LECTURE 1 TO 17

1. WEDNESDAY SEPTEMBER 2TH

BACKGROUND MATCHING only works if the animal is not moving aka being CRYPTIC
Seasonal colour change also helps with background matching, especially in winter

Discreet patches of colour can also be used for concealment (warbler)
Many songbirds have eyelines and eyestripes for concealment, they break up the general shape of the bird's head when it is nesting: DISRUPTIVE PATTERNS
Killdeer have breast bands that act as disruptive patterns
Canada geese also have a chinstrap looking stripe that's disruptive

(Group) Coincident Disruptive colouration
not only colour can make animals camouflaged-
ie: some butterflies are shaped like dead leaves,
or the "walking stick" praying mantis

dead or live leaf mimic or twig mimicry
MASQUERADE: to mask as something already in the environment by form and colour such as dead leaves or rocks or twigs

scarlet lily leaf beetle: covers itself in its own poop

if an animal has 3d shape it stands out more
countershading // self shadow concealment principle
this is why so many animals have lighter bellies than upper bodies,
when the upper part casts a shadow, it makes the lighter part darker
if the lighter part was already dark, it would get darker because of the shadow
This is called COUNTER SHADING

2. FRIDAY SEPTEMBER 4TH

Startle patterns: underwing moths

Startle structures (osmeterium): Orange like horns come out of a swallow tail caterpillar

Startle Sounds: The beaver's tail slap is a startle sound.
Ruffed grouse take off with an explosion of wing sound

Some startle patterns aren't always hidden, ie: Eyed elater beetle/common wood nymph/ common buckeye/northern pearly eye/eyed brown butterflies) , as such
they're not referred to as startle patterns.
Eyespots always displayed make animals look larger, ie: pandorus sphinx

Distraction/Deflection patterns, as seen on underwing moths, are used to
deflect a predator's attack to a non vital body part
Some part of their wings are dispensable

Hairstreak butterflies, bright colours near their tails make them look like antennae
as such if a bird goes to grab them they can escape unscathed
These are distraction structures

Autotomy: when animal can easily shed one part of their anatomy
ie purple tailed lizards and certain species of butterflies

DEFENCES

Physical defence can consist of body armour
armadillo, snails, turtles --> Shells can be made of calcium
clams have shells called bivalves because they have two shells
Blanding's turtle also have two shells, and they can partly close them
Snapping turtle snap their teeth when you approach, they cant pull inside their shell
coz they have no bottom plate so they're more aggressive.

Physical defences can also be soft structures;
eastern tent caterpillar silk tent (they also have hairy bodies)
because birds dont wanna get all that silk/hair on their wings or faces.

Fall webworm silk tent // they eat insde the leaf tent
whereas eastern tent caterpillars leave the nest to feed

3. WEDNESDAY SEPTEMBER 9TH

Woolly bear caterpillars have hairs that can be modified into hard spines
they also curl up when under attack

Porcupine are also another species that have modified hairs into hard quills
Quills are modified guard hairs, most are on the tail
They cannot shoot their quills, they have to make contact
The quills have little scale projections that can make their way into
flesh and muscle of the predator. They have antibiotics in the quill,
mostly to protect themselves when they impale themselves.

Hairs and poison are referred to as Poison Spines
This is a CHEMICAL DEFENSE

The Io Moth caterpillar have spines that release a burning chemical
Poisonous caterpillars are usually brightly coloured, as a warning sign
Milkweed Tussock moth caterpillar
The Giant leopard moth caterpillar has poison spines, it's black
so you would think the colour principle doesn't apply to it
until it feels threatened: it turns into a ball with bright red spines

The red Eft salamander has bright colours, because it has poisonous skin

The scientific name for warning colours is APOSEMATIC colouration

Raccoons/skunk are black and white because they are more active at night

to remember: "black & white, aposematic at night! colour in day, keep away!"

bumble bees, wasps, milkweed bug, milkweed beetles, honey bees are all aposematic

Ladybug beetles manufacture their own toxins
Other animals attain chemicals by eating plants that contain them
monarch caterpillars as well as the milkweed tussock moth caterpillar eat milkweed
and SEQUESTER the poison and store it in their bodies: cardiac glycoside (a terpenoid)

Fireflies are beetles, they produce lights due to the chemicals mixed in
their thorax compartment. The males flash patterns as signals that allow them to find a mate

Photuris fireflies sequester steroidal toxins, they get their toxins by eating photinus fireflies
The photuris females will mimic the photunis female signals to attract photunis males & eat them
This is called AGGRESSIVE MIMICRY

Chemical defences can be released from different parts of the body
Sawfly larvae release terpenoids orally
Blister beetles release toxins through the leg joints
Bombardier beetle release hot quinone gas in their body's chambers
the burning gas is 100degrees when it's released & comes out with a loud pop.

animals armed with chemical weapons often bear aposematic colouration
Aposematic colouration allows a predator to learn and avoid that colouration

When a group of unrelated animals are all defended and bear similar appearances
this is called MULLERIAN MIMICRY, after Franz Muller

4. MONDAY SEPTEMBER 14TH

The viceroy butterfly copies the monarch butterfly in an effort to protect itself,
because the monarch butterflies are poisonous
The viceroy mimicry is called Batesian mimicry wherein harmless animals
will take on more poisonous species' aspects to look more threatening than
they actually are. Batesian after Henry Bates.
Hoverflies also do this, they look like bumble bees/wasps/honeybees/bald faced hornets
If the model goes extinct, the mimics will evolve into something else (or go extinct as well)
Models and mimics have to occur at the same time for mimicry

American toads have toxin Bufotalin in skin glands, but they are not brightly coloured
Toads have another defence: they inflate themselves to look bigger
This is a BEHAVIOURAL DEFENCE

Hog nose snakes bluff by pretending to be a puff adder snake, if that fails they play dead
The scientific name for playing dead is called Thanatosis

Behavioural group defence, like when deer/zebras stay in groups-there's safety in numbers.
Flocking is group defence by birds, to protect against attacks from hawks
Flocking might serve to:
1) visually confuse predators - highly unlikely
2) lower the odds of being caught - number principle

Group defences can be aggressive, ie yellowjacket wasps have attack pheromones that
pretty much "summon the troops" even if only released by one wasp

Bird behavioural defence can also be aggressive, often small birds will attack big birds
ie: redding black bird vs hawk/raven

Alarm calls will summon other birds to join in the attack, this is called mobbing.
mobbing is sometimes referred to as a pre-emptive defence, like when small birds will
attack an owl to discourage the nighttime owl's impeding attack

Some animals have bodyguards, ie: carpenter ants that guard aphids
aphids produce a sweet honeydew that ants eat, ants stroke them with their antennae to
encourage the aphids to produce more honeydew.

