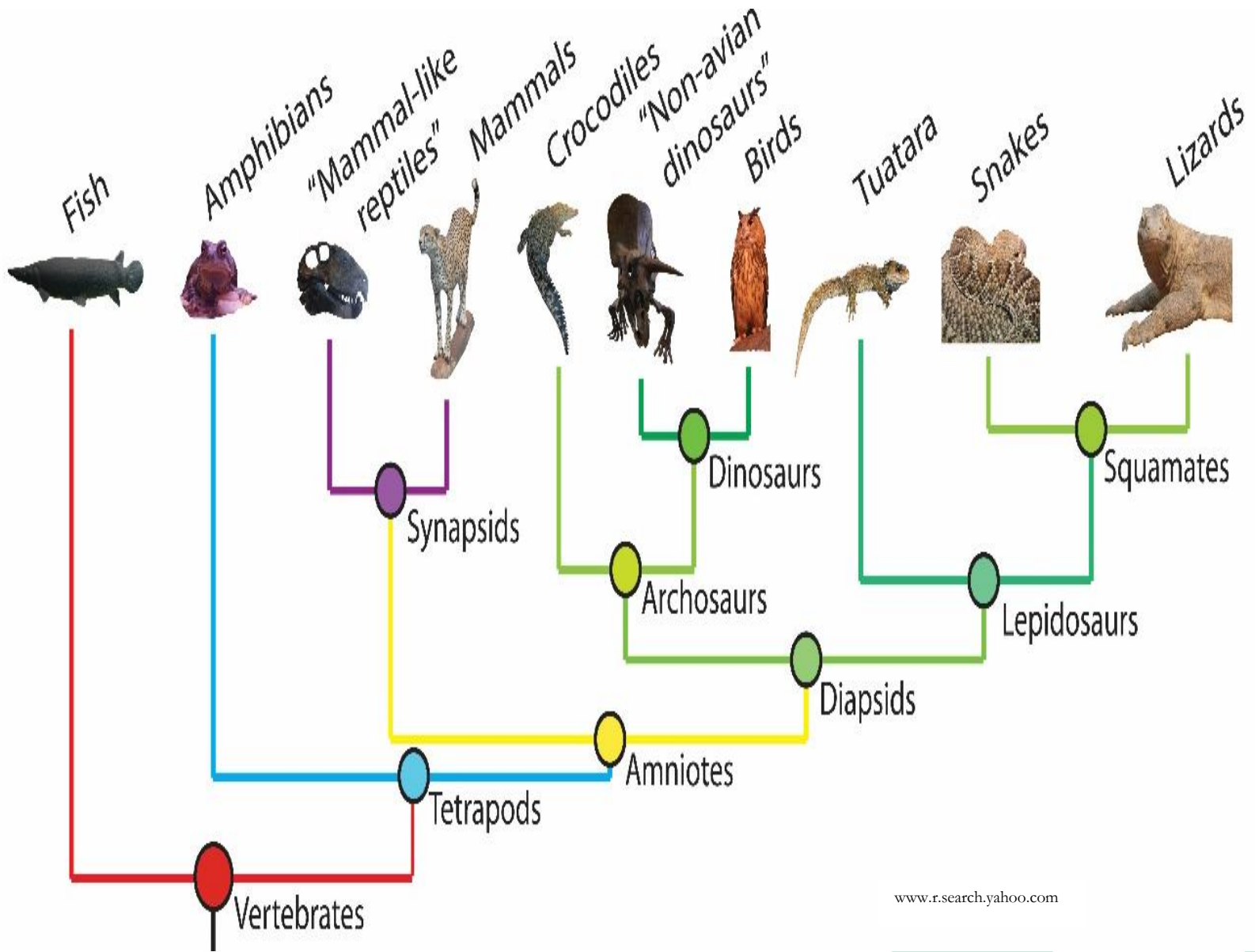
Vertebrata – the True Vertebrates

Vertebrates have a long history on this earth -- more than 500 million years, from the late Cambrian period to today. These first vertebrates lacked jaws, like the living hagfish and lampreys. Jawed vertebrates appeared 100 million years later. Vertebrates are found from the tropics to the polar regions, from the deep sea to high mountains, and even the air -- vertebrates and insects being the only groups of animals to have mastered powered flight.

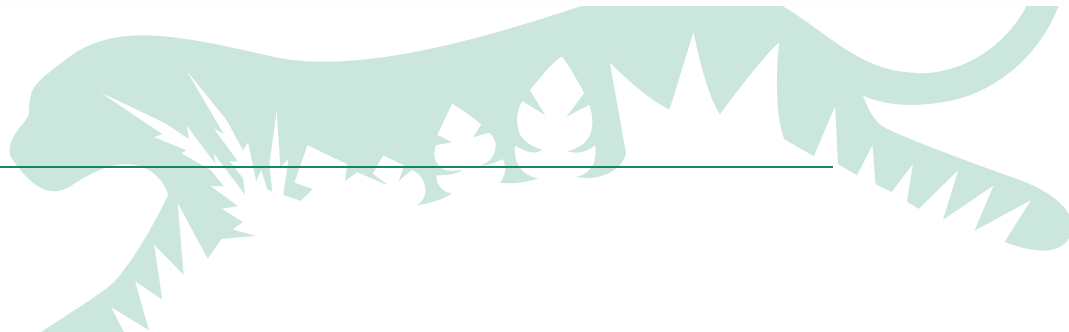
With rare exceptions, vertebrates have two separate sexes. Most lay eggs and are said to be oviparous, but a number of fishes and snakes retain their eggs in their bodies, and the eggs hatch internally. Such animals are called ovoviviparous. Many vertebrates, such as dogfish sharks and almost all mammals, have further modified the ancestral structures of the egg so that the embryo is not only retained inside the body of the female parent, but actively nourished through a special connection with the mother's body. This is known as being viviparous.

Vertebrates are members of the larger phylum Chordata, and show all of the major chordate features at some point in their life cycles: notochord, dorsal hollow nerve cord, pharyngeal slits, and a post-anal tail. The vertebral column, or backbone, which surrounds and protects the main nerve cord differs considerably in form among different groups of vertebrates. Features that separate vertebrates from other chordates include: neural cells that form important nerves and head/facial features, a relatively well-developed brain, paired complex eyes, a muscular mouth and pharynx, and a well-developed circulatory system with a heart.

Vertebrate Phylogenetic Tree



www.r.search.yahoo.com



What types of bone are found in vertebrates?

Vertebrates possess two types of bone. Dermal bone consists of bony structures (plates and scales) that develop in the skin. The bony armor of the earliest jawless fish was dermal bone; so are shark scales, shoulder blades, and the roof of your skull. Dermal bone does not form from cartilage first and then calcify, but endoskeletal bone does; in fact, in cartilaginous fishes it may never form true bone. Vertebrae, ribs, appendages, and the jaw are endoskeletal bone. The vertebrate skull is actually a complex structure of both endoskeletal and dermal bone.



All vertebrates have cartilage in addition to bone, or instead of bone. Cartilage may be flexible, like the cartilage in your nose and ears, or hard and firm, like the cartilage you can feel in your larynx (voicebox). Cartilage also covers the adjoining surfaces of bones in movable joints; damage or breakdown of this cartilage results in painful movement. The calcified cartilage that makes up shark teeth and vertebrae is not true bone; it is dead when functional, whereas bone is a living tissue.

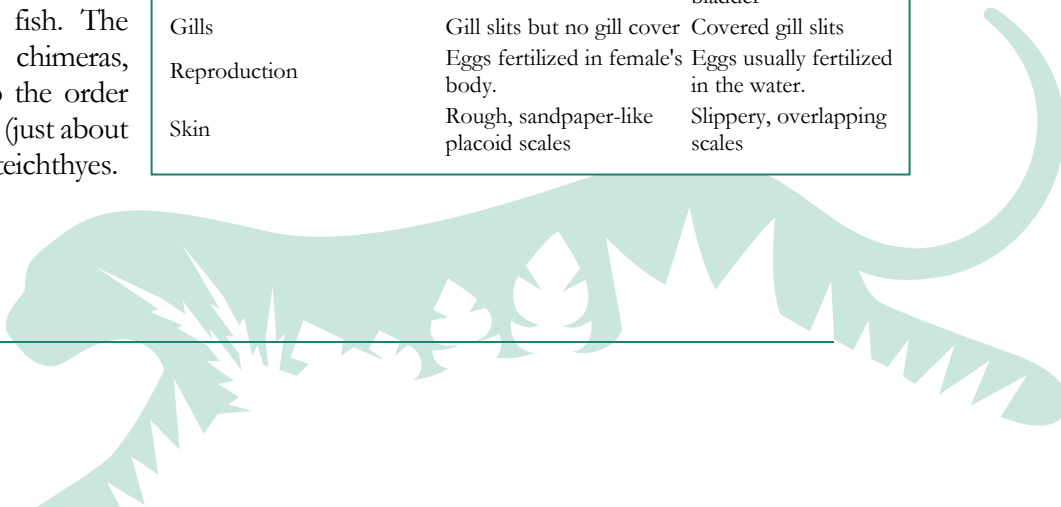
Class Ichthyes

Vertebrates first evolved in the ocean.

The invertebrate ancestors of vertebrates had gill slits, but these were used primarily for filter feeding; these organisms took up most of the oxygen they needed through the skin. As early vertebrates grew larger and developed bony scales or plates between their tissues and the water, they developed gills for taking up oxygen from the water. Gills are complex, highly branched and folded structures; this increases the surface area for taking up oxygen. Because water is heavier and more viscous than air, fish must pump water through their mouths, through their gill chambers, and out the gill slits. When you see an aquarium fish gulping water, or "making a gookie," you will also see the gill cover opening and the gills fluttering, as water is drawn over the gills and the fish breathes. Very active fish increase oxygen uptake by swimming rapidly, forcing water into the mouth and over the gills by a sort of "ramjet" action.

