

## Lecture 2- Sept 12 2016

Background matching - the ability to camouflage with your background

- Doesn't work well through the entire year, seasons change
- Hares change well in seasons, seasonal colour change
- Songbirds have eyelines and eye stripes for concealment
- This is called *disruptive patterns*
- In order to camouflage you must be still
- Killdeer have breast bands
- Canadian geese have white chinstraps, disrupts the shape of body
- Loons have necklaces
- Coincident patterns - match up
- Shape for camouflage, butterflies may resemble leaves

Coincident, colouration, disruptive patterns

Katydid- live leaf mimic

Twig mimicry

Thorn mimic- treehopper

Bird dropping mimic-giant swallowtail

Camouflaged looper (it's a caterpillar)

Spittlebug creates spit like residue - normally on plants

Bicoloration- two toned species, water surface (from above it's dark from under its bright)

Countershading (self shadow concealment) light below dark above

Startle patterns - hidden patterns until needed to be used (term for moths/ butterflies)

- Under wings
- Eyespots - artificial eyes that make them look larger than life

Beavers use tail slap to frighten predators

## Lecture 3- Sept 14

Natural selection- the process of evolution where the strong species survive

startle sound- beaver tail slap

- ruffled grouse

startle patterns are hidden until needed ex. butterfly eyes

some have startling patterns that aren't hidden- startle eyes

they can have more than one purpose- to scare a predator, As Well as distracts

distractions pattern- deflects the attack so that if it is bitten it will be on a non vital body part

some butterflies have "tails"/fake antennas with a fake head- possibly designed as a distraction pattern so the predator will attack the wrong side  
five-lined skink: bright blue tail, which detaches from the body as a defense mechanism. He will grow a new tail back- autotomy

Physical Defence can consist of body armour- narceus millipede curls up, turtle goes into his shell

Shells can be made of calcium

You can tell the age of a turtle by counting the rings on its shell

Snapping turtles cannot pull into their shell- which is why they snap as a defence

physical defences can also be a soft structure- eastern tent caterpillars make silk tents

hairy caterpillars- birds do not like to get hair in their mouth

fall webworm silk tent

physical defence can be soft hairs-gypsy moth caterpillars

Woolly bear caterpillar- hairs can be modified to appear more spiky/stiff

mammals can also use stiff hair for defence (porcupine)

quills are modified guard hairs

Hair + poison = poison spine

Chemical defence- monkey slug, Bog bean caterpillar,

io moth caterpillar- pointy spines smartweed caterpillar

Poisonous spine caterpillars are usually brightly coloured

Milkweed tussok caterpillar

Yellowjacket- paper wasp

Milkweed beetle

Warning colouration- aposematic coloration

Striped skunk

Black and white can be a form of aposematic colouration

Other animals attain chemicals by eating plants

Ex. monarch caterpillar eats milkweed and sequesters cardiac glycoside poison from milkweed

Osmetarium

Photuris fireflies sequester steroidal toxins by eating male photinus fireflies

When you eat prey- aggressive mimics and get poison

Chemical defenses can come from different parts of the body- mouth legs butt

Blister beetle- you will get a blister from just touching this lil guy

Injector system- wasps  
Spray system- skunks

Bombardier beetle

Mimicry- when a group of unrelated animals are all defended and bear similar appearances -

### Lecture 4- Sept 19

Batesian Mimicry- Mimic vs Model

model is poisonous, original -mimic is edible, harmless

- There must be more models than mimics
- Models and mimics must appear at the same time of the year

American toads have the toxins Bufotalin in skin glands

They also have another defence- they puff up with air to make them appear larger and harder to swallow : this is behavioural defence

Other animals with behavioural defences are:

- Hog nosed Snakes-blow up with air to become larger, Plan B is to play dead
- Thanatosis means to play dead
- Blister beetles
- Opossum- playing possum

Behavioural Group Defense

Yard- an area where white tailed deer have gathered

Flocking- Bird group defense

- Reasons: visually confuse predators
- Less chance of getting caught

Group defences can also be aggressive

- Ex. yellowjackets- release attack pheromones to warn other wasps
- Birds: small birds attack big birds by swooping in
- Alarm calls to notify others
- Mobbing: when a bunch of smaller birds attack a single one
- Mobbing is a pre-emptive defence
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Some animals have body guards- carpenter ants guarding aphids