Eastern cottontail rabbit have a seemingly nonsensical defence

They run erratically and their white cottontail is up in the air,
but the rabbits are basically mimicking the white tail deer
Why do they do this?
Flags (as in their tails) advertise awareness, as in i see you and you're not gonna catch me
Another theory is that it serves a warning to other member of its species.
They also run erratically to distract the predator, the tail serves as a flag that the predator
follows - it's slightly disorientating, lowering the efficiency of the predator.

Vigilance: animals have adaptations for danger scanning

moose have a large nose (olfactory scanners), large ears (auditory), side eyes (visual scanner)
large external ears that can pivot in all directions
beavers have small ears because they wouldnt be able to swim,
demonstrating that there's other considerations that limit the scanners that animals can have.

Tiger moths also have ears - vibrating membranes on thorax
Lacewings have ears at the base of their wings
Mantids have one ear in front of their hind legs on the underside of the abdomen, pick up vibrations

5. WEDNESDAY SEPTEMBER 16TH

Snakes cant hear but they can sense vibrations and have enhanced smell & taste senses
A snake's tongue is forked for a very specific reason, the snake's tongue picks up chemicals in the air
scents are analysed in Jacobson's Organ in the roof of the mouth - when the chemicals in both tongue tips are
balanced that tells the snake that the intruder or prey is right ahead of them.

Moose have an enlarged snout that houses more sensory cells and a jacobson's organ
Moose and other mammals expose the jacobson's organ by Flemen pose
(lift head up a little, curl up lips, expose jacobson's organ)
As snakes stick their tongue out to pick up scents, so do moose and fox.

Visual scanning:
Snowshoe hare & mallard ducks have eyes on the side of their head to aid visual scanning
this allows the animal to have a very wide field of view (the amount of space seen by one eye w/o moving)

The american bittern's eyes are placed near the base of the beak, to allow the bittern to see ahead while its bill is pointing up/down.
full binocular vision. American bitterns, when scared, put their beak up in the air
- which is not a perfect adaptation because they have a blindspot behind them (no adaptation is perfect)
The eyes of an american woodcock or sand pipers have eyes toward the upper rear of their heads
because they feed by probing into the mud, so they need to look upwards & backwards
as that is where danger is likely to come from.

Nocturnal animals tend to have large eyes, to see better
Nocturnal animals display eyeshine - a result of an adaptation for seeing in low light.
What it is: in the back of the retina, when the light comes in the eye and misses the sensory cells,
there is an extra layer behind the rods & cons (torpidum lucidem) that reflects this light back to the sensory cells.
This gives the nocturnal animals an extra chance to pick up light. eyeshine is a factor of torpidum luciderm.

More eyes allows for more complete vigilance.
Flocking offers two advantages: more eyes for vigilance & safety in numbers
Two kinds of flocks: one species or mixed species (sometimes as many as fifteen in one flock)
Waxwing birds are typically single species flocks
Differences lie in food resource type:
If they eat less and/or there is a more varied source then mixed species flocks.

Many plants have physical defences. Trees and other woodly plants have armour: bark
Seeds protected in hard coats: acorns.
Some plants develop armour that is configured to be unpleasant to touch: thistle spines
spines are modified leaves as opposed to prickles that are epidermal growths (much like hairs on us except harder)
New rose buds resemble prickles (automimicry)
Hawthorns are super sharp thorns, some birds have evolved to use these as a skewer to conserve food
they impale their prey on them and come back to eat it later.
Thorns, unlike spines and prickles, are modified branches.

Do these defences work?
Yes, for example cows don't eat thistles.

Ragweed have what's called soft defences: little soft hairs all over
Little soft plant hairs are called trichomes. These serve the purpose of impeding little bugs from eating the plant.
More as a physical impediment than an poisonous or otherwise dangerous feature

Some trichomes actually contain liquid chemicals which make them sting on contact - glandular trichomes
ie: stinging nettles - not unlike the Io caterpillar

No trichomes on leaves in water - water smartweed -
sometimes they can grow trichomes when exposed, like when water level goes down considerably
These are referred to as INDUCIBLE DEFENCES

Structural elements such as cellulose, hernicellulose and pectin make plant tissues hard to digest
They were developed as a deterrent to consumption.
Another element lignin gives leaves stiffness, nuts and cheery pits their hardness.
Structural elements are referred to as digestibility reducers.
Silica is found in horsetails (equisetum) - not many animals can eat this, it's a very abrasive material
Grasses are full of silica.

Other digestibility reducers are not structural components, sometimes called plant secondary metabolites
ie: Tannins are astringent (they're a drying agent)
Calcium, another abrasive material, is also used as a deterrent.
The Arum plant (skunk cabbage/jack in the pulpit) has calcium oxalate crystals in its leaves.

Terpenoids are a major group of plant chemical toxins, they taste bitter & do not contain nitrogen.
New pine cones have resin. Resins contain terpernoids.
Squirrels have evolved a solution, they just let the pine corn dry in the sun for a couple of days.
Poison ivy also contain resin as well, the terpenoid's called urushiol

Toxins containing nitrogen are called alkaloids. ie: buttercups, astors
Alkaloids interfere with digestion by binding to digestive enzymes;
some alkaloids are sugar mimics. Because they're part of the plant they are called CONSTITUTIVE defences.