There are two orders of fish. The cartilaginous fishes like chimeras, sharks, and rays belong to the order Chondrichthyes. Bony fish (just about all other fish) belong to Osteichthyes.

MAJOR DIFFERENCES BETWEEN SHARKS AND BONY FISH		
ATTRIBUTE	SHARKS	BONY FISH
		
Skeleton	Cartilage only	Bones and cartilage
Swimming	Can only swim forward.	Can swim forwards and backwards
Buoyancy (floating)	Large oily liver	Gas-filled swim bladder
Gills	Gill slits but no gill cover	Covered gill slits
Reproduction	Eggs fertilized in female's body.	Eggs usually fertilized in the water.
Skin	Rough, sandpaper-like placoid scales	Slippery, overlapping scales



Class Amphibia

The moist melting pot

Source: <http://www.ucmp.berkeley.edu/tetrapods/amphibintro.html>

Amphibia includes some familiar creatures: frogs, toads, newts, and salamanders, and some not-so-familiar creatures like the legless, burrowing caecilians, are also amphibians. Amphibians are ectothermic (cold-blooded) animals that have moist skin and live close to or in water. As suggested by their name, which means "double life" in Greek, amphibians spend at least part of their lives in water; some are entirely aquatic. Adult amphibians usually live on land, but their soft eggs must be laid in the water. Females shed eggs into the water and then the male sheds sperm over the eggs.

Traditionally, the living amphibians have been grouped into three orders:

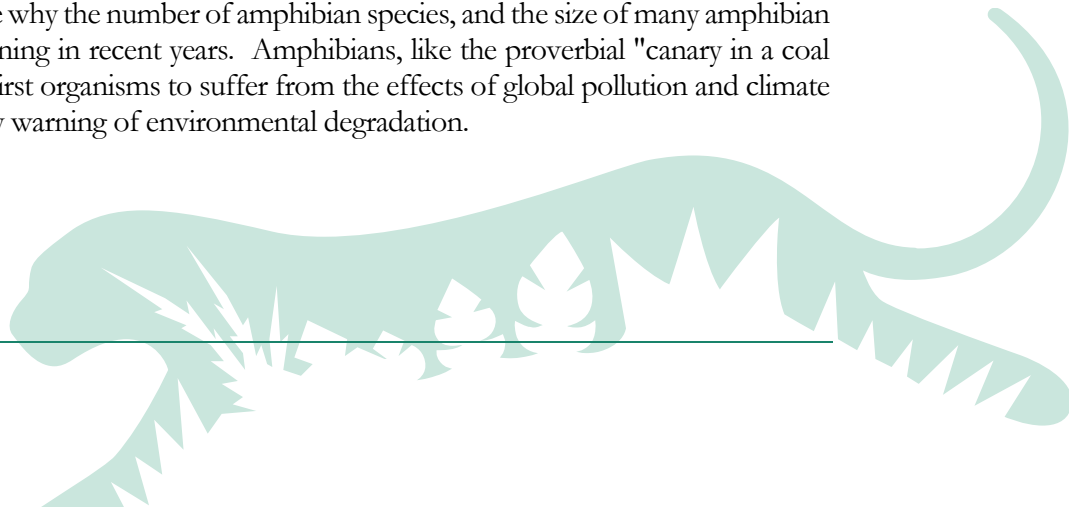
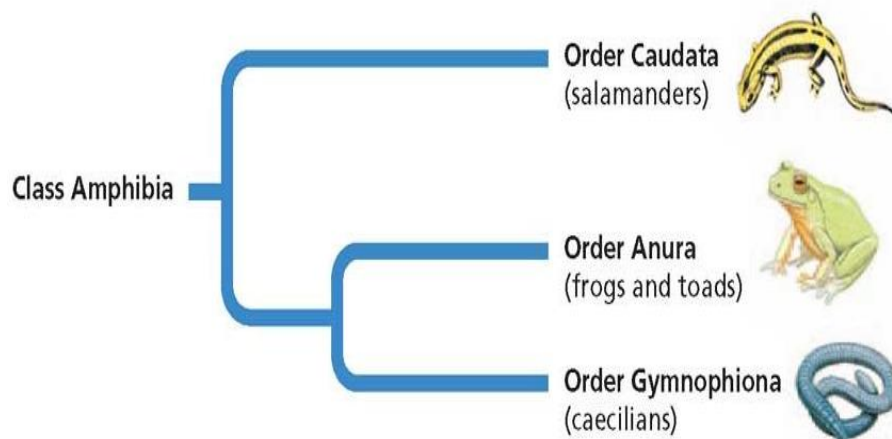
- Anura** – “tail-less ones” -- frogs and toads
- Caudata** - “tailed ones” – newts, salamanders, mudpuppies
- Gymnophiona** – “legless ones” – caecilians

Young amphibians spend their early years in the water, breathing through gills in the side of their head in much the same way as fish do. In many ways they resemble fish more than they resemble their parents, for they have no legs, and

swim by wriggling their tail. As they mature, amphibians will usually lose their gills and develop legs. A number of salamanders, such as the North American "mudpuppy" and the Mexican axolotl, develop legs but retain their larval gills and stay in the water throughout their lifetimes. This is a classic example of an evolutionary phenomenon known as neoteny -- the retention of larval or juvenile features in mature adults.

Most amphibians have soft skin which easily absorbs water. This puts them in very close contact with their surroundings. It also makes them particularly susceptible to certain man-made toxins and pollutants. This may be why the number of amphibian species, and the size of many amphibian populations, has been declining in recent years. Amphibians, like the proverbial "canary in a coal mine," may be among the first organisms to suffer from the effects of global pollution and climate change -- providing an early warning of environmental degradation.

<https://slideplayer.com/slide/6676245/>



Class Reptilia

Source: <http://www.ucmp.berkeley.edu/diapsids/index.html>

What does the word “Reptile” really mean?

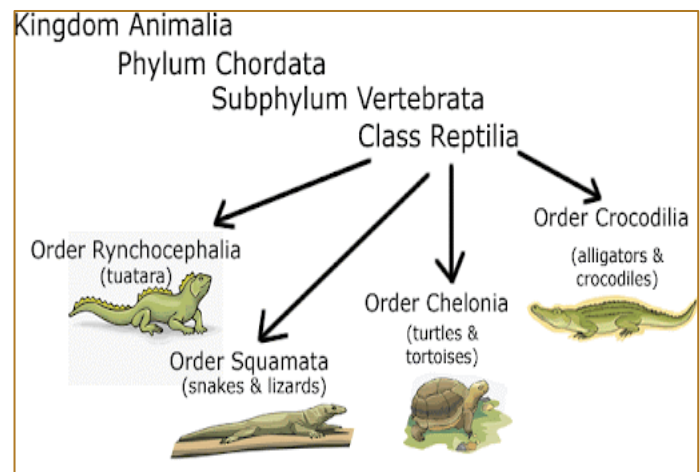
Reptiles are amniote vertebrates, which means they breathe air and can lay eggs on land. They are or were four-legged animals, and most are ectothermic (cold blooded) with scales. Dinosaurs, snakes, lizards, crocodiles, turtles, and even birds are considered reptiles by their phylogeny, or evolutionary relationships.

Reptile is a term applied to the group comprising the first reptile and all of its descendants. Birds are certainly quite different from other living Reptilia, the main differences being birds are endothermic (warm blooded) and have feathers. But the traits that modern birds possess were acquired gradually over many million years of evolution. The first birds were quite different than modern birds, and looked much more like good traditional reptiles than hawks, doves, or turkeys do.

Birds have been classified as a subclass of Reptilia: Aves. Other living Reptilia have been grouped into orders:

- Chelonia (or Testudines):** turtles
- Squamata:** lizards and snakes
- Crocodylia:** alligators and crocodiles
- Rhynchocephalia:** tuatara

<https://www.blendspace.com>



Turtles

The term “turtle” is all inclusive, including sea turtles, tortoises, and terrapins. The term “tortoise” is used for turtles on land, and “terrapin” for aquatic turtles in freshwater. Turtles are ectothermic (cold blooded) animals with a shell.

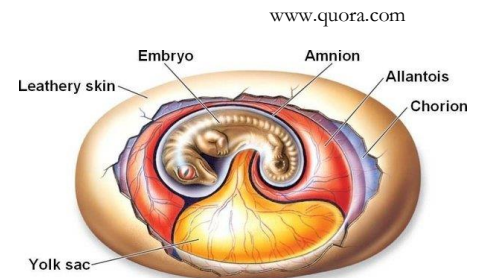
As you will learn if you delve further into the history of this group, the proper name for the living species of turtles is Chelonia. Testudines refers to both Chelonia and some of their extinct relatives known from the extensive fossil record of turtles. Modern sources refer to this order as Chelonia or Testudines, interchangeably.

Turtles are certainly a successful group -- they date back to the Triassic period, and today are represented by a modest 200+ living species. Today, however, many turtle species are not doing so well, and such endangered species as the Green Sea Turtle have become international symbols for environmentalists and other vanguards of biodiversity conservation.

Turtles have a bony or cartilaginous shell integrated into their skeleton. The shell is not a suit of invulnerability, although it does help. Their armor may seem impregnable, but still the turtles have their predators -- aquatic turtles have large fish, predatory birds, some mammals, and crocodylians to deal with, and even the heavily armored terrestrial turtles occasionally fall prey to cunning predators who find their weaknesses.