Some Behavioural Defences seem odd

- bunnies/deer When alarmed they run away which shows their little white tail
- Their tails advertise awareness

## Lecture 5- Sept 21

Vigilance- being alert and scanning for danger

- Adaptations for danger- nose (olfactory sense), ears, eyes
- Large ears external pinnae) capture sound
- Ears pivot to scan all directions
- Some insects hear too: internal membranes that act like eardrums, detect sound vibration: mantids, butterflies
- Snakes don't have ears, forked tongue help enhance smell/taste- scents are analyzed by jacobson's organ
- Enlarged snout houses more sensory smells
- Moose use their tongue to pick up airborne scents
- Animals expose jacobson's organ by *flehmen*

Scanning visually

- Eyes on side of head provide larger view of the surroundings
- They are able to see behind and forward
- Eyes on front help you hunt- owls are able to turn their head very far in order to see
- Beavers eyes are lined with their nose so they can swim with just head showing
- American woodcock has eyes atop of head
- American bittern has eyes on side of head so they can still see when they look up
- Big eyes gather more light
- Nocturnal animals display eyeshine- result of adaptation for seeing at night
- Reflective cells in eyes- tapetum lucidum
- Animals herd because, more eyes to watch for danger- more vigilance

Single species flock vs mixed species flock

- M species- Diversity: warblers
- M species: food is scattered
- S. Species- when food is plentiful in the area

Plant defences

- Physical defences
  - Bark of trees is considered armor
  - Seeds can be protected in hard coats (acorn)
  - Thistles, burrs, spikey Spines- modified leaves
  - Prickles are epidermal outgrowths, like hair
  - Thorns are modified branches
  - Plant hairs are called trichomes- physical/chemical
  - No trichomes on leaves in water- but when it dries they're there- inducible

Cellulose makes plants hard to digest

Lignin gives leaves stiffness, nuts and cherry pits their hardness

Structural elements are digestibility reducers

Silica is used in horsetails- very hard to digest, rarely eaten

Grasses are very high in silica

Tannins are astringent: drying effect

Calcium is also used as a deterrent. Arum plants have calcium oxalate crystals in their leaves- skunk cabbage

Jack in the pulpit- arum, well endowed with calcium oxalate crystals

## Lecture 6- Sept 26

Milkweed

Cardiac glycosoids

Terpenoids- are a major toxin

- Taste bitter
- No nitrogen
- Usually serve to repel

New pinecones have resin

- Resins contain terpenoids
- Poison ivy has resins

Alkaloids- Toxins that contain Nitrogen

Insect growth hormone

- Moulting hormone
- Allows them to shed skin
- =ecdysone
- Juvenile Hormone (less of this)
- JH only present in early stages

Rock polypody (a fern) is loaded with moulting hormones= phytoecdysones

Bracken Fern is loaded with phytoecdysones

Insects mature too quickly and die

Balsam Fir contains phyto juvenile hormone (it would stay young forever if it had too much)

Insects that contain PJH do not mature

Reproductive hormones

- Effect animal's reproductive system
- phytoestrogens

Phototoxins

- Very nasty side effects

Mustards advertise by smell

Plants use aposematic colours too

When a plant is under attack an alarm is sent to other parts to prepare themselves.

Chemical messengers= phytohormones travel through plant to initiate biochemical responses

Extrafloral nectaries provide food

There are plants that call "911" for help- call other animals for help

Parasitoids can also be attracted

Temperature extremes

Sub zero temperatures

- Endothermic (controlled internally)& exothermic (controlled by environment)
- Mammals/birds- reptiles/insects
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How animals deal with extreme cold

- Mammals put on layers of hair
- Two layers of hair- Guard hairs:outer grow longer and thicker, Dense underfur: traps body heat
- Birds grow bulkier feather: contour feathers on the outside, down feathers below
- Animals add extra layers on the inside too
- Two types: subcutaneous fat for insulation= warmth, internal brown fat around internal organs: metabolized by the body produces more heat
- Colour can be used to provide warmth: white is a better insulator

### **Lecture 7- Sept 28**

- A deer's shape is not the best for preserving heat, long and lanky legs with not a lot of meat or insulation
- In northern regions an animal's extremities are smaller,
- Short/smaller extremities are better: Allen's rule
- Low surface area: volume ratio (Bergmann's rule) \*know the difference between the two

How can certain animals stand on ice?