Other toxins are produced on demand because the plant cannot store them without killing itself.
Hydrogen cyanide (HCN) is an inducible toxin: the black cherry and bracken contain hcn - do not eat them

A wounded leaf sends out WOUND HORMONES as a warning to the rest of the plant to get ready for attack.

Some plants produce insect growth hormones.
During their growth, insects need MH (moulting/ecdysone) & JH (juvenile)
some plants have these phytoecdysones and flood the animal, so when larvae eat these plants they die
either by changing too fast (unsustainable metamorphosis) or not changing at all (unable to reproduce)
Rock poly ferns are loaded with moulting hormones, the bracken fern has phytoecdysone (MH) hormones
Balsam fir have phytojuvenile hormones on their tree trunks, ensuring insects do not mature

These hormones all have different qualities: some keeep insects young, some speed up their growth,
some make the insects sick and some starve them.

6. MONDAY SEPTEMBER 21ST

Reproductive Hormones are another class of defences,
some plants can mess up an animal's reproductive system.
Animals that eat phytoestrogens will have miscarriages or become infertile.
These defences are reserved for larger animals like sheep

St John's wort had phototoxins. These toxins migrate through the animal's skin and
have the ability to make animals very sensitive to light so that they get really bad sunburns,
forming blistering pus balls that get infected - eventually killing the animal.

The mustard smell of mustard flowers advertises their defences (glucosinolates)

Plants use aposematic colours too - like when berries are ready to eat.
The lighter coloured ones have terpenoids as a defence

When a plant is under attack, a pheromone alarm is sent to other parts to prepare themselves
Chemical messengers are called PHYTOHORMONES to travel through the plant initiating biochemical responses.

Recall some animals pay ants for protection, some plants do too: extrafloral nectaries provide food to ants.

And then there plants that call for help: wasps will answer the call & kill the attacking caterpillars,
thereby getting "payment" in food

Challenge: Environmental Stress

Temperature extremes: sub zero

when water turns to ice, it expands.

the scientific term for "cold blooded" animals is ECTOTHERMS.
the regulation of temperature is done by the environment
whereas ENDOTHERMS, like humans/wolves maintain their own body temperature

How animals deal with extreme cold

animals that stay active:
mammals grow more hair - the outer coat called GUARD HAIRS grow longer & thicker
dense UNDERFUR traps body heat - it's dense and woolly

Birds like black capped chickadees grow bulkier feathers: contour feathers on the outside
as well as down feathers underneath. There can be a 50C difference btwn their skin & the top layer of feathers.
Birds add subcutaneous fat for fuel that is burnt up by shivering (thermogenesis) while they sleep

Animals also add extra layers on the inside: FAT
Mammals have two types of fat: subcutaneous fat for insulation and
brown fat around internal organs to burn for warmth.

Pale colours retain body heat better, darker colours lose a lot of heat to environment
When wind's a factor, darker colours lose more heat.
Gloger's rule: the more northern you go, the paler they animals are.

Snowshoe hares gain 27% in the coat's insulation value by being white, also providing camouflage

Best Physical Features for extreme cold:

short extremities are better: because the longer they are the more heat they lose
Allen's rule: the smaller the surface area of endotherms' extremities, the better.
The animal with a low SA:Vol ratio the easier it will be for the animal to generate heat as it's lost (Bergmann's rule)

Deer mouse do not have a good body shape for extreme cold: tail too long, ears too big
Ever wonder why beavers, swans, mallard ducks can stand on ice and swim in cold water without freezing?
They have a system whereby they maintain their bodies at 35C but their feet are only 2-3C,
this allows them to lose less heat because there is a lower heat gradient from feet to environment!
Counter current heat exchanger: Rete Mirabile, system mammals use to lessen heat loss in extreme cold

Tucking extremities (feet, alternating)under a wing can also help keep warm - duck, swans, rough grouse do this
How an animals breathes in winter also conserves energy
Foxes have a counter current heat exchanger in their snouts, but they also keep their mouth shut/no panting.
Birds roost in coniferous trees that are covered in snow, snow is like a blanket
Wood peckers will always go back to the same place where they've hollowed out a cavity.
Voles and flying squirrels will huddle together to share heat.
Muskrat lodges are an example of animals building their own shelters, beavers also build lodges.
Lodges have chimneys aka breathing holes, wolves can track beavers this way but they can't get in
because the muds used for insulation freezes and becomes cement.

7. WEDNESDAY 23rd SEPTEMBER

layer of snow that s easily pushed around by small animals in the search for a warmer area: subnivean space
animals could suffocate if they stay too long, so they have to dig up for air, which is when predators wait
Ruffed grouse snow bed: they go down to the subnivean area to stay warm and burst out in the moning
animals BASK in the sun to stay warm
On cold nights, black-capped chickadees lower their body core temperature by 12 degrees celsius
They enter a very deep sleep when they do this, it's called TORPOR - so they are in a TORPID state.
This has the purpose of lowering the heat gradient, conserving more energy in the long run.
They do shiver on and off to ensure their temperature doesn't lower beyond that initial 12 degree drop
This is odd for a bird as most birds only practice shivering as a means of thermogenesis.

Birds are endotherms which means their temperature is internally regulated
reptiles are ectotherms so they can't be out in subzero temps, their cells would burst

Frostline: the level at which cold doesn't affect ground temperatures
snakes have to get below the frostline to survive the winter, they become lethargic- basically dormant
This is a behavioural avoidance method: avoid frost
Snake's shelter also referred to as their "Hibernaculum"

All adult and MOST hatchling turtles escape subzero temps by going to the bottom of ponds and lakes
american toads dig beneath the frostline, as do many salamanders.
Snapping turtles can't supercool and they're not freeze tolernat.