Turtles range in diets and habitats, and thus fill a variety of ecological roles. Today's turtles inhabit a wide variety of environments: the open seas, tropical reefs and coastlines, saltwater marshes and estuaries, freshwater areas of all sorts, and most non- arctic terrestrial biomes; including deserts, rainforests, mountains, and prairies. All turtles may share similar horny beaks, but they eat a wide variety of food, including such seemingly inedible things as cacti, birds, berries, poisonous jellyfish, squid, fish, and so on.

Vertebrates whose eggs have an amnion can lay eggs on land. Reptiles, birds, and mammals are amniotes. All turtles have the basic strategy of laying eggs in nests on land (either buried in sand or vegetation usually). As you probably know, this has been a major (but not the only) factor in the endangerment of many modern sea turtles; the eggs are abandoned to the mercy of predators, and many nesting sites have been lost to human development of coastline areas. Juvenile turtles often have different ecological niches from their larger parents; especially as prey for the multitude of predators that await their hatching. However, turtles in general have relatively long life spans and mate repeatedly, so their generalized life history strategy of producing many young for natural selection to cull from seems to have worked well.



Crocodiles & Alligators

This section pending, see handouts from reptile training for information on this group.

Snakes & Lizards

This section pending, see handouts from reptile training for information on this group.

The Dinosauria

Dinosaurs, one of the most successful groups of animals (in terms of longevity) that have ever lived, evolved into many diverse sizes and shapes, with many equally diverse modes of living. The creatures that we normally think of as dinosaurs lived during the Mesozoic Era, from late in the Triassic period (about 225 million years ago) until the end of the Cretaceous (about 65 million years ago). But we now know that they actually live on today as the birds.

Dinosaurs are not extinct. Technically. Based on features of the skeleton, most people studying dinosaurs consider birds to be dinosaurs. This shocking realization makes even the smallest hummingbird a legitimate dinosaur. So rather than refer to “dinosaurs” and birds as discrete, separate groups, it is best to refer to the traditional, extinct animals as “non-avian dinosaurs” and birds as, well, birds, or “avian dinosaurs.” It is incorrect to say that dinosaurs are extinct, because they have left living descendants in the form of cockatoos, cassowaries, and their pals.



Types of avian dinosaurs

- **Ratites:** flightless birds (ostrich, kiwi, and emu).
- **Carinate:** all other birds (sparrow, eagle, chicken, etc.).

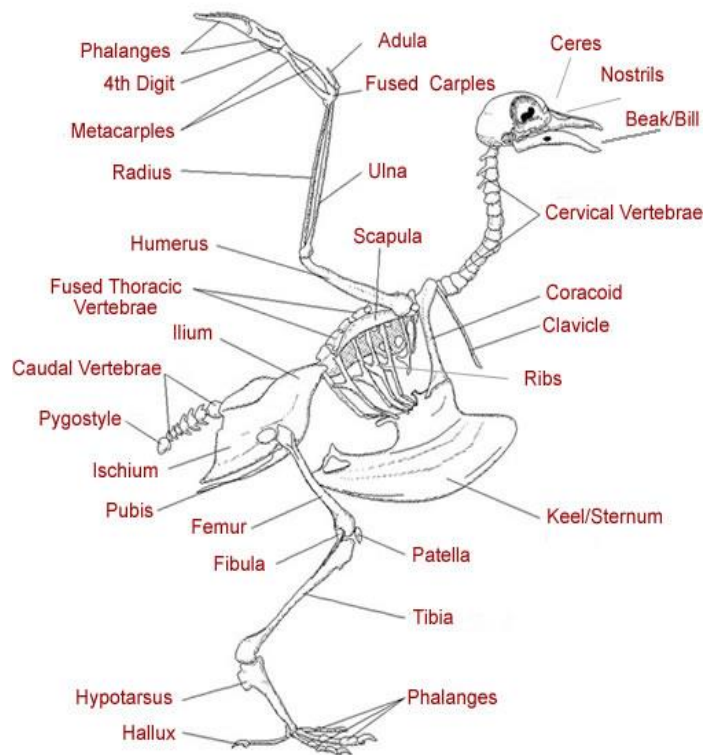
Groups of interest

- **Raptors** – birds of prey (hawks, eagles)
- **Psittacines** – nutcrackers (parrots, macaws, cockatoos)
- **Passerines** – songbirds (sparrows, blue jays, cardinals)
- **Galliformes** – medium sized runners (turkeys, chickens, curassow, guan)

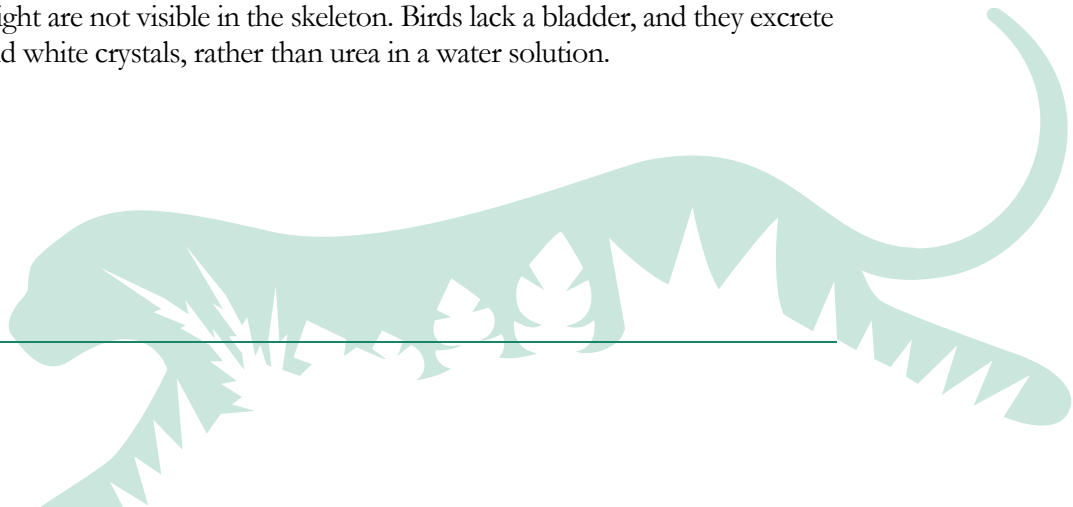
Avian Morphology

As birds go, the domestic chicken is hardly built for high-performance flight. Yet even in the chicken skeleton many of the flight adaptations found in most birds can easily be seen. The sternum, or breastbone, bears a prominent keel where the flight muscles attach. The powerful downstroke of the wing is powered by the large pectoralis muscles, which also attach to the sternal keel. The furcula, a fused clavicle (collarbone) visible as a large Y-shaped bone ahead of the sternum, serves as a brace during the flight stroke.

A number of other features of birds have the effect of reducing weight or otherwise contributing to flight capabilities. Birds have highly shortened tails, which effectively reduce the bird's weight. Birds lack teeth, and the jaws are covered by a horny beak. Bird bones are hollow and filled with extensions of the body's air sacs, which are extensions of the lungs that allow for increased respiratory efficiency. The hollow bones are thin-walled, but actually quite resistant to stress from bending -- the stresses involved in flight. The eyes are large and the visual cortex of the brain is well-developed. Other anatomical features of birds that are probably connected with flight are not visible in the skeleton. Birds lack a bladder, and they excrete uric acid in the form of solid white crystals, rather than urea in a water solution.



<https://animalcorner.org/bird-anatomy/>



But the most obvious anatomical feature of birds is, of course, their feathers. Feathers are highly modified scales, and are important in several ways. Soft down feathers trap still air close to the surface of the body, thermally insulating a bird (or a human wearing a down jacket). Feathers are also crucial for flight; contour feathers on the body establish the smooth, streamlined contour of a bird's body, and the enlarged flight feathers form the aerodynamic surfaces of the wings and tail. Some birds, such as the flycatchers, have bristle-like feathers around the mouth that assist in trapping insects in flight.



Finally, feathers are important in bird behavior: the brightly colored feathers of the males of many species, such as the finch, are used as signals during courtship and mating. Bird feathers used in mate attraction may form huge crests, ruffs, or tails: the male peacock tail is a case in point. On the other hand, the females of many species with brightly colored males have rather drab feathers acting as camouflage.

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Avian Ecology

As everyone knows, birds lay eggs -- specifically, they lay very typical amniote eggs with calcified shells. Birds brood their eggs until hatching. Some bird species are naked and helpless at birth, and must be fed by their parents; these birds are said to be altricial. Many common songbirds, such as the American robin, are altricial species. Precocial birds, on the other hand, are born feathered, and are able to walk and to feed on their own shortly after hatching -- ducks and chickens are well-known precocial birds. Whether precocial or altricial, birds grow rapidly, reaching adult size within one year.

A phenomenon that has been well studied in birds is altruism. In altricial species, the parents of hungry nestlings may be helped in feeding and guarding their young by other adult birds who have not bred that year. This may seem contrary to "survival of the fittest" concepts of evolution, in which lineages that do not maximize reproductive output are supposed to go extinct. However, the "altruistic" helper birds are closely related to the parent birds and their offspring -- which means that they share many genes with the young birds they are helping to raise. By helping the parents ensure the survival of their offspring, helpers are ensuring that their own genes will be passed on to the next generation.