- Have more arteries in their foot than veins, arteries bring warm blood to circulate
- \*\*Countercurrent heat exchange: Rete mirabile or wonderful net (use this to balance things out (how it's beneficial to have a colder foot in winter)

animals save energy by warming up the air through snout

- Where they sleep at night is very important
- Birds are normally in a tree full of needles (coniferous tree) block the wind, offer protection

- Some birds make holes in trees, special roosting hole for winter (owls use cavities in tree) so do black capped chickadees, huddling is used by many animals, a way of getting body warmth and retain body heat.
- Some animals build shelters (muskrats chunk of cattail and soft plant material, beavers)
- Beavers lodge- use sticks, thick layers of mud to keep the heat in better
- Small animals find warmth under the snow, they will burrow into the snow
- Subnivean space- the bottom of the snow
- Ruffed grouse snow bed-burrows in the snow

On cold days animals can bask in the sun warming up

- Black capped chickadees can lower their body core temperature by 12 degrees
- By doing this they release the gradient, less heat loss, conserves body energy, enter deep sleep in that process (torpor)
- Shivering raises the body temperature
- For most animals body temperature before 0 is fatal, snakes are ectothermic
- Snakes go down in cracks in the ground and become dormant, below frost line
- dormancy= behavioural defence. Northern water snake leaving its hibernaculum
- All adult turtles and most hatchlings escape by going near lake, frogs too,
- toads burrow into ground beneath frost line, salamanders too
- Many animals stay above the frost line, How? Go dormant and use glycerol (antifreeze) cryoprotectant, insects use shelter as well and go under rocks
- Praying mantid all die in frost- lay eggs before winter ( praying mantis egg is called ootheca) no water in egg, antifreeze
- Walking sticks also over winter as egg

When no ice forms inside the body= supercooling

Other insects survive the season as adults

### **Lecture 8- Oct 3**

Goldenrod gall fly grub

- And it is frozen but alive
- Cryoprotectants inside the cells (cells themselves do not freeze)
- Ice nucleating sites between them
- This is called freeze tolerance (tolerate ice inside their bodies) - between cells not inside them
- Birds try to get the grub inside

Not all Herps (amphibians/reptiles) avoid freezing temperature

- Gray tree frogs stay near the soils surface and freeze, as do wood frogs, spring peepers, chorus frogs- are all freeze tolerant
- Snapping turtles are not freeze tolerant and cannot super cool: overwinter on bottom of lake: lay eggs in spring hatch in fall
- Painted turtles stay in the ground all winter: they are freeze tolerant as hatchlings- first few months after hatch

- Endotherms cannot freeze, they go Dormant: undergo periods of lethargy, when it gets warm they come out- not true hibernating, live in tree cavities
- Porcupines, not true hibernator, chipmunks undergo longer periods of torpor=hibernation
- Low heartbeat, low temperature, but awake every few days
- Bats undergo light hibernation: high heart rate, low body temperature, and are easily awoken- torpor/form of dormancy
- Black bears Hibernate?: low heart rate, high temperature, easily aroused
- Beechnuts- food for bears
- Still fat in spring- bears don't go to the bathroom in winter
- The tappen is a rectal plug that keeps them from fouling their den

What's a true hibernator?

- Groundhogs: heart rate goes way down
- Jumping mice (meadow jumping mice) heart rate and body temperature goes down

Subzero temperatures= 2nd problem for winter active animals

- Mobility is strained
- Physical adaptations
- Moose have very long legs for going through snow
- Snowshoe hares have big feet- easier to get around in winter

Ruffed grouse has snowshoes for winter- they grow little scales out to get a bigger surface area

Behavioural adaptations for mobility- squirrels make tunnels under the snow-subnivean

Wolves travel in packs

Otters use their bodies and slide (tobogganing) through snow

Mink slide on their bellies too

Migrations

- Many animals just leave the area for warmer climates
- Animals leave for lack of food
- Birds leave because of no insects

## Lecture 9- Oct 5

Migration

- Birds, butterflies, whales, etc
- Arctic tern, migrate from arctic to antarctic,
- Red knot- champion migrator
- Fat powers their flight, burn up the body fat and fuels them
- Double their body weight in 10 days, hyperphagia
- Bay of fundy to south america
- Most songbirds migrate only at night-because the cold air cools their overworked muscles: calmer soother safer
- Bluejays fly during the day, some birds fly during the day because: they soar
- Hawks, eagles and vultures soar up on a thermal pg66