Many instects survive winter above the frost line, many adults die but before they die they mate
So these insects survive winter as eggs: Praying Mantis makes an Ootheca egg case
No water, antifreeze is used in the egg (glycerol = cryoprotectant)

Walking sticks also survive winter as eggs, mate for 3 days, female then lays eggs that look like seeds
ants carry these eggs and eat the edible capitulum, and discard the inedible part, months later sticks emerge
unharmed by the ants.

Some overcome winter as LARVAE, woolly bear moths do so using glycerol antifreeze
when no ice forms inside = supercooling
female mosquitoes survive winter as adults, they stop eating in the fall and void their gut of all contents
Angle wing butterflies survive winter as "supercooled" adults, which is why the 1st ones seen are angle wings and mourning

cloaks
Silk moths survive winter as PUPAE in cocoons & pupal cases that keep the dormant insect from contacting water/ice

Some insects overwinter in special sites: fly grugs
fly lay eggs on golden rod stem, egg has steroid that makes plant grow around it
fly hatches and eats the plant through the winter, tunnels out after winter is done
Goldenrod gall - simply a plant swelling
Goldenrod gall fly grub is inside the gall - frozen but alive as it has cryoprotectants inside the cells
They can control where ice forms: ice nuleating sites between their cells
As such they are said to have FREEZE TOLERANCE

Black-capped chickadees and downey woodchipper eat these fly grubs

Not all HERPs physically avoid freezing - gray tree frogs stay near the surface and freeze
as do wood frogs, spring peepers and chorus frogs. They're the first to come out in the spring
They are all FREEZE TOLERANT: they have nucleating sites between their cells

Snapping turtles can't supercool and they're not freeze tolerant.
They absorb oxygen through their skins.
They lay eggs in late spring, and they hatch by early october
Snapping turtle hatchlings head for the water immediately, where they will spend winter in a dormant state
They spend winter in the water, at the bottom where it doenst freeze

Some hatchling Painted Turtles are freeze tolerant and stay in the ground all winter.
By the next fall, they won't be able to....only Northern painted turtles can do it - ones in places like NC cant

Endotherms cannot freeze but some do become dormant.
Hybernation and Dormancy are not the same thing,
Hybernation: body temp is only slightly above zero, heart rate is very low
Dormancy: body heat stays high, heart rate relatively high, eat occasionally

Chipmunks undergo longer periods of torpor, they live underground during the winter
They have intermittent days of sleep where their heart & body temp lowers but they awake every few days
This is a light hibernation

Bats also undergo dormancy, high heartrate of 24-36bpm, low body temp of 5C, easily roused from sleep

Black bears: low heart rate (8pm), high body temp (30C), easily roused from sleep
Bears do not urinate or defecate during winter dormancy, they have a little plug in their rectum
This rectal plug is called a TAPPEN, keeps them fouling their winter den

True hibernators: ground hogs, woodland jumping mice

Sub zero temps are an issue because lowered temps means water freezes, food is scarce, snow decreases mobility

8. MONDAY SEPTEMBER 8th

Mobility issues in winter

Moose have adapted long legs, 6feet to the shoulder
snowshoe hare have large surface feet, front legs are smaller than the hind feet
most northern moose is the CARIBOU, malleable foot that spreads like snowshoe allowing it to walk on snow
Many northern animals such as fisher & marten weasels have large hind feet
Ruffed grouse have the ability of developing a winter adaptation, their feet have scales that allow them to
walk on snow easily
Tarmaggen birds have very dense feathers on their feet, used for warmth and to ease mobility.

Behavioural adaptations for mobility:

The subnivean space also solves the mobility problem for little animals like squirrels
White tailed deer move to a yard (sheltered area with less snow and more fodd)
BROWSE LINE identifies where white tailed deer feed in the winter
Wolves also have behavioural adaptation, they follow a single file where the first broke the trail
it makes it easier for the pack to travel through snow
Otters have short legs, so they slide on their bellies, this is called TOBOGGANING
Mink weasels also use their bodies as toboggans

Animals solve the sub zero temp problems in a variety of ways, not all stay and face the challenge
Many escape by MIGRATION
birds that feed on insects mostly have to migrate - insect gleaners, their food supply is gone
or unavalaible unless they're wood chippers
Dragonflies (common green darner) migrate, just like monarch butterflies
A few bats such as the Red Bats also migrate
Most birds migrate over tremendous distances, as far as Brazil (scarlet tanagers)
Arctic Tern - Arctic, Africa, Antarctica (20'000km round trip)
Red Knot - (26'700km round trip)
Fat powers their flight - birds don't have brown fat, they use subcutaneous white fat
Semipalmated sandpipers that probe their bill in the mud have to leave, because mud freezes & they cant feed
They'll land somewhere, eat for 10 days till they double their body weight
Most songbirds migrate only at night - like the red-eyed vireo 300 to 500km
They fly at night because there's usually fewer predators, less wind and it's cooler (less chance of dehydration)

Hawks and eagles fly in the daytime. They soar up and down on THERMALS, this is called THERMAL HOPPING
This allows them to conserve fuel body fat. They have SLOTTED wing feathers for extra lift
Swallows fly in the daytime and eat flying insects.
Hummingbirds also migrate in the daytime.