Birds as a whole feed on a wide range of foods, from fish and flesh to insects to fruits and seeds, and in the case of the New Zealand kea, occasionally sheep's blood. Living birds lack teeth, and the jaws are covered by a horny beak, which often shows adaptation to the bird's particular diet: long, slender beaks for probing for insects, flat or paddle-shaped beaks for sieving food out of the water, heavy beaks for cracking and crushing seeds, or sharp, hooked beaks -- like that of the vulture -- for tearing flesh. Birds play important roles in the pollination and dispersal of flowering plants. A number of flowering plants have flowers which are structurally modified for bird pollination.

Extremes and Oddities

Reptilian Edition

Source: <http://www.enchantedlearning.com/subjects/reptiles>

- ✦ **Biggest reptile** - the estuarine crocodile (over 23 ft long).
- ✦ **Smallest reptile** - the British Virgin Islands gecko (about 2/3 of an inch long)
- ✦ **Fastest reptile** - the spiny-tailed iguana (tracked at 21 mph)
- ✦ **Biggest (heaviest) snake** - the anaconda of South America.
- ✦ **Longest Snake** - reticulated Python (over 33 ft long)
- ✦ **Fastest-moving snake** - probably the poisonous black mamba
- ✦ **Biggest lizard** - the Komodo dragon (up to 10 ft long)
- ✦ **Biggest turtle** - the leatherback turtle (up to 8 ft)
- ✦ **Most poisonous land snakes** - the taipan (from Australia), black mamba, and krait.
- ✦ **Only poisonous lizards** - the Gila monster, the bearded lizard
- ✦ **Weirdest ability** - Horned lizards can squirt a thin spray of blood from their eyes up to 3 feet away.

Avian Edition

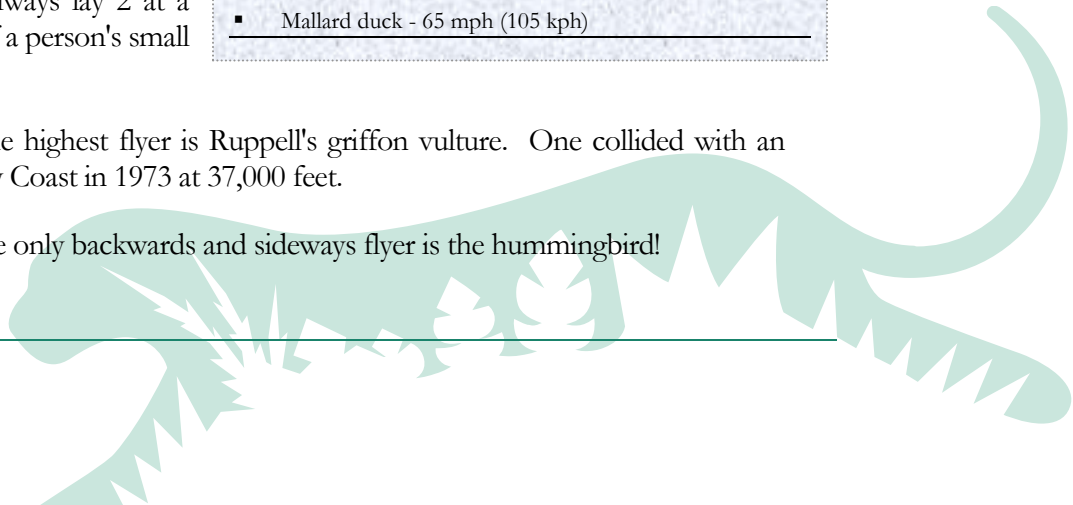
- ✦ **Biggest** - The largest bird is the ostrich. It can grow up to 9 feet tall. The ostrich also lays the largest birds' eggs which are up to 4.5 x 7 inches across and weigh 3 pounds.
- ✦ **Smallest** - The smallest bird is the bee hummingbird, which is 2.5 inches long and weighs only 0.06 oz. Hummingbirds also lay the smallest birds' eggs. They always lay 2 at a time, each the size of a person's small fingernail.

FASTEST IN THE SKY

The fastest flying birds include:

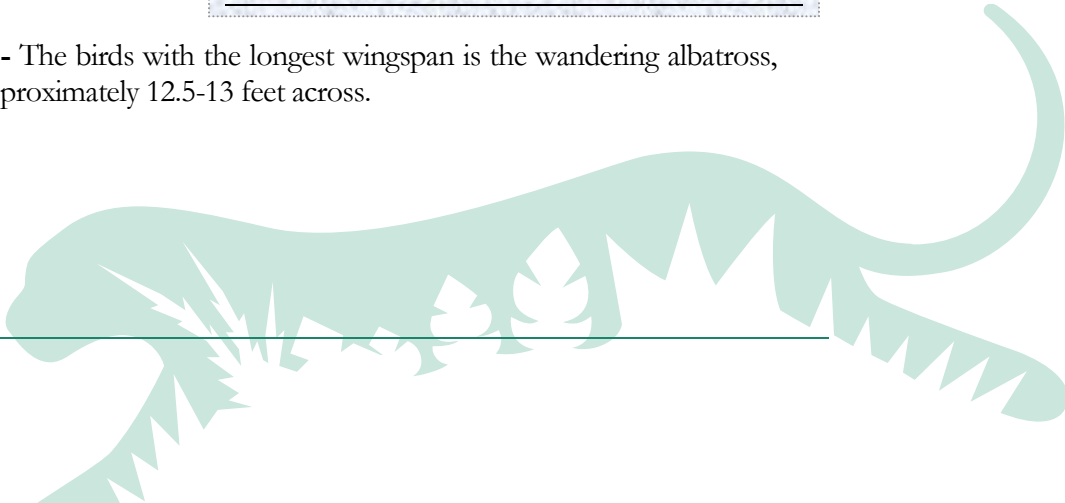
- The peregrine falcon, clocked at 90 mph (145 kph). There are even accounts of these raptors diving at speeds up to 200 mph (320 kph).
- The spine-tailed swift, about 90-100 mph (145-160 kph)
- The harpy eagle - 37-50 mph (60-80 kph)
- Champion racing pigeons fly up to 53 mph (85 kph)
- Mallard duck - 65 mph (105 kph)

- ✦ **Highest Flyer** - The highest flyer is Ruppell's griffon vulture. One collided with an airplane off the Ivory Coast in 1973 at 37,000 feet.
- ✦ **Oddest Flyers** - The only backwards and sideways flyer is the hummingbird!



- ✦ **Heaviest Flyer** - The heaviest flying bird is the great bustard, which weighs up to 46 pounds.
- ✦ **Fastest Swimmers** - Gentoo Penguins are the fastest swimming birds.
- ✦ **Fastest On Land** - The fastest-running bird is the ostrich that can run up to 43 mph.
- ✦ **Birds With Wing Claws** - The Hoatzin has small claws on the first and second wing digits when it is young (it uses the claws to climb trees). The African touraco also has wing claws when it is young. The ostrich has three claws on each wing.
- ✦ **Longest Migration** - The arctic tern makes the longest migration each year, flying 20,000 to 25,000 miles each year from the Arctic to the Antarctic.
- ✦ **Poisonous Birds** - The only two known poisonous birds are the Hooded Pitohui (*Pitohui dichrous*, also called the "garbage bird") and the Ifrita (*Ifrita kowaldi*) from Papua, New Guinea. The toxin (homobatrachotoxin, a steroidal alkaloid) is concentrated in these bird's feathers and skin, and is probably obtained from their diets.
- ✦ **A Beak Longer Than The Body** - The sword-billed hummingbird (*Ensifera ensifera*), which lives in the Andes in South America, has a beak that is longer than its body. It uses this incredible beak to sip nectar from the long, tube-like datura flower.
- ✦ **Most Powerful Bird Of Prey** - Harpy Eagles (*Harpia harpyja*) are the most powerful bird of prey. They are about 2.8 ft long and have a wingspan of about 6.5 ft. Their curved talons are up to 5 inches long, as long as the claws of a grizzly bear.
- ✦ **Largest Tongue** - The flamingo.
- ✦ **Biggest Eyes** - The ostrich has the biggest eyeballs, which are 2 inches (5 cm) across.
- ✦ **Best Hearing** - Owls (especially Barn Owls and Great Horned Owls) have the best hearing.
- ✦ **Longest Wingspan** - The birds with the longest wingspan is the wandering albatross, whose wingspan is approximately 12.5-13 feet across.

AVIAN LIFE SPANS	
▪	Parrots are extremely long-lived with lifespans ranging from 40 to 100+ years
▪	The rhinoceros hornbill, lives up to 33 years in captivity
▪	The rhea, a large, flightless bird that lives up to 40 years in captivity, 20 year in the wild.
▪	The vulture, a scavenger which can live up to 30 years in captivity
▪	The ostrich, which has a life span of up to 40 years!
▪	The swan, which can live up to 50 years in captivity, up to 19 years in the wild
▪	The bald eagle, that lives over 50 years in captivity



Class Mammalia

Hairy, milk-producing, warm-blooded animals are mammals.

Let's introduce our discussion of mammals with the quagga (left). The quagga is symbolic of the continuity between the living and the extinct — it was native to desert areas of the African continent until it was exterminated in the 1880s. Related to horses and zebras, it was a yellowish-brown with stripes only on its head, neck and forebody. The quagga was a placental mammal, a group also called Eutheria by scientists.



Mammals are warm-blooded animals that have hair, produce milk for their young, and depend on their mother for nutrition and development.

Living mammals are classified into one of these major groups:

- **Monotremes**- mammals that lay eggs
- **Marsupials**- mammals born early and live, but develop in a pouch attached to a teat
- **Eutherians** – most mammals; develop in uterus joined to mother through placenta, birthed live.