- Glide down to the next thermal then soar up on it- this is called thermal hopping
- Slotted wing feathers for extra lift
- Swallows migrate in the daytime- they feed as the fly, need insects during the day
- Hummingbirds migrate during the day
- Sandpipers fly by day and by night

How do they know where to go

- Daytime migrants navigate by the sun, landforms and other visual clues, mountains, coastline
- Night time migrators use: moon, constellations. When it is cloudy they use earth's magnetic field
- Rhodopsin is a retinal photopigment

Why do they fly in a V formation

- To conserve energy- They get lift
- Banding a bird- reveals migration secrets
- Songbirds are caught in very fine nets called mist nets
- Geolocators provide even better migration data
- Motus- more efficient way of tracking birds

Migration is a great solution to an environmental problem

- 50% of the birds that migrate die and do not return
- Normally they hit windows, cats kill them- many factors

Plants become cold hardy

- Excess water is withdrawn and evaporated from leaves
- Water is drawn out of the cells which increase solute concentrations
- Protective sugars - increase
- Flexible membrane

Plants who cold hardy allow ice to form between cells, not in it

This is like freeze tolerance in animals

Plants become

- First stage of acclimation is triggered by Photoperiod- light to dark skies
- Cause cell to go dormant
- Make plant more responsive to low temps
- Second stage is triggered by cold (not sub zero temperatures)
- Some trees are cold hardy to -80 celsius
- Enable chlorophyll to use sun's energy to create heat, not photosynthesize
- Skunk cabbage has an unusual adaptation
- Desiccation is another problem - dries out completely
- Conifers retain their leaves, leaf surface area is small, close stomata, thick cuticles
- It reduces leaf surface area by rolling them up

- Deciduous trees have big leaves with a large surface area- they drop them
- Avoids desiccation
- Female maple leaves turn yellow, male ones turn red
- Leaf loss helps solve a second problem associated with sub 0 temps- The weight of snow
- Conifers trees retain needles
- Balsam firs have a spire shape, black spruce are spindly
  
- Too much heat can also be a problem- causes desiccation, curl their leaves on hot days
- Animals deal with heat by going in the water, finding shade
- Insects move heat through out body and pump to a larger surface area, get in a better position- obelisk
- Tiger beetles raise themselves up from the ground with their legs- called stilting
- Rete mirabile isn't used in summer, let temp go to feet so it's easier to cool down
- Honeybees fan their wings to cool colonies
- Panting is a way to lose body heat
- Doves let their body temps rise

### **Lecture 10- Oct 12**

#### Nutrition

- Plants can produce their own food, animals cannot
- Solutions: animals eat plants (herbivory), eat other animals, fruit, seeds, sap, nectar, some eat dead plant material (detritivore)
- Some animals have food delivered to them (moving water delivers)
- Black fly larvae feed with elegant labral brushes,
- Filter feeders: clams, black fly larvae, ducks
- Dabblers or puddle ducks have lamellae, filter: water passes through and organic material is taken in
- Tongues also help filter the food from water

#### All plant foods require feeding adaptations

- Nectar requires a long proboscis (tongue)
- Hummingbirds have a long beak and tongue
- The HYOID Horns: extend the tongue-extensible tongue
- This normally starts around the skull or eyeball and is joint at the tongue
  
- Plants also give off sap: they have stylets
- Aphids are sucking bugs

#### Problems animals face when eating plant tissue

- Tough structural components
- Ingestion

- Slugs and snails break off plant tissues with a *radula*
- Caterpillars are modified
- Some caterpillars eat leaves from the inside- leaf blotch miner( mines material in the membrane)
- Mammals use modified teeth- incisors: these incisors never stop growing and self sharpen
- Moose have only lower incisors so they rip off plant material
- Large Cheek Teeth grind up the food and are powered by large masseters

### Lecture 11- Oct 17

Milkweed beetles, sever off the veins of the milkweed plant so they don't overdose on milkweed toxins (vein drain)

Groundhogs have enzymes to neutralize the toxins (MFO's)

Red headed pine sawflies only eat pine needles

Monarch caterpillars only eat milkweed (they are called specialists)

Beavers eat a wide variety of foods: they are called generalists

Animals sometimes have dietary switches- Moose have this, their diets end up being very low in sodium