Daytime migrants navigate by the sun, landforms and other visual cues
For nightime migrants, the moon and constellations are used as compasses
Both day and nighttime migrants use the EARTH'S MAGNETIC FIELD
Rhodopsin is a retinal photopigment that is likely involved with electromagnetic interaction

Why do geese fly in a V-shaped flock?
To conserve energy, each bird exploits the lift created by the wind going over the foremost bird's wing

Small birds are caught in very fine nets called MIST NETS
GEOLOCATORS provide even better migration data

Only half of the birds that migrate return, so no adaptation is perfect

9. WEDNESDAY SEPTEMBER 30TH

Subzero temperatures also poses problems for plants
Ice inside their cells will kill plants
Many plants go dormant in the soil under the snow
Plants become COLD HARDY, much like animals have freeze tolerance
-> Excess water is withdrawn from leaves, twigs (the parts that are exposed) and evaporated
-> Water is drawn out of the cells, which increases solute concentration - lowers the freezing point
-> They add protective sugars in their cells, also increases solute concentration
-> the membrane becomes more flexible (unsaturated fatty acids added)
-> antifreeze proteins to suppress ice formation and proteins to resist dehydration

Plants become cold hardy by a process of ACCLIMATION
The first stage of acclimation is triggered by a change in the PHOTOPERIOD (period of light vs darkness in a day)
Phytochromes - light sensitive photopigments - cause cells to go dormant, make plant more responsive to low temps
The second stage is triggered by cold (sub-zero) temperatures [10C- 0C)
Some tres are cold hardy to -80degrees Celsius

Retaining needles creates problems for coniferous trees
Damage by solar radiation (like drying out), they have xanthophyll pigments works kinda like sunscreen
Another solution: They enable chlorophyll to use the sun's energy to create heat not to photosynthesise

Skunk cabbage has an interesting way of surviving winter: it generates heat

DESSICATION (aka drying out) is another problem,
Coniferous trees retain their leaves so size and shape is very important
-> Leaf surface area is small, cuticle is thick, hairs on leaf underside to lock in moisture
-> They close stomata pores

How do evergreen fern survive? They curl up to reduce surface area

What about deciduous trees like the maple? They lose their leaves

Anthocyanins make leaves red

Another problem in subzero temps for plants is the weight of the snow
Some shapes shed snow: balsam fir have a SPIRE shape
Black spruce have SPINDLY shapes

HEAT DESSICATION:

Heat can be shunted to body parts with a greater surface area, such as the abdomen
Dragonflies reduce their surface area facing the sun by assuming a position called the OBELISK

Tiger beetles live in hot places, so they raise their bodies STILTING

Ducks and beavers bypass their rete mirabile and shunt blood to their extremities to cool down
Beavers lost 90% more heat through their tail than when the RM is in operation
Honeybees are SOCIAL INSECTS that work together to air cool their hive
In the hive, honeybees use their wings to fan the colony

PANTING is a form of EVAPORATIVE COOLING: foxes and even insects use this
Vultures employ a very unusual method of evaporative cooling: they urinate on their legs

Mourning doves employ the dangerous strategy of allowing their internal temp to rise to 45C
This allows them to lose heat faster: HYPERTHERMIA

Some animals eat dead plant material: DETRIVORE
all plant foods require feeding adaptations: filter feeding, nectar requires a long PROBOSCIS
hummingbirds have a long beak and longue tongue
HYOID APPARATUS the base of the tongue that extends the tongue
bugs have probing mouthing parts called STYLETS

10. MONDAY OCTOBER 5TH

Problem #1: INGESTION

Plant tissue is really hard to digest because of how structurally complex they are
TOUGH STRUCTURAL COMPONENTS
Snail & slugs have RADULA: rotating chainsaw, rip and shred plant tissue
Caterpillars have modified mouth parts called MANDIBLES
Some caterpillars eat leaves from the inside: leaf blotch miner
Mammals use modified teeth: INCISORS
Beaver teeth are orange because of high IRON content, never stop growing and self-sharpen
Moose and deer only have lower incisors so they rip off plant tissue,
the upper part of their palate is solid so they use that to hold the branches.
Large CHEEK teeth to grind up food (molars and pre-molars)
Cheek teeeth are powered by large muscles called large MASSETERS, that's why they have a large empty space on their jawbone. that's where the muscles attach.
The muscles that drive the incisors are called the TEMPORALIS
Mandibles, radula and cheek teeth all perform the same function but arise from different origins
Whenever you have components in diff animals that serve the same function but arise from different origins,
the term is called ANALOGOUS STRUCTURES.
Ruffed grouse have no teeth, teeth are heavy it would make it hard for them to fly.
Spruce grouse eat conifer needles
Analagous to the radula, mandibles and cheek teeth are the grouse's GIZZARD

Problem #2: DIGESTION

Slugs and snails produce digestive enzymes
But caterpillars dont produce the enzymes
Moose and deer need help from BACTERIA to digest their food: a rumen ant (symbiotic relationship)
The food is processed twice, coughed back up from their RUMEN, this process is called RUMINATION
Hare and rabbits have bacteria that live in long chamber named CAECUM (plural CAECA)
They can't pull food back up to their mouth, so they poop and eat their droppings
COPROPHAGHY: eating droppings
Most fruit-eating birds don't only eat fruit(seasonally). They also eat worms
Animals that only eat fruits are called frugavores
Bohemian waxwing (winter) & Cedar waxwing (summer) - fruit eating specialists
if an animal only eats fruits, they need to eat lots of fruit to survive (fruits are small and lacking in proteins)
They swallow berries whole; large gapes for fast external processing
they also have short intestines for fast internal processing.
Animals that eat fruit and pass out the seeds are helping the plant propagate,
they are called SEED DISPERSERS
Seed eaters like chipmunks are SEED PREDATORS
american finchers have fine bills for thistle seeds
Red Crossbill eat coniferous cones, they use their bills to pry the cones open.
Their bills are modified for getting seeds out of cones but it makes it hard for them to eat normally,
they have to turn their heads sideways to eat
Red squirrels bite off the cone scales with their incisors
Chipmunks use their incisors, turkeys swallow whole and the nut is ground by gizzard

Problem #3: Plants have chemical defences to overcome

Some herbivores sequester plant toxins, like the monarch butterfly
VEIN DRAIN: some animals bite through the plant veins to minimise toxin distribution
Groundhogs have enzymes to neutralise toxins, MFOs mixed function oxidase
Monarch caterpillars eat only milkweeds, red headed pine sawflies eat only pine needles
Some animals only eat one or two kinds of food - SPECIALISTS

Beavers eat a variety of plants, they eat all parts: leaves, roots, stems, flowers

They are not specialists, they are generalists.
Some animals switch foods at diff times of the year for a balanced diet
Moose do that fresh leaves and twigs which are rich in carbs and protein but lacking in sodium
In winter, they eat balsam fir. They spend spring and summer eating aquatic plants that have a high sodium content
They eat WATER SHIELD plants that have 500x times more sodium (Na) than land plants.
They store the sodium in their rumen, and draw on it all winter long.