Monotremes - Egg-laying Mammals

There are only three living monotremes, the duck-billed platypus and two species of echidna, or "spiny anteaters." All of them are found only in Australia and New Guinea. Monotremes are not a very diverse group today, and there has not been much fossil information known until rather recently.

In some ways, monotremes are very primitive for mammals because, like reptiles and birds, they lay eggs rather than having live birth. In a number of other respects, monotremes are rather derived, having highly modified snouts or beaks, and modern adults have no teeth. Like other mammals, however, they have a single bone in their lower jaw, three middle ear bones, high metabolic rates, hair, and they produce milk to nourish the young.



<http://www.ucmp.berkeley.edu/mammal/mammal.html>

Marsupials – Pouched Mammals



<https://www.livescience.com>

Marsupials are the group of mammals commonly thought of as pouched. Like other mammals, the marsupials are covered with hair and mothers nurse their young with milk. They give live birth, but they do not have long gestation times like placental mammals. Instead, they give birth very early and the young animal, essentially a helpless embryo, climbs from the mother's birth canal to the nipples. There it grabs on with its mouth and continues to develop, often for weeks or months depending on the species. The short gestation time is due to having a yolk-type placenta in the mother marsupial.

The only naturally occurring marsupial in the United States is the opossum, *Didelphis marsupialis*. During the Mesozoic era, marsupials were more common than placental mammals in North America. Many South American forms are similar to the opossum, and began to go extinct in the late Miocene when a land connection with North America formed allowing placental mammals to cross into South America. In Australia, marsupials continue to be very diverse and the dominant native mammals. They include kangaroos, koalas, tasmanian devils, wombats, and others.

Though marsupials today do not have as many species as do the placental mammals, they are quite structurally diverse. They range from small four-footed forms like the marsupial mole, *Notoryctes*, to the large two-legged kangaroos. There are several cases of *convergent evolution* between marsupials and placental mammals, in which the two animals have evolved to fill the same ecological niche in different parts of the world. There are burrowing forms, grazing forms, gliding forms, and even long-snouted ant-eating forms which have evolved independently in the two groups.

Eutherians – Placental Mammals

Placental mammals, or Eutherians, are a rather diverse group, with nearly 4000 described species. They include diverse forms as whales, elephants, shrews, armadillos, cats, and humans.

Placental mammals all bear live young, which are nourished before birth in the mother's uterus through a specialized embryonic organ attached to the uterus wall, the placenta. The placenta is derived from the same membranes that surround the embryos in the amniotic eggs of reptiles, birds, and monotreme mammals. The term "placental mammals" is somewhat of a misnomer because marsupials also have placentae. The difference is that the

<https://en.wikipedia.org/wiki/Placentalia>



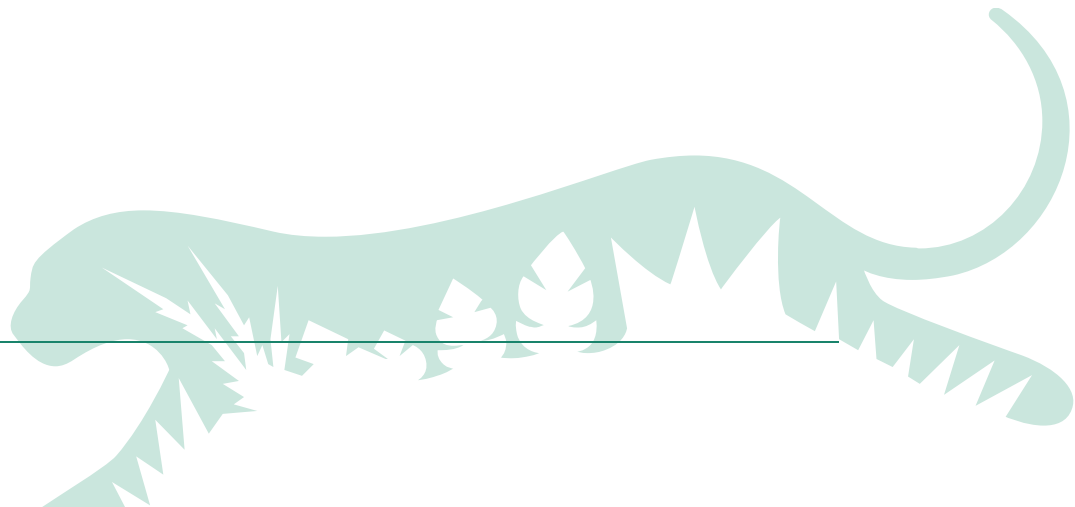
placenta of marsupials is very short-lived and does not make as much of a contribution to fetal nourishment.

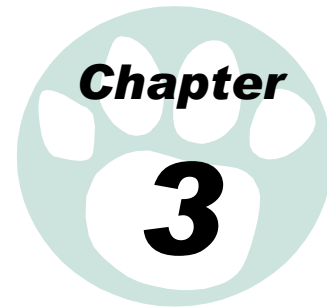
The degree of development at birth varies greatly among different eutherian groups. Young ungulates may be able to walk within minutes of being born, while human children may take a couple of years to accomplish this. The length of parental care following birth also varies greatly, from about a month to several years.

Extremes and Oddities - Mammal Edition

- 🦁 **Fastest mammal** (also fastest land animal) - the cheetah (60-70 mph = 97-110 kph)
- 🦁 **Slowest mammal** - the sloth (less than 1 mph, or 2 kph)
- 🦁 **Biggest mammal** that ever lived on Earth (biggest animal too) - the blue whale
- 🦁 **Biggest land mammal** - the African Elephant
- 🦁 **Tallest mammal** - the giraffe
- 🦁 **Smallest mammals** - the pygmy shrew (weighing 1.2-2.7 gm) and the bumblebee bat (weighing about 2 gm)
- 🦁 **Loudest mammal** - the Blue Whale. The second loudest is the Howler Monkey.
- 🦁 **Smallest newborns** - marsupials (pouched mammals, like the kangaroo)
- 🦁 **Smelliest mammal** - the striped skunk (*Mephitis mephitis*)
- 🦁 **The only venomous mammals** - duckbilled platypus (males only), several species of shrews, and the Solenodon
- 🦁 **Fattest mammal**- The blue whale has the thickest layer of blubber, but ringed seal pups have the greatest percentage of fat (about 50 %).

Source: <http://www.enchantedlearning.com/subjects/mammals>





Plants

It's good to be green.

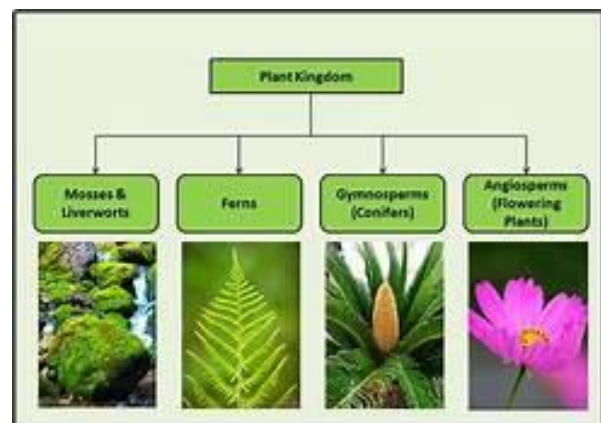
Plants – they are everywhere. They are essential to life on our planet. They produce the oxygen that we breathe and the energy that we need. They define our world in many ways - by providing raw materials for our survival, by influencing our weather patterns, and by forming habitats where animals can live. Without plants, animals couldn't exist.

The relationships between plants and animals are very diverse and complex. Sometimes plants and animals cooperate to increase their chances of survival. Plants provide habitat for animals, including shelter and nesting sites, and form the foundation of the food chain. Animals provide pollination and seed dispersal that ultimately help plants reproduce. But, the relationship between plants and animals is also one of exploitation and competition for survival. Animals exploit plants as food, fiber, and shelter, which may kill them in the process. Plants fight back with chemical warfare and elaborate defense systems to protect their resources, their offspring, and their lives. The lives of plants and animals are dependent on one another.

As both a zoo and a botanic garden, we exhibit both animals and plants. Our mission is to preserve diverse species and the living ecosystems they depend on. As a Docent, you may interpret the diversity of native and exotic plants on grounds, or the animals that depend on them for their exhibits, natural habitats, diet, behaviors, and conservation status. To begin, you will need a basic understanding of plants.

Introduction to Plants

The Plantae Kingdom includes 250,000 species in an amazing range of diverse forms - mosses, liverworts, ferns, conifers, flowering plants, and so on. Plantae is second in size only to the Arthropods of the Animalia Kingdom.