Moose go to water in the summer mainly to get their sodium fix-

- Watershield is a plant with 50x the sodium
- Sodium is stored in the rumen
- In the spring moose eat the mud in the ditches from the snow because of the salt on the roads gets pushed to the ditches
- Animals who eat other animals get a lot of protein
- Far more return for their efforts
- Animals flesh is easier to digest than plant tissue

Disadvantages of eating animals

- Can be hard to find
- Prey can fight back
- Predation (act of killing another animal for food)

Some eat from the inside while the animal is still alive - parasitoid

Some eat them without killing them (lime tic)

Some eat dead animals (ex vultures)

Predation

- Locate the meals
- Capture the meal

- Immobilize the meal

Hawks

- They have modified eyes and enhanced visions, large eyes take in more light
- Large number of cones
- Hawks eyes are magnified 2-3x more
- Frontal placement of eyes are for depth perception
- Fovea in eyes lock onto prey
- Owls have large eyes to let more light in at night
- Glycogen- rich rods
- Cones for daylight visions, rods are better for night
- Some drawbacks to this are large blind spots

Tiger beetles have large compound eyes

Ground Beetles are nocturnal counterparts

Dragon flies are visual hunters

A dragonfly eye can have 28000 ommatidia each with 6 or 7 sensory cells

Whiligigs can see above and below the water at the same time

Spiders have 8 eyes

Crab spiders are als visual hunters

- Large ears can be used for hearing
- They hear with their faces, facial disks
- Asymmetrical ear openings

## Lecture 12- Oct 19

- Owls have very wide heads for horizontal sound separations
- Asymmetrical ear openings for vertical separation of sound

Bats have echo location- where they send sonor in and out to find food or other

Shrews are local mammals that use ultrasound as well

Sense of smell is also used- **olfactory**

Scent trails are easier to track at dusk

Snakes also use scent trails to find their prey- they analyze that with their jacobs organ

Raccoons have touch sensitive front paws they give sensory information to their brain- Tactile sense is the touch sense

Otters have many hairs on their face that help them find their food (Vibrissae)

Birds also have these rictal bristle feathers which are sensory

Star nosed moles have eimer's organs in their nose

Sandpipers have Herbst corpuscles in the bill tip (they can't see their prey so they have sensory)

Ducks have this too, some birds have sensory on the tip of their tongues- Herbst corpuscle

Rattlesnakes have infrared heat sensors- that will tell them if there's a mammal that gives off body heat

The heat pit lies between the eyes and the nostrils can detect changes as small as 0.001 cel

How to find prey?

Some animals sit and wait for prey others attack

Active searching- wolves and spiders do this

Tiger beetles also search and capture

Preying mantis sit there and wait for their prey- wait and ambush

Owls sit and wait

Crab spiders sit and wait

Golden crab spider changes colour to match flower

Spiders also get their prey through the use of webs (Traps)

Orb weaver spiders build spectacular webs

Their webs are flight intercept traps

Funnel weavers usually build webs on the ground- get animals that jump and hop

Sheet web spiders- knockdown strands to knock them down and then they fall on the sheet and the spider eats it

Spider strands have to stay elastic- they absorb moisture from the air webs are hygroscopic

Webs can contain 6 or more types of silk

Spiders can recycle silk from broken webs to build a complex orb web takes

20 minutes is all it takes for a spider to build a web- Argiope has a zigzag pattern of silk in the middle of the web- called stabilimentum it attracts insects to web it uses UV light to trap bugs

Antlion larvae create pitfall traps

Lecture 13, 14 MISSED

### Lecture 15- Nov 7th

- Ectoparasites get food from the outside of animals such as blood, this is their only source of nutrients, they depend on it. Ex: Mites and Ticks
- Haller's Organ detects Humidity, Temperature and Carbon Dioxide
- They have to have mouth parts to latch onto the animal in order to get at the blood.

Lamprey- Parasitic leeches that latch onto fish and- they have barbed prongs

- Anticoagulants to keep the blood flowing: ensures a constant flow of food coming to the mouth.
- Flattened body shape to climb through feathers, hair (flat flies, lice) They have claws to grip.
- Black flies, stable flies and insects like that- are not ecto parasites because they do not get all their nutrients from blood.
- Obligate parasites: obligated to feed on blood, no other choices
- Problems of being an ectoparasite: their blood source dies, may contain contaminated blood, hosts try to remove parasites
- Hosts groom and preen
- Herons have pectinate toe: a special claw used to align feathers and remove ectoparasites
- Beavers also have a grooming claw: double or split toenail
- Some parasites live inside their host: endoparasites
- Cuterbra ( a Robust Bot Fly) is endoparasitic only as larvae.
- A true parasite does not kill its host

Deer have a parasitic Brain Worm, then leave through droppings. Snails then come along and eat their droppings,

A slug or snail becomes the intermediate host when it eats the droppings. Deer are the parasite's definitive host

Brainworm also go into moose and go into the flesh of the brain and kill them. It takes only 1 brainworm to kill a 1300 moose

WHy do brainworms live in deer but kill moose?