11. WEDNESDAY OCT 7TH

Sodium is stored in the moose's rumen
road salt = sodium chloride (they've learnt they can get it by roadside ditches in the spring)

Advantages of eating the plant eaters
high levels of protein,
for the most part, they're available year round
they're easier to digest than plants

Disadvantages:
they're harder to find/catch
Often prey is well protected
they fight back

Some animals eat from the inside while the animal is still alive.
They are called PARASITOID
Others eat without killing the animals
They are called PARASITES (true parasites dont kill)

PREDATION

before a meal is enjoyed, a predator must first:
Locate
Capture (in a variety of different ways)
and Immobilise (again, in a variety of ways)

Diurnal birds of prey: birds that hunt in the daytime
Sharp Vision: Large eyes that collect light (large in proportion to their head)
Large number of CONES (colour vision) for visual acuity
an image appears approx 2-3 times larger to a hawk's eye than to the human eye
Frontal placement for depth perception: binocular vision to precisely judge distance to prey
They have special litle pits in the retina that have greater number of cones there
Owls have plenty of rods, better for nighttime vision - Glycogen rich rods (more light sensitive)
Just like hawks, have frontal placement of eyes
There are 14 vertebrae in an owl's neck, generally the opening in the vertebrae is very snug on the artery that goes through which means most animals cant turn their heads too much....
In an owl, the opening is up to 10times bigger than the arteries going through, allowing them to turn their heads without pinching their nerves or veins
Tiger beetles hunt visually and have large compound eyes
Ground beetles are their nocturnal counterparts
Dragonflies have 28000 OMMATIDIA each with 6/7 sensory cells for picking up light
Whirligigs can see above and below the water at the same time (usually found on pond surfaces)
Spiders have eight simple eyes - not compound unlike insects
Different groups of spiders have different eye placement, jumping spiders have the best vision
Crab spiders are also visual hunters, they wait for prey by sitting still on flowers

Hearing is also important
Large pinnae to magnify sound (eastern wolf, large ears)

Owl hear very well but have no external pinnae
They have FACIAL DISKS around their eyes that capture sound,
transmit it to the ear openings that are on the side of their faces
To precisely pinpoint where the sounds are coming from, the width of the head matters & ear position matter
allows for horizontal (width) & vertical (ear openings are asymmetric) basis of sound capture
(works just like the snake's forked tongue)

Bats produce ultrasounds to find prey, this is called ECHOLOCATION
Shrews also use ultrasound for echolocation

OLFACTORY SENSING
Heightened sense of smell: elongated snout in wolves & foxes - Vomeronasal Organ
Certain times of the day are better for hunting by smell - before sunset
Helpful due to wind situations around that time.
Cold air is pushing down, hot air is pushing down - this line of compressed air holds onto scents
This only happens for a few hours making scent trails easier to track at dusk

TACTILE SENSING
Raccoons have touch sensitive front paw
Tactile sensors can be located around the mouth in otters, these are called VIBRISSAE
Birds have sensitive hair-like feathers around the mouth opening called RICTAL BRISTLE feathers
bristles help them with geolocation
Star-nosed moles are practically blind, they have ELMER'S ORGANS in their nose protuberances
Sandpipers have HERBST CORPUSCLES in their bill's top
Ducks that filter-feed have pressure activated sensors in their bill (also herbst corpuscles)
Woodpeckers have herbst corpuscles in the tips of their tongues

HEAT SENSING
Rattlesnakes have pits between the eyes and nostrils, these are infrared heat sensors
They can detect temperature changes as small as 0.001 degree Celsius

How are these tools used? by ACTIVE SEARCHING
Not all animals actively search, some are pretty sedentary
Praying mantids and many owls sit and wait for their prey to come to them, as do crab spiders
The goldenrod crab spider changes colour to match the flower it's waiting on
Some animals wait BUT they set a trap - FLIGHT INTERCEPT traps
Orb weaver spiders buil giant roundish webs off ground level
FUNNEL WEAVERS usually build webs on the ground level,
this is not for flight interception but rather to catch little jumping insects
Sheet-web spider web are really messy for a reason:
2 components: thinner knockdown strands and a "bowl" of slightly thicker sticky capture sheets
Webs are HYGROSCOPIC, they absorb moisture to ensure they dont dry out and snap when hit by prey

Spider web facts

Webs can contain six or more types of silk
Spiders recycle silk from broken webs by chewing on them
To build a complex orb web, it takes an average of (just) 20minutes!

12. WEDNESDAY OCT 14TH

key terms:
spider webs are flight-intercept traps
hygroscopic webs: attracting dew to stay elastic
different groups of spiders make different types of webs: orb weavers, funnel weavers and sheet web spiders
ARGIOPE spiders (slightly different orb weavers) have a very visible web, it has white silk down the middle

STABILIMENTUM: silk w special properties, ultraviolet patterns make it look like a flower attracting insects

Pitfall traps are made by ant lions
Adult ant lions dont eat ants but baby ant lions do
Baby ant lions have mandibles and poison bites.