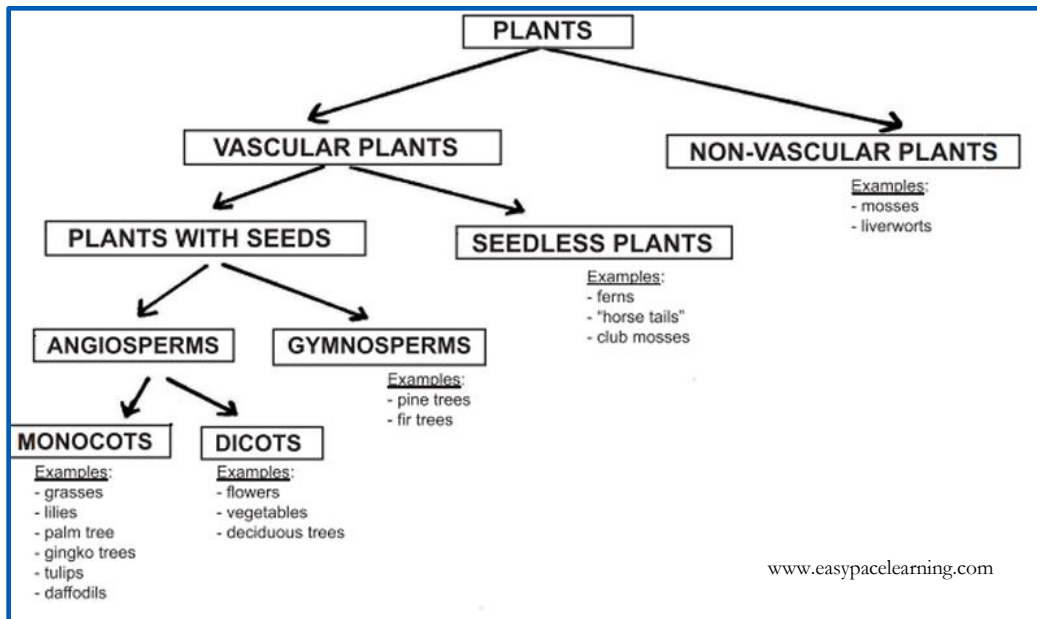


Plant Classification

Plants are classified based on their physical characteristics and for growth and reproduction.

Plants may be vascular or nonvascular. **Vascular** plants have tissues – true roots, leaves, and stems - that transport water and nutrients, while **nonvascular** plants do not and must grow close to the moist ground.

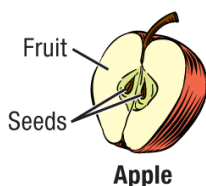
Plants may produce **seeds** or **spores** for reproduction. Ferns and club mosses for example produce spores. Those that produce seeds may produce them in cones or fruits. **Gymnosperms**, also known as conifers, produce naked seeds in cones. **Angiosperms**, also known as flowering plants, produce seeds in enclosed structures such as fruits. Angiosperms are by far the most numerous and the most familiar to us. Angiosperms are further classified as monocots or dicots.



www.slideserve.com

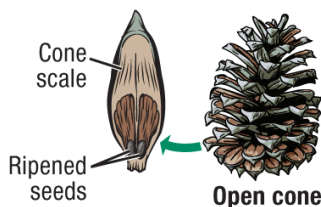
<https://way2usefulinfo.blogspot.com/>

ANGIOSPERM SEEDS AND FRUIT



vs.

GYMNOSPERM SEEDS



Angiosperms – Flowering Plants

MONOCOTS ARE FLOWERING PLANTS WITH ONE COTYLEDON.			
One cotyledon	Parallel veins	Flower parts in multiples of three	Scattered vascular tissue
DICOTS ARE FLOWERING PLANTS WITH TWO COTYLEDONS.			
Two cotyledons	Netlike veins	Flower parts in multiples of four or five	Ringed vascular tissue

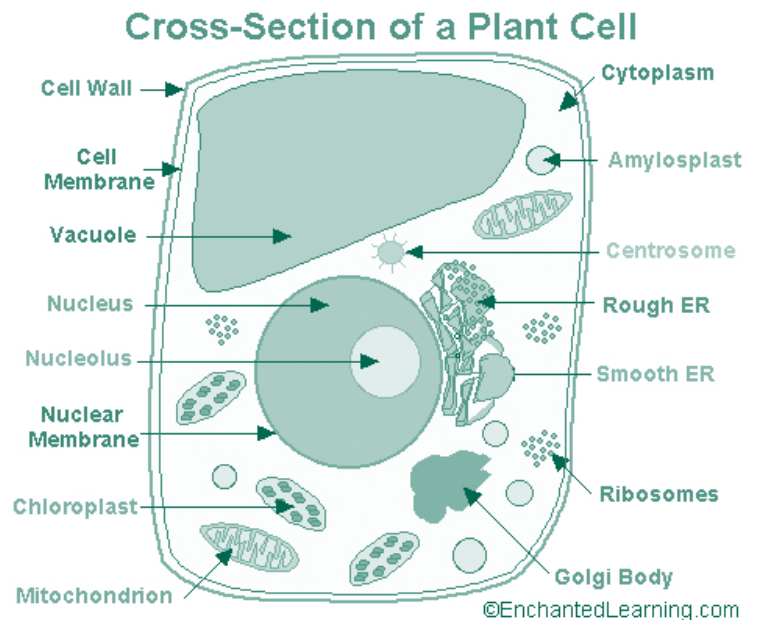
Plant Morphology

Plant cells

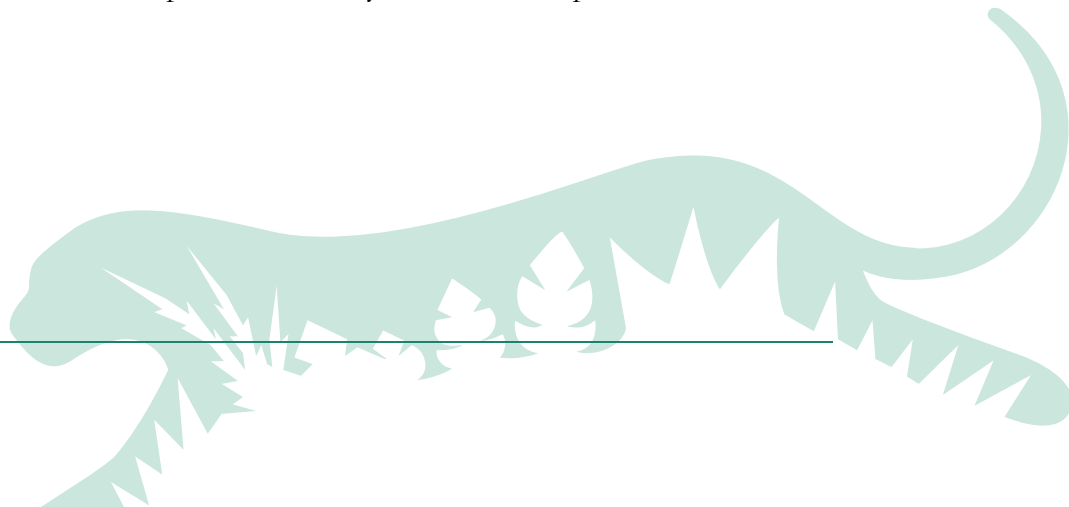
Plants are true celled organisms called eukaryotes (as are animals, fungi, and protists). Their cells have a cell membrane, nucleus, and other specialized organelles that carry out all of the duties of maintaining life. But plant cells differ from animal, fungal, and protist cells in a number of important ways.

A feature of plant cells is the presence of a cell wall which surrounds each cell. It is composed primarily of cellulose, a complex carbohydrate made from glucose. Cellulose provides structural support for leaves, stems, and seed pods. It is strong and rigid, yet flexible, and is one reason plants can grow tall and not fall over. It is also why plants are hard to digest, yet beneficial as “fiber” in our diets.

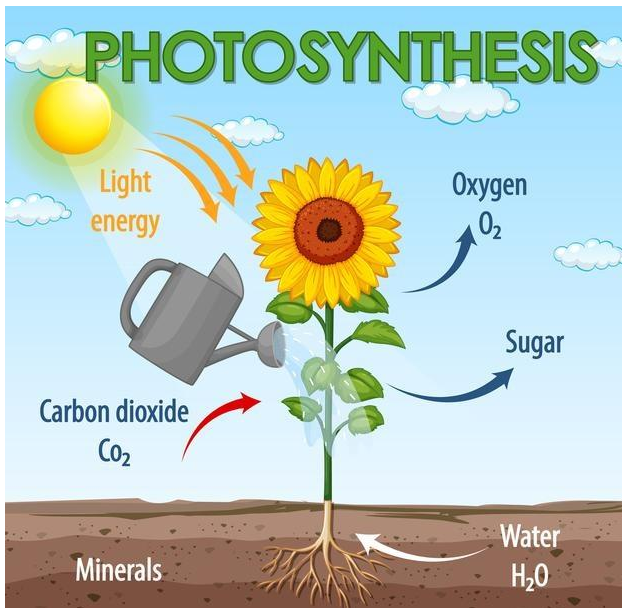
Plants also have a central vacuole - a membrane-bound bag of fluid, containing ions, nutrients, and waste materials. The vacuole allows the plant cell to store raw materials needed for metabolism, as well as the waste produced by it. The central vacuole allows plant cells to store an optimum volume of water. When the cell is full of water, the cell exerts outward pressure (turgor pressure) on its cell wall, the rigidity of which will prevent the cell from over-expanding and bursting. When all cells are maintaining an optimum turgor pressure, the plant gains rigidity. You can notice this by comparing crisp fresh celery with celery that has sat around and grown limp. The old celery has lost fluids, and is no longer rigid.



Plastids are perhaps the most notable feature of plant cells. The plastid is an organelle which contains colorful chemicals called pigments. Pigments interact with light producing the colors we see in plants, and most notably the green color imparted by the pigment chlorophyll. Chlorophyll is only one of several pigments found in plants, but it is by far the most important because of its role in photosynthesis.



Plants manufacture their own food by photosynthesis.



Plants require sunlight to survive, as it is their only source of energy. The pigment chlorophyll is able to capture sunlight energy and convert it to a chemical form – a sugar called glucose. In this process called photosynthesis, carbon dioxide and water in the presence of chlorophyll and light energy are changed into glucose (a sugar). This energy rich sugar is the source of food used by most plants. They can also store it as more complex carbohydrates called starch and cellulose to use as later energy sources, or to make up plant leaves, stems, flowers and fruits. Because plants are able to use light energy to produce their own food, we call them photoautotrophic.