- White tail deer and this parasite evolve together, for millions of years this has happened
- As Moose evolved in North America moose and deer overlapped, they began to eat the same food as deer did and they contracted the brainworm

Robins are the definitive host for a parasitic fluke, they poop it out in water- then snails in water go to eat it. Snail is intermediate host

Most endoparasites are smaller than the host. Many millimeters in size.

Parasitic castration: when a parasite alters the behaviour of their host

Problems too. Wrong host might be entered

Parasitoid kills, parasite does not kill

Some animals eat animals that are already dead- scavenging

Even birds that eat seeds and insects can be scavengers: most eat other living things

Eagles are also part time scavengers, especially in winter

Turkey vultures are full time scavengers: obligate scavengers

Adaptations for scavenging: featherless head- for sticking into gross places

- Big sharp beak- huge raptorial bill
- Refined sense of smell
- Enlarged nasal chamber
- Raptorial bill, large olfactory bulb in brain
- Huge Nares (nostril) not separated
- Flight adaptation for conserving energy

Dihedral wing position-

Vultures fly low and they fly slow

Blow flies- find dead animals and lay their eggs on them. Larvae eats it not adult

Carrion beetle larvae, also called burying beetles,

Necrophagous- eating dead things

### **Lecture 16- Nov 9**

Predictable food supply strategies

- When there's a shortage you may migrate, or go into dormancy
- Seeds and nuts, fruit, or small mammals (all very in abundance from year to year)
- Solution: move to food rich region
- Nomadic and irruptive
- Crossbills are seed specialists: highly nomadic and irruptive
- Great Grey Owl: nomadic and irruptive
- Shrikes and owls sometimes stash their prey in case they are ever running low
- Shrikes do this by impaling them on trees: Larder for the shrike->

There are animals that store food when there is predictable shortage

- Gray squirrels create hundreds of solitary caches
- Scatter hoarding- hiding and storing a lot of food in a number of places
- Grey Jays scatter hoard food in the winter, cache food all summer only one item and in one location.
- Grey Jays have enlarged salivary glands to coat their food, holds it in place under the tree
- They nest early
- Amazing memory; large spatial memory
- Red squirrels store food for the winter, but they do not scatter hoard
- Chipmunks have expandable cheek pouches,
- Beavers create a central cache of branches call a food pile, often near their home lodge
- Beavers drag their food on a drag trail where they bring down branches to their pile, poplar is a beavers favourite food for winter storage

- Plants make most of their own food, but they also have nutritional needs. Photosynthesis
- Plants are autotrophic: self feeding
- Different habitats have different feeding stuff: bogs are very difficult to provide food in, they are very nutrient poor, no real soil,
- Heath family: heath plants have fungal partners, associated with their roots, they have expanded series of roots that extend into the fungi
- Mycorrhizal - some endosome exto

Alders have a solution for Nitrogen, root nodules, some plants use fungi some use bacteria in their roots

Some plants eat animals

Great sundew- in the family of a venus fly trap

Pitcher plants are also carnivorous,

### Lecture 17- Nov 14

Sundew leaves are adhesive traps

- Pitfall traps:
- Bladderworts are also carnivorous
- Their underwater leaves are suction traps
- Other nutrition related problem: if a plant does not have enough sunlight it will not be able to blah blah
- Large forest canopies serve as a problem as there is a lack of sunlight coming through

How do plants get by with a limited amount of sunlight?