Mole tunnels can be considered traps, even if the mole's primary intention may not have been food

Alligator snapping turtle and angler fish use aggressive mimicry (much like the Argiope spider) to attract prey
OSPREY hawks have special feet for catching fish: they carry fish head first to help w aerodynamics
They have scales on underside of their feet, rough pads/projections for holding on to fish better
Osprey hawks also have an outer toe that is REVERSIBLE: to help w grasp in water and air.
Osprey are not unique to having a reversible toe, owls also have this special feature (to help w subnivean hunts)

MERGANSERS are fish-eating ducks, they have long & narrow bills w serrated edges for grabbing slippery fish
Teeth or mandibles can be used to catch prey but so can tongues (preferably extendable)
Otters use their mouths to capture fish, they have large canines
Tiger beetles use modified mandibles to capture prey
Toads and frogs use TONGUE FLICKS to catch insects, their tongues are extensible and folded inside their mouths
A woodpecker's tongue wraps around the skull, their tongue is covered in sticky saliva
They have an attachment called the HYOID APPARATUS that extends the tongue, called horns because it's forked
Spiders that don't use their webs (jumping/crab/wolf spiders) use their legs to catch prey
Praying mantis also use their legs, they have little scales all over their legs - RAPTORIAL legs

Foxes use their mouths, they use TEMPORALIS muscles to power their canines - larger than masseters for biting purposes
Huge masseters usually found in herbivores for grinding,
whereas large TEMPORALIS muscles more prevalent in carnivores for biting
Foxes use a shake and break technique because their prey tends to be smaller
Wolves on the other hand kill much larger prey (like deer) by using a slash&shock method
This technique draws a lot of blood in a small amount of time, killing their prey w the least amount of energy expanded

Weasels bite into the prey's cranium - like hare
Cats bite into the neck vertebrae, snapping the neck.

Larger birds of prey kill with their RAPTORIAL BILL
Shrikes also kill with their bill, they have a MEATHOOK TIP just like hawks.
Bird Hawks (accipiters) kill with their talons

Many snakes swallow their prey whole, while it is alive.
They have jaws that are not fixed, they breathe through their nostrils
Gray rat snakes and milk snakes are CONSTRICTORS
The one snake in Ontario that is poisonous is the Massasuga rattlesnake,
Poison is a toxin, Venom is injected toxins: contains digestive enzymes to help the snake w ingestion & digestion
Crab spider and Assassin bug also inject toxins and digesting enzymes
The spiders dont bother distinguishing between batesian mimics because their toxin immobilises prey

Robber flies and short-tailed shrew have venomous bite
Spiders and many predatory insects slurp or suck out the prey's liquids leaving an empty shell

Hawks practice SELECTIVE FEEDING
Fishers, contrary to their name's suggestion, dont eat fish. They skin procupines
Black bears also skin moose calves.
Eastern Wolves also feed selectively but small bones are eaten
To protect their digestive tracks from damage, the bones are wrapped in hair
This is why wolves faeces have hair in them,, they pass indigestible pieces through their body
OWls swallow their prey whole, 12hrs later a PELLET is coughed out
the pellet contains the bones and hair of the prey

13. MONDAY OCTOBER 19Th

Predatory animals can get injured in pursuit of prey when prey fights back.
During the chase they might acquire injuries ie: eagles that impale themselves on branches

They might be weak/young/older/disabled, become unable to find any food; thereby succombing to STARVATION

They can also die by ingestion of toxins: BIOACCUMULATION usually happens w unnatural toxin build-up
BOTULISM: food poisoning caused by a bacterium (botulinum) growing on food.
PEREGRINE FALCONS were driven to near extinction by DDT
DDT bioaccumulation in peregrines resulted in thinner egg shells & behavioural changes (no young produced)

HUMAN PREJUDICE results in unregulated death of predatory animals

LOSS OF HABITAT results in loss of food source

Predators are a major force in natural selection and evolution

Other animals eat their prey from inside them: the host can be either killed or left alive
PARASITOIDs kill their hosts. BRACONID WASPS are parasitoids only in the larval stage.
TACHINID FLIES are also parasitoids as larvae/grub, just like FLESH FLIES.
They don't lay their eggs on just any caterpillar, it has to be a certain age ie: not cocooning anytime soon
Some lay eggs on leaves they know will be eaten by a caterpillar
Some even paralyse the caterpillar, lay eggs inside it & bury it in a prepared "tomb". They then cover up.
The larvae eat their way out when ready.
^ SPIDER WASPS do this, so do DIGGER WASPS.

Some parasitoids findhosts through VISUAL SEARCHING
if it's too big a caterpillar, it'll change form too soon for the larvae to survive,
if it's too small, it won't hold up the egg without dying too soon, so the selection is a careful process
When the right host is found, eggs are laid through an OVIPOSITOR - an egg laying apparatus
Sometimes they can smell the prey they're after
ICHNEUMON WASPS are a huge group of Parasitism
MEGARHYSSA ICHNEUMON ovipositors are impressive in size
They can use it as a chemical drill, coz the sawfly/horntail caterpillar lives inside trees & eats wood
When the wasp's egg hatches, the paralyzed horntail is eaten alive.
Pelechinid wasps lay eggs on June Beetle grubs in the ground

PARASITES: if the parasite lives outside the host, they're called ECTOPARASITES
Many leeches are ectoparasites in all life stages
Ticks are also ectoparasites
Female ticks are carriers of LYME DISEASE
Some MITES (arrenurus) are also ectoparasites
Some migratory birds harbour ectoparasitic flies (under the feathers, close to the skin)
These flies are called FLAT FLIES, they are flat to help w aerodynamics while they live on the birds

Baby clams are ectoparasites for fish, they clamp on gills and feed on fish blood
They are called GLOCHIDIUM (sing.) or Glochidia (plur.)

