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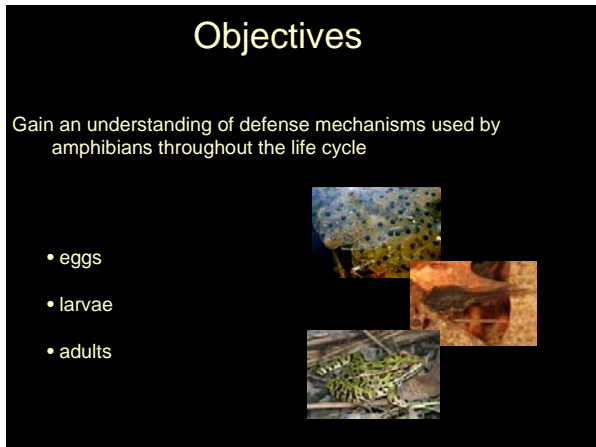
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## Amphibian as Prey

What makes amphibians such easy prey?

1. Amphibians are numerous
2. Most are small to moderate in size
3. Amphibians have soft, thin skin
4. Tadpoles and larvae are often concentrated
5. Adults of most species aggregate during breeding seasons.

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## Amphibian Predators

- Amphibians have to deal with many predators due to the factors previously mentioned, these predators include:

Mammals: including humans  
Reptiles: snakes - turtles  
Birds: wading birds  
Insects: odonates – diving beetles  
Fish: large-mouth bass  
Plants: venus flytrap  
And... Themselves



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## Amphibian Egg Predators

Aquatic eggs of amphibians are predated by:

- Fish and aquatic invertebrates in permanent ponds and streams
- Aquatic invertebrates are the main predators of amphibian eggs in temporary ponds. Aquatic invert predators include members of the Odonata family, leeches, and some Tricoptera
- Other predators include salamanders, newts, anurans and reptiles like snakes and turtles



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## Amphibian Egg Predators

Terrestrial eggs of amphibians are predated by:

- Insects such as beetles and wasps (carabid, tenebrionid)
- Arachnids (lycosid)
- Snakes (Leptodeira)
- Amphibians (Plethodontid, cannibalistic)



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## So what is a mother to do?

- Strategically lay eggs in protective areas
- Cluster eggs together
- Stringing eggs along as they are laid
- Embryos may alter hatching time if a predator is sensed.
- Or as some species do, one parent guards the eggs.



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## Amphibian Larval Predators

Amphibian larvae (both aquatic and terrestrial) that have survived to this life stage are once again having to face many of the same predators that they escaped as embryo's.

- Fish
- Wading Birds
- Aquatic and Terrestrial insects
- Reptiles
- Small mammals like raccoons
- Conspecific cannibalism, occurs especially in temporary ponds where food sources and time are scarce.



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## Amphibian Larval Defenses

Unfortunately for most amphibian larvae their only defenses are:

- Hiding to avoid being seen
- Escape, either by running or swimming
- Or a combination of both; in essence running for cover
- Lastly, not concentrating or schooling together

These defense mechanisms can only be performed if the larvae have some sense that a predator is in the region.

Larvae can respond to the stress of predators by growing longer, wider tails to increase maneuverability, and in some species growing a dark tip at the end of the tail to divert attention away from their bodies, especially in the presence of fish and Odonates in permanent ponds.

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## Adult Amphibian Predators

- Adult Anuran, Salamanders, and Caecilians face many of the same predators as larvae and embryos, but they face much more pressure from terrestrial mammal and avian species than do the young.
- Examples include monkeys, hawks, skunks and possums.
- Also two genera of bats (Megaderma and Trachops cirrhosus) feed on Anuran species, attracted by vocalizations.
- The Venus flytrap can also be a predator of Anuran species.

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## Escape Behavior of Amphibians

- Predation can be avoided many times by using escape behaviors that are natural to the amphibian
- Many Anurans jump to escape predators. By jumping far they can escape, and cause the predator to lose the scent between jumps
- Terrestrial caecilians escape by burrowing into the soil
- Salamanders can run fast if they are capable, but others use a series of flipping movements and coiling and uncoiling to move.




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## Cryptic Coloration

The colors and patterns of many amphibians are important in their ability to avoid visual recognition by predators.