<https://www.freepik.com/free-vector/diagram-showing-process-photosynthesis-plant-12869030.htm>

Without plants and photosynthesis, most life on earth would be impossible. Animals cannot eat light energy, so we need plants to convert it to chemical energy that we can all use. Without plants, there would be no fruits, vegetables, grains ...or even any animals, which ultimately rely on plants for their food. Every organism depends on plants directly (eats plants) or indirectly (eats animals that eat plants) for their food. Plants form the foundation of our food chains.

Photosynthesis produces another useful by-product that all animals need – oxygen. However, plants are not the most important producers of this gas. Most of our oxygen comes from phytoplankton in the earth's oceans.

Plant Structure

Plants can be either herbaceous or woody. Most herbaceous plants usually have stems that are soft, green, and contain little woody tissue. These plants are ones that usually die to the ground each year. Most annual and perennial flowers fall into this category along with vegetables and houseplants. Woody plants are characterized by special cells for structural support and transport of minerals, nutrients and water – which all together is called wood. The basic parts of plants are roots, stems, leaves, flowers, fruits, and seeds.

<http://www.urbanext.uiuc.edu/gpe/index.html>

Roots

The roots help provide support by anchoring the plant and absorbing water and nutrients needed for growth. They can also store sugars and carbohydrates the plant uses to carry out other functions. Plants can have either a taproot system (such as carrots) or a fibrous root system (such as turf grass). In both cases, the roots are the links between the water and nutrients needed for plant growth.

Stems

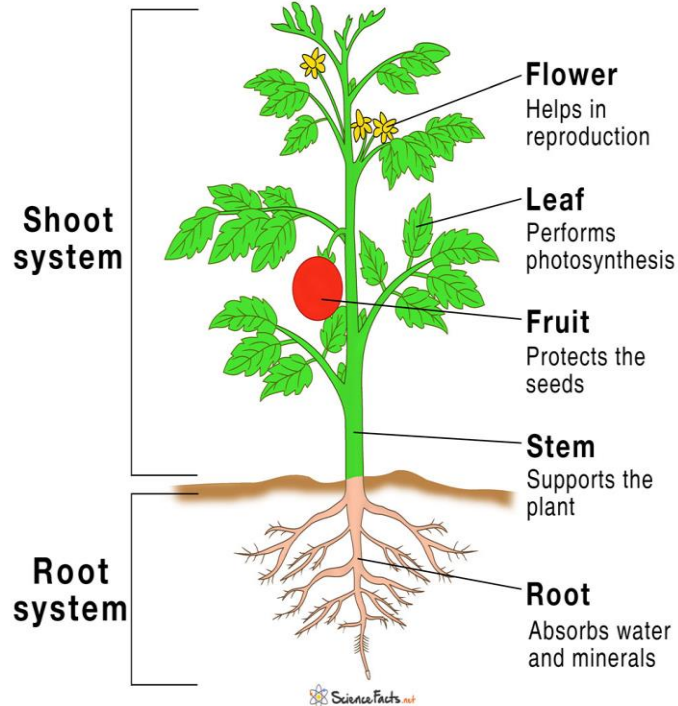
Stems carry water and nutrients taken up by the roots to the leaves, and then the food produced by the leaves moves to other parts of the plant. The cells that do this work are called the xylem cells (move water) and phloem cells (move food). Stems also provide support for the plant allowing the leaves to reach the sunlight they need to produce food.

Leaves

Leaves come in many different shapes and sizes. Leaves can be simple, made of a single leaf blade connected by a petiole to the stem (oak, maple), or compound, in which the leaf blade is divided into separate leaflets attached by a petiole to the stem (ash, locust).

Leaves are the food making factories of green plants. Leaves are made to catch light and have openings to allow water and air to come and go. The outer surface of the leaf has a waxy coating called a cuticle that protects the leaf. Veins carry water and nutrients within the leaf.

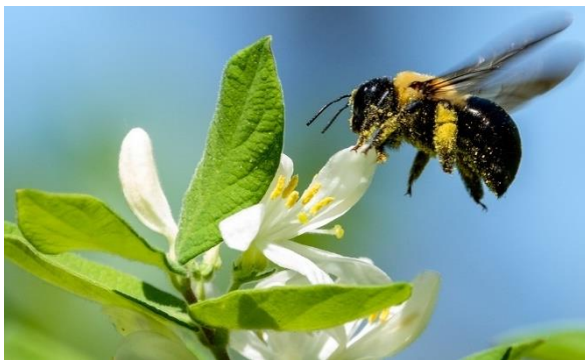
Parts of a Plant



Flower Structure

Flowers are variations on a simple, basic plan.

Some flowers are tiny and hard to see: others are showy and flamboyant, like orchids and roses. Some flowers grow in clusters, some bloom alone. All flowers, however, are the reproductive organ of flowering plants that produce seeds in protective fruits.



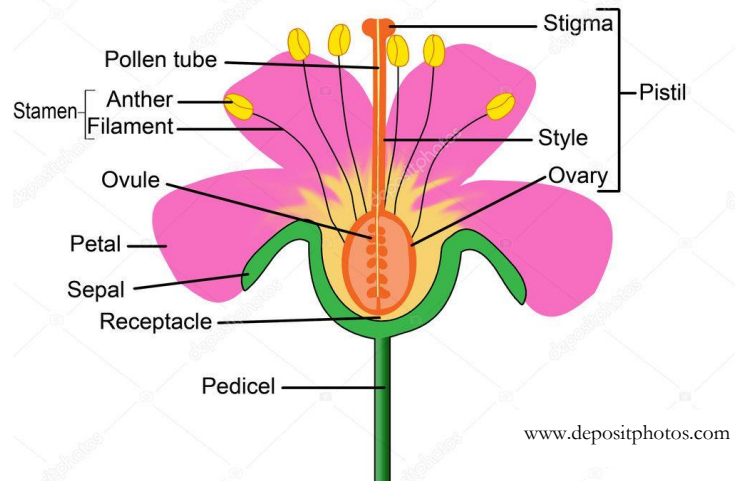
Flowers were developed by land plants to help them reproduce, even spreading their genetic material to mates that bloom beyond their reach. Flowers have showy petals, sweet nectar, and smells to lure insects, birds, bats, and other reproductive assistants called pollinators. Pollinators help plants fertilize their flowers, whether on the same plant or on other plants of the same species. Pollinators transfer the pollen (male sex cells, a.k.a.

Adapted from:
<http://curriculum.calstatela.edu/courses/builders/lessons/less/les8/flower.html>

gametes) to the ovary (home of the female sex cells, a.k.a. gametes). There are other ways to attain plant fertilization. Some plants spread their pollen through explosion (called dehiscing), water, or wind transmission. However, simple flower structure is easiest to see on a general insect-pollinated flower, so that is what we will focus on here.

Flowers have a well-defined structure. When the bud first appears on the stem, we can only see the green sepals. Sepals are the green parts that protect a flower bud before it opens. There is usually one sepal for each petal. All together the sepals are called the calyx (pronounced kay-licks). After the flower opens the sepals can still be seen behind the petals. The sepals protect and sometimes support the corolla (all the petals together).

PARTS OF A FLOWER



The petals are really advertisements for insects and other pollinators signaling "Nectar Here!" Nectar is usually secreted at the base of the petals on the inside of the flower. The nectar is used to lure pollinators to the flower, and it is placed so that the pollinator picks up pollen as they feed. The plant "hopes" the pollinator will fly off to visit other flowers of the same species, carrying the pollen from the first flower to its distant mate. This is one of the reasons that plant species with a single flowering season flower at roughly the same time, and flowers are designed specifically to suit a specific type of pollinator.

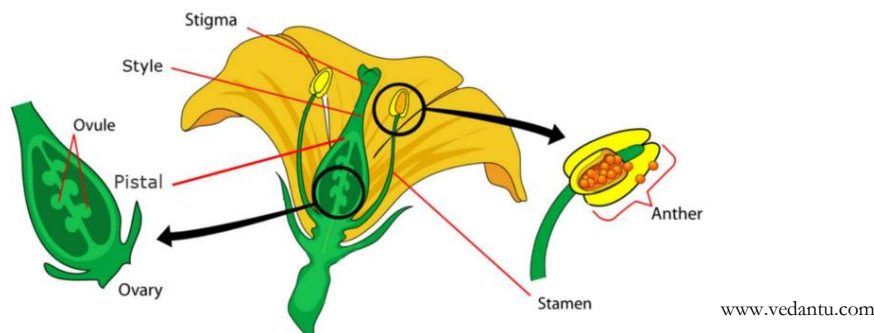
The inside of the flower holds the reproductive parts. The stamens, which are orange in our diagram, produce the pollen, which is represented by yellow dots. The pistil, which is the green part in the center of the flower, is considered to be the female part: you can see the unfertilized seeds waiting in the ovary at the bottom of the pistil.

The Pistil

The pistil is the part of the flower that produces the seeds. It consists of three parts:

- The stigma -- the pollen grains stick to this small sticky pad
- The style -- the pollen grains grow down through this stem-like cylinder
- The ovary -- this is where the young seeds wait for the chromosomes in the pollen, and where they grow into mature seeds

The wall of the ovary protects the developing seeds. When the seeds are mature they are often found in some sort of seed case, a pod, perhaps, or a fruit or berry. Animals and birds who eat the fruit scatter the seeds abroad.