- Some shade plants have a large surface area: ex round leaved orchid
- Parallel to the ground: less energy needed to hold them up
- Thin flat leaves: less energy spent in building support tissues, light reaches it easier, suppresses competition
- Hobblebush
- Colonial growth- have lots of leaves but are attached to just one plant( bunchberry)
- Another way to beat the shade is to grow away from it - positive phototropism
- Climb atop the competition
- Tendrils are thigmotropic= thigmo is greek for touch
- Trilliums bloom in the early spring: bloom before any trees
- Many spring ephemerals grow in deciduous forests

Lose the need ufor sunlight- no leaves

Does not prodce its own food

Coral roots are beautiful orchids that live like scavengers

They have mycorrhizae- root fungus association

Indian pipe gets nutrients from living plants: parasite- mycoheterotrophic

Its roots form haustoria in the roots: strigolactones  
holoparasite photosynthesize and steal carbon from other plants through mycorrhizal-

End of Chapter

Asexual versus sexual  
Internal versus external

Fish: external fertilizations: fish drops eggs out of body, males drop sperm  
Frogs and eggs use external fertilization- amplexus  
Most animals use internal fertilization to better guarantee their efforts,  
Some sperm donors never meet

Sponges are hermaphrodites- they can change sexes: they release sperm into the water  
Clams can also send their sperm into the water, they are also hermaphroditic and never meet  
They double their chances to reproduce

Insects called springtails are not hermaphroditic- they never meet their mates

Spermatophores- can be picked up by the female  
Slugs and snail are also hermaphroditic, they meet their mates and use personal delivery for sperm= internal fertilization  
Gastropods use an intromittent organ to get sperm to eggs- meaning putting inside  
Sedentary or slow moving animals double their chances of reproducing by being both sexes

Male spiders use palps(their mouthparts) to syringe sperm into female

Male snakes have two intromittent organs called hemipenes- only one is used at a time

### **Lecture 18 Nov 16**

### **Lecture 19- Nov 21**

Advertising for mating

- Antlers are ornaments
- Products of sexual selection

Dobsonfly - tusks as ornaments- used as an ornament

Many ducks use head displays

Aerial displays

- Midges: females midges fly into swarm and pick a random mate
- Ebony jewelwing
- Male fireflies use aerial use- as night they blink their lights to attract females

Swans have choreographed synchronized displays- they mimic each other displays

Sandhill cranes perform ritualized

Wild turkeys have communal display grounds- (leks) display sights for where a communal family

Male sharp tailed grouse also dance at communal area

Yellowjackets emit pheromones when an attack is coming

Chemical advertisements=olfactory advertisements

- Sex pheromones
- Females let out this
- Male moose dig rut pits when
- Wallow pits

Female snakes leave pheromone trails- when in mating season then slither around the ground and release pheromones

Insects use pheromones very commonly-

Males use their antenna to pick up airborne scents

Female moths advertise with pheromones

Giant silk moths advertise in plumes

Pheromones can have a secondary function

- Males pee on female hares (to either leave scent so no one else can have her)
- Stimulation

Porcupines also pee on their female

Courtship can involve gift giving

- Most common gift is: FOOD
- Courtship feeding males do this to show females that they are good at feeding
- Terns give fish to their female, spiders do this, scorpionflies do this

Marsh wrens also give gifts

- males are good hunters- great at getting food,
- They make dummy nests to show the female they can build while getting food

Male bass and bluegill sunfish also offer nests

Paternity- contact guarding

- Males stick by their female until they are done processing
- The wheel position- a position that used in dragonflies mating- makes a heart
- Male walking sticks use bondage- long copulations
- Claspers keep them from getting away (like handcuffs)
- Many beetles use headless sperm
- Featherwing beetles use giant sperm
- Mosquito ejaculate jaspers making a cement plug

Some add anti aphrodisiacs to the plug so no one else will mate with her  
Male garter snakes also create a plug and secrete anti aphrodisiacs

Honeybee- honeybees die after having sex- they literally explode

Lecture 20/21 missed

### **Lecture 22- Nov 30**

Toads just lay their eggs and then leave

- Dragon flies do the same

Temporary ponds are very important for freeze tolerant animals

Females must choose the right host plant for their eggs on

Female monarch butterflies lay their eggs on milkweed

Parental care in turtles

- Involves laying their eggs in the ground, and then they leave them and never come back
- Temperature of ground determine the sex of the eggs

Walking stick eggs end up underground but are not placed there by the female

- Northern water and garter snakes hold eggs internally until they hatch= ovoviviparity
- The young that are born are not guarded
- Other female animals guard their eggs
- Female red backed salamander guard eggs- they lay their eggs under rotting logs unlike other salamanders who lay their eggs in water
- Female wolf spiders carry their eggs around. Babies are carried on their mother's back
- Female nursery spiders
- Do many male animals guard the eggs and the young? Some male fish (bass and bluegill sunfish) do. Male giant water bugs also do this