### 1. Concealing Coloration:

- Employing color schemes that match the substrate in which the amphibian lives.
- These could be lichen like markings as in the salamander *Hynobius lichenatus* and *Aneides aeneus* or the dull browns, grays, and blacks of ground dwelling species.



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## Cryptic Coloration

Another concealing coloration scheme for amphibians is to reflect the uniform color of the leaf or twig that they rest on. This is especially common among the tree frogs.



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## Cryptic Coloration

### 2. Disruptive Coloration:

- A predators visual search for an amphibian can be confused by color patterns that do not conform to the outline of the prey.

-Many anurans have a dark stripe along the side of the head, disrupting the image of the head, like the Wood frog.



- A midorsal pale or colored line is a common disruptive scheme used in many species like Rana and Bufo.



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## Cryptic Coloration

### 3. Confusing Coloration:

- Longer amphibians that rely on speed often have linear color patterns that presumably create an optical illusion when on the run from predators.
- This is uncommon in anurans, but caecilians of the genus *Rhinatrema* and some salamanders do have this coloration scheme.



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## Cryptic Coloration

### 4. Flash Colors:

- Common in Anurans, especially the tree frogs, flash coloration is visible only when the frog leaps, and are found on the flanks and thighs.
- Used to confuse and startle predators, they see a flash of color, then the frog is cryptic again while at rest between jumps.



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## Cryptic Structure

- These are structural features that help to camouflage the amphibian, especially those that are rather sedentary.

- Dermal ridges



- Bony extensions of the squamosal



- Spinous tubercles



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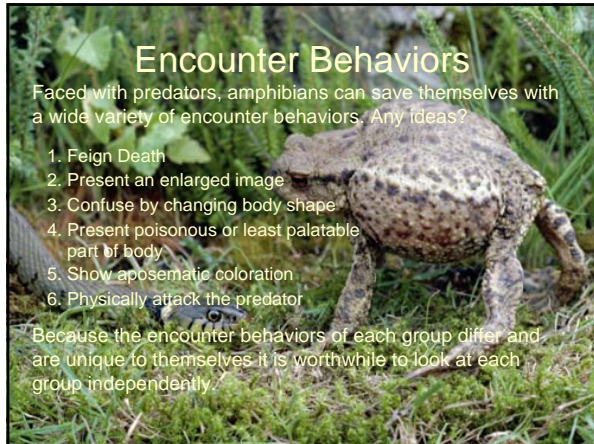
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## Encounter Behaviors

Faced with predators, amphibians can save themselves with a wide variety of encounter behaviors. Any ideas?

1. Feign Death
2. Present an enlarged image
3. Confuse by changing body shape
4. Present poisonous or least palatable part of body
5. Show aposematic coloration
6. Physically attack the predator

Because the encounter behaviors of each group differ and are unique to themselves it is worthwhile to look at each group independently.




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## Caecilian Encounter Behavior



- Can excrete large amounts of mucus which can make them hard to handle.
- Larger caecilians are capable of inflicting deep bites and lacerations with their teeth.
- Also, some caecilians are capable of secreting toxins.

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## Salamander Encounter Behavior

1. Tail Lashing: salamanders with glands in the tail and any aposematic coloration restricted to the dorsum region often lash their tail at predators to attract attention to the tail instead of their body.
  - The tail is the most expendable part of the salamander.
  - The tail area of these species also contain the poison from the glands in the dorsum.
2. Tail Undulation: like above, the tail contains the poison or bad taste, and the salamander directs attention to the tail by keeping the body immobile while waving the tail like bait.
  - They do this for the same reason as above.

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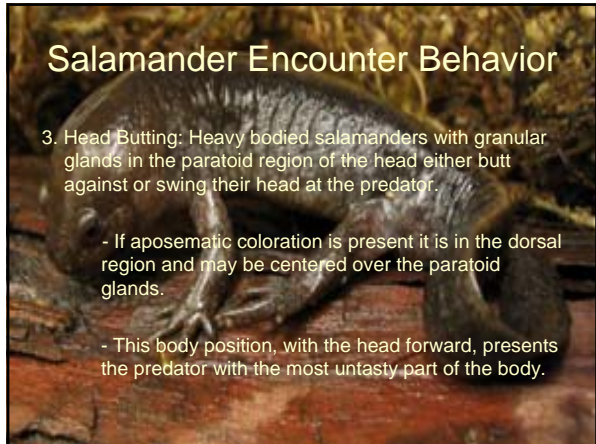
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## Salamander Encounter Behavior

3. Head Butting: Heavy bodied salamanders with granular glands in the paratoid region of the head either butt against or swing their head at the predator.