The Stamen

Stamens are slender structures that hold the pollen. They consist of two parts:

- The anther -- a small case in which the pollen grains form
- The filament -- a slender stem that supports the anther

The pollen grains form in the anthers, which open when the pollen is mature. The pollen is a fine, powdery, golden dust that is easily picked up by an insect or a finger.

A flower may receive pollen from many different kinds of plants. However, only pollen grains from the same kind of plant will begin to grow. The pollen sticks to the stigma and a tiny tube grows down from the pollen grain. When it reaches an unfertilized seed, the sperm cells in the pollen slide down the tube and fertilize the seed. It may take a day or two for the little tube to grow. Once the seed is fertilized, it stays in the ovary and matures. The seed will have two parts: a cell that is ready to grow into a new plant, and a food supply to help the new plant to grow.

Plant Ecology

Source: <http://www.ucmp.berkeley.edu/plants/plantaelh.html>

Plants deal with their environment in different ways than animals do.

Plants utterly shape the environment. Think of a place without plants. The only such places on earth are the arctic wastelands, really arid deserts, and the deep ocean. Everywhere else, from tundra to rainforest to desert, is populated by plants. In fact, when we think of a particular landscape, it is the plants which first come to mind. Try to picture a forest without trees, or a prairie without grasses. It is the plants which produce the terrestrial environment as we know it.

Although we are surrounded by plants all our lives, most of us never realize just how alien they are. From the way they manufacture their food to the ways in which they respond to the environment, plants are quite different from animals.

While some animals are sedentary, such as barnacles and sponges, most are quite able to move around. When conditions become uncomfortable, most animals may simply move elsewhere. By contrast, plants are generally sedentary and unable to move to a new location. When conditions get

rough, they must cope with the circumstances in which they find themselves. Plants have ways to deal with situations when they are in peril.

Plants must deal with heat in the place where they grow. If you become hot, you would simply move into the shade; if you are thirsty, you go for a drink. Plants do not have these options. In order to deal with heat, plants use water to soak up much of the heat, and then allow it to pass out of the plant as water vapor. Other plants will produce thick cuticle or reflective hairs to reduce the amount of light and heat they receive.

Water, or loss of it, can be a serious problem as well, and land plants have developed two basic strategies for coping. The first is desiccation tolerance, and is most common among liverworts and mosses. These plants produce compounds which protect their cells when they dry out, and also have repair mechanisms which rapidly go into effect when the plant rehydrates. Some mosses for instance, have been packaged in envelopes in collections for several decades, and then brought out, rehydrated, and allowed to begin life again.

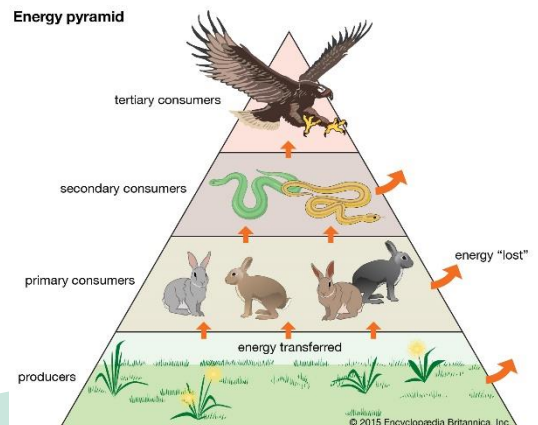
<https://www.plantsnap.com/plantblog/types-of-moss/>



<https://www.britannica.com/story/can-you-drink-water-from-a->

The other strategy for dealing with water loss is drought avoidance, in which plants develop features which reduce the loss of water, or store it in their tissues. This is the strategy taken by vascular plants, which have special vascular tissues to distribute water throughout their system. Some vascular plants have developed succulence, a condition in which the tissues are spongy and swollen for storing water, as in cacti and agaves.

And of course, plants have to cope with predation by animals. They are the foundation of the food chain, and animals eat them. Plants produce an abundance of stems, leaves, and fruits for this reason, so they can survive a limited amount of predation. Plants have even adapted to take advantage of animal activities, relying on them to pollinate their flowers, to disperse their seeds, and fertilize them. But plants also have defenses of their own to deter too much predation, including woody growth, toxic chemicals, sharp spines, sticky burs, tough fruits, and sticky saps.

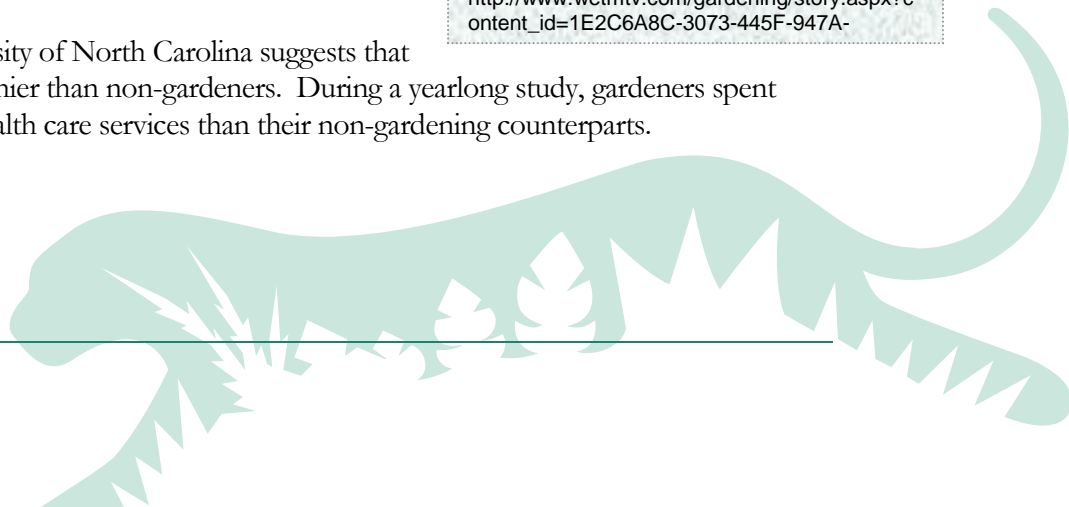


<https://www.britannica.com/story/can-you-drink-water-from-a->

Plant Extremes and Oddities

<http://www.corsinet.com/trivia/p-triv.html>

- According to the Guinness Book of World Records, the single-seeded fruit of the giant fan palm, or *Lodoicea maldivica*, can weigh 44 lbs. Commonly known as the double coconut or coco de mer, it is found wild only in the Seychelles in the Indian Ocean.
- Almonds are the oldest; most widely cultivated and extensively used nuts in the world.
- Americans eat more bananas than any other fruit: a total of 11 billion a year
- Avocados have the highest calories of any fruit at 167 calories per hundred grams.
- Cranberries are one of just 3 major fruits native to North America. Blueberries and Concord grapes are the other two.
- Orchids have the smallest seeds. It takes more than 1.25 million seeds to weigh 1 gram.
- The California redwood - coast redwood and giant sequoia - are the tallest and largest living organism in the world.
- The largest single flower is the Rafflesia or “corpse flower.” They are generally 3 feet in diameter with the record being 42 inches.
- The oldest living thing in existence is not a giant redwood, but a bristlecone pine in the White Mountains of California, dated to be aged 4,600 years old.
- The world's tallest grass, which has sometimes grown 130 feet or more, is a bamboo.
- Wheat is the world's most widely cultivated plant; grown on every continent except Antarctica.
- The world's oldest living rose is thought to be 1000 yrs old and is in Germany (on a cathedral). <http://www.thegardenhouse.com/meadow/gardening/trivia/>
- Scientists have found a fossil in China that may represent the oldest known flowering plant. At 142 million to 148 million years old, *Archaeofructus liaoningensis* is at least 20 million years older than the next-oldest angiosperm (seed-bearing plant). Seedpods are clearly visible on the fossilized stem. http://www.wetmtv.com/gardening/story.aspx?content_id=1E2C6A8C-3073-445F-947A-
- Research at the University of North Carolina suggests that gardeners may be healthier than non-gardeners. During a yearlong study, gardeners spent 17.2 percent less on health care services than their non-gardening counterparts.



The Role of Plants at Zoos

Beautification

Colorful plantings of bulbs, perennials and tropical annuals are popular with visitors.

Landscape Immersion

The plants at any zoo creates a “sense of adventure” landscape and provides a natural context from which to view the animals. Modern zoos need to meet the needs of animals and enhance the experience for the visitor.



<https://www.sunset.com/garden/garden-basics/flower-bed-ideas>



<https://www.houstonzoo.org/explore/exhibits/>

Behavioral Enrichment

Plants and animals are adapted to interact in ecosystems throughout the world. Appropriate landscaping in exhibits can help preserve a species’ natural behavior. Exhibit animals can engage in foraging, climbing, territorial displays, and etcetera. Appropriate use of landscaping in exhibits can also help eliminate non-typical behaviors. Landscape screens provide necessary screening to relieve the stress on animals caused by visitors and other animals.

Native Wildlife Habitat

Many plants are included in the zoo’s landscape because of their wildlife value. As a result MPZBG is a great place to view native wildlife.

Education

Plants are essential to life on our planet. By presenting a diverse botanical collection to our visitors, we hope to encourage interest in planting these beauties at home and conserving them in the wild. They are also an integral part of any good interpretation of our animals and their needs.

Climate Control

Landscaping at zoos provides climate modification year round. Plantings provide shade for animals and visitors in summer and allow sunlight to warm exhibits in winter.

Erosion Control

Zoos are artificial environments with artificial concentrations of animal. Without careful management this can lead to soil erosion and destruction of desirable plants and property.