Moose

- Young are precocial
- Parental care involves protecting their young
- They protect their young for one year
- Total parental investments = 20 months

Wolves and foxes exhibit biparental care

In mid summer pups are taken to open places called rendezvous sites, this is where they eat

Not all female mammals invest a lot internally

Black bear cubs are born highly altricial- completely helpless and dependant

They stay with their mommas for 1.5 years

Even more altricial are the young of opossum, they are born after 13 days of pregnancy

Female black bears mate in June and give birth in January- their gestation period is only 2 months though

Delayed implantation allows bears to mate and to give birth when the time is right

Many carnivores experience delayed implantation

Bats mate in summer and give birth the next spring

Gestation is only 40 days though

Bats store sperm and let it out when the time is proper

Social insects (bumble bees and paper wasps) also store sperm and take part of group care for the babies

90% of all birds provide biparental care

Ducks, grouse, sandpipers = large eggs 40% yolk

Shells require lots of calcium and inside = yolk

They make lousy nests

Songbirds = small eggs, 25% yolk- longer period of development in nest

Songbirds = elaborate nests

Precocial chicks leave the nest after hatching

Songbirds - 14 days in gestation

Big birds like geese - 1 month

Incubation is also an investment

Female ducks and grouse do all the incubation

Phalaropes have males doing all the incubation

## **Lecture 23- Dec 5**

Polyandrous- when the female has multiple mates

Female ducks and grouse do all the incubation

After mating the males desert them

- Female only hummingbirds do incubation, males leave after

In many cases females do the incubation because the male deserts them or males provide them food.

Both sexes can incubate as well- killdeer: males guard the nest all night and females in the day

Brood patches: if they have one they're an incubator: wrinkly skin that they press against an egg

How can you tell which adult birds are the parents

Cuckoldry is common in monogamous birds

Mature males return first and take over the highest nest site (it's safer when you're up higher)

Female scarlet tanagers solicit EPCs but from males wandering in from distant territories

Synchronous hatching- they all hatch at one time

- They lay their eggs throughout 14 day period but don't start incubating until they are all out
- The birds can communicate in their eggs and they decide when they want to come out

Precocial bird- hatch over a 12 day period

-

Owls and hawks have asynchronous hatching

- Incubate as soon as each egg is laid, the chicks come out at separate times.
- -many lessen feeding stress on parents
- Reduces odds of losing the chicks
- Ensure survival if food is hard to come by
- Oldest might eat their siblings= siblicide: when a young animal kills its siblings
- Parental care includes nest sanitation
- They clean their nests and drop the mess elsewhere
- Many cavity adopters and green leaves to their nests
- They do this because it deters nest mites from coming to their nest

Cavity adopter- when you use an already made home

Cantharadin- chemical in blister beetle

Birds do this and wipe the chemical around their house to deter

Parental care includes

- feeding the young
- Nest defence- aggressive responses, mobbing, distraction displays: rodent run, ducks give a broken wing act, feigned injury display
- Altricial and precocial birds differ in nest defence intensity

Red winged blackbirds nest defence is paternity dependant

- The bird defended mainly his eggs, if the nest had less of his eggs he wouldn't care as much

Duck and goose broods can be extremely large due to brood amalgamation

Creche

Ducks don't feed their babies

Egg dumping- a female duck will lay her eggs then leave them in another duck's nest

Black Billed sometimes lay their eggs in another bird's nest

Possoms only have 13 nipples so the rest of their litter (30 other) will die  
Natural selection- only the most fit possums make it to the nipple to survive  
Brood reduction occurs in eagles- oldest eagles kills the youngest- siblicide  
Muskrats kill their neighbours so that there's more food source for their own babies  
When a female tree swallow re mates the new male kills all of her young  
Infanticide occurs in swallows

In dense populations females may abort their fetus  
Brown headed cowbird do not display parental care- foster parents always raise their young  
Fast eggs laying 20-40 seconds- thick eggshells, fast hatching, outcompete their nestmates  
Up to 40 eggs per season

They find a host nest 3 ways  
Sit on perch and watch, walk on ground and watch, drive off nest

Some recognize and don't accept the other egg, host can abandon the nest  
Smaller birds are puncture ejectors

Cowbirds are violent-