- If aposematic coloration is present it is in the dorsal region and may be centered over the paratoid glands.
- This body position, with the head forward, presents the predator with the most untasty part of the body.




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## Salamander Encounter Behavior

4. Defensive posturing is often used upon encountering threats (Unken reflex)

- This posturing is to show threatening colors and warn of poison glands on the ventral side of the abdomen and tail or the dorsum. They also become immobilized during this time.


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## Salamander Encounter Behavior

5. A salamander's last line of defense is to actually bite or harm the predator once they have been captured.

6. Also some salamanders can force their ribs to rotate, elevate, and penetrate the skin in order to harm the predator or cause a toxin from the granular gland to be ingested by the predator.

7. Another mechanism is for some salamanders to wrap their tail around the neck of the prey, like a garter snake.




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## Anuran Encounter Behavior

•Although most Anurans seem to use escape as their many survival skill, some other slower frogs have developed other responses to defend themselves against predators.

1. Feigning Death is widespread in anurans, and they have many styles through which they do this.
  - Some species of *Hyla* and *Phyllomedusa* tuck their limbs in close to the body and remain motionless.
  - Other species like *Stereocyclops parkeri* assume a position with their limbs stretched out stiffly.
  - While the hyperoliid *Acanthixalis spinosus* crouches with it's legs tucked up against the body, and sticks it's orange tongue out.

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## Anuran Encounter Behavior

2. Another common defense mechanism used among heavier bodied anurans inflate the lungs to create a larger image to the predator, this behavior is usually associated with raising of the body off the substrate.
  - Some species also lower the head presenting the parotid glands towards the predator.
3. The Leptodactylids of the genera *Physalaemus* and *Pleurodema* have large inguinal glands posterior that look like eyes, which make the animal seem larger to the predator.
4. Some anuran species simply gape at the predators.
  - This picture is of the hylid *Hemiphraactus fasciatus*, which warns predators that it bites by gaping at the predators.



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## Anuran Encounter Behavior



5. Unken Reflex- A few of the *Bufo*'s use this as a predator defense like the salamanders. Where they arch their back, with the head and posterior elevated showing bright warning colors.

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## Anuran Encounter Behavior

6. Various less common defenses:

- Some species will startle prey with vocalizations.
- Other species will use scent to make them unattractive to predators.
- Aggressive defenses including biting of the predators by species like *Pyxicephalus adspersus*.
- Another aggressive defense used by african frogs *Ptychadena* is to kick the predator, with a claw like third toe.



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## Noxiousness and Toxicity

-Presumably all amphibians have granular glands through out that either make them toxic or noxious to possible predators.

Skin Toxins-

- Caecilians- Some species have been found to have skin toxins that are specific to main predators of the species.
- Salamanders- The family Salamandridae contain most of the salamanders that secrete toxins from their skin. Tarichatoxin is the most prevalent form of toxin found in the salamanders, and in some cases can be potent enough to kill 25 white mice.
- Two species of Plethodontid use proteinaceous toxins, which have been found to cause hypothermia in mice.

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## Noxiousness and Toxicity

-Anurans- Frogs possess a wide variety of toxins, including serotonin, phyllokinin, caerulein, etc. Most have been found to only have effects in large quantities, and can cause vasoconstrictive or hypertensive reactions in predators.

- Bufo's are known to possess bufodienolides, like bufotoxin and bufogenin which are cardiotoxic steroids.

-Other species like the Dendrobatid frogs have extremely toxic steroidal alkaloids, for example batrachotoxins, which when extrapolated could kill several humans. Most species with these toxins have aposematic coloration like seen in the poison dart frogs.



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## Aposematic Coloration

- Bright colorings usually associated with poisonous amphibians, and used as a warning sign to predators, don't mess with me, I'm toxic. Colors are usually red, orange, or yellow.



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## Mimicry

-Mimicry is fairly unusual in amphibians, but there are some species that mimic colors and patterns of other toxic species found in the same environment.

-One good example of this is the imitator salamander, which tries to mimic the coloring and red cheek pattern of the toxic Jordan's salamander.



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## Questions/Discussion



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