14. WEDNESDAY OCTOBER 21ST

ectoparasitic adaptations;
Organs for detecting a host, the organs detect humidity, temp and carbon dioxide
special mouthparts developed for penetrating and holding on to the host's skin

these mouthparts are called HYPOSTOMES on leeches and mites
the hypostomes has barbs that spread, much like on a zip tie (or a porcupine quill)
they have anti-coagulant enzymes to keep the blood flowing
Flat flies have claws to grip on birds
OBLIGATE PARASITES only feed on blood
Problems that affect ectoparasites include death of the host, or removal by grooming/preening
Herons have a special grooming claw called a PECTINATE TOE
Beavers have a specialised split toenail for grooming purposes

Other parasites live INSIDE their host, they are called ENDOPARASITES
CUTEREBRA bat flies are endoparasitic only as a larvae
Deer have a parasitic BRAINWORM
Brainworms live around the spaces of the deer's brain, the larvae leave the deer in its faeces
When a snail or slug eats these faeces, the larvae change the behaviour of their hosts
The behaviour change makes snails/slugs daytime feeders, which makes them susceptible to being eaten off a leaf
When the parasite gets eaten (within the snail) they make their way back up the moose's spine affecting the moose's walk, leaving there AGAIN as an adult fly. This will eventually kill the moose as the fly burrows in (not around) the moose's brain.
A slug or snail becomes the INTERMEDIATE HOST when it eats the droppings
This process makes the deer the DEFINITIVE HOST
The brainworm only kills moose and not the white-tail deer because they did not co-evolve.
The moose is new to North America and does not have the evolutionary history to defend itself from brainworms
Robins are the definitive host for a parasitic FLUKE or FLATWORM

Endoparasites have adaptations: small size
They may suffer problems too such as: not finding an intermediate host or finding the wrong host

Parasitic CASTRATION: the parasites change host behaviour chemically
If the parasite shuts down the host's sexual activity or growth, it can be advantageous
When animals are mating, they make themselves more obvious to predators shortening their lifespans
which is not good for the parasite - it does not want to end up in the wrong definitive host

Some animals eat animals that are already dead: SCAVENGING
Part-time scavengers are FACULTATIVE, especially in winter: Marten, Eagles, Foxes, Gulls, Ravens

Turkey vultures are full-time scavengers - OBLIGATE scavengers
Vulture have developed several adaptations for scavenging:
claws to tear & pull, featherless heads, internal enzymes for eating putrid meat, raptorial bill
powerful sense of smell: huge nostrils (not separated), enlarged nasal chamber, large olfactory bulb in brain

Many small animals are obligate scavengers; such as blow flies that lay their eggs on fish, the grubs eat their way out the fish

Carrion Beetles are NECROPHAGEOUS; they eat the dead (they feed their grubs w dead animal skin).
Some carrion beetles are also called BURYING BEETLES

Predictable food shortage solutions
Dormancy/Hibernation
Migration - move to food-rich regions when necessary, bohemian waxwings move to areas w large fruit crops
NOMADIC and IRRUPTIVE migration <--- happens unpredictably as opposed to the predictable shortage of food usual in winter

15. MONDAY NOVEMBER 2ND

To counter food shortages some predators keep killing but store excess, ie: shrikes that store food by impaling it on branches
LARDER - technical name for storage of excess food in case of shortage
Other animals store food for a PREDICTABLE SHORTAGE.
Gray squirrels create hundreds of solitary caches. This is called SCATTER HOARDING
Squirrels are active all winter and feed mainly on cached food
Gray Jays do not migrate, they scatter hoard and cache all summer & fall
Adaptations for storing food: they wrap their food in an opaque saliva
1) enlarged salivary glands
2) sticky saliva
3) early nesting allows young to survive the following winter easier
4) amazing memorey: large hippocampus that provides spatial memory

Red squirrels create a number of larger stashes called MIDDENS

Chipmunks are partially dormant through winter, so they collect food as well
They have expendable cheek pouches that allow them to gather more food & make less trips

Beavers create a CENTRAL CACHE of branches called a food pile
Beavers' favourite food is the poplar/aspen tree
Beavers use the back of the tail to break the ice if their pond's frozen

Plants also have nutritional demands even if most make their own food via PHOTOSYNTHESIS
AUTOTROPHIC plants can make their own food. They need water, sunlight adn nutrients (nitrogen, calcium, phosphorus)

BOGS are very low in nutrients but heath plants (bog laurel, labrador tea) survive with a little help from their friends
Heath plants have fungal partners associated w their roots called MYCORRHIZAE
if found inside the root, they're called ENDOMYCORRHIZAE
Orchids also have endomycorrhizae as do Grass Pinks
Mycorrhizae also allow trees to grow in bogs like black spruce
Spruce has mycorrhizal associations on the outside of their roots: ECTOMYCORRHIZAE
mycorrhizae increase uptake of nutrients such as Nitrogen and Phosphorus, prevent uptake of toxic compounds
Alders have a diff solution for Nitrogen, they get help from bacteria living in parts of their roots forming ROOT NODULES
They fix nitrogen into a form plants can use

Some animals eat animals (insects)
round-leaved SUNDEWS are carnivorous, hairs off the leaf pad release glue & digestive enzymes
The leaf slowly folds over onto the insect, "eating" it
Sundew leaves are called ADHESIVE traps, as are butterwort leaves
PITCHER plants are also carnivorous: downward facing hairs, waxy surface, then water trap w/ digestive enzymes
These plants make PITFALL TRAPS much like the ANT LION
Bladderworts are also carnivorous, called so because their traps are sack-like like bladders
Their underwater leaves are SUCTION TRAPS, scientific name UTRICLES

Some habitats have a lack of sunlight, as such some plants have adapted leaves w a large surface area
The leaves are perpendicular to the ground to save energy, and to capture max sunlight
Thin flat leaves offer other advantages like light reaches photosynthetic cells quickly, suppresses competition
Hooker's orchids have similar leaves, but are found in drier cedar woods

Different kinds of chlorophyll: A and B, B is a helper that brings reactans to A
shady plants have more B than A

Some plants have lots of leaves as opposed to a few large ones: colonial growth or clonal (as in colony/clones)
Another way to beat the shade is to grow away from it, the term for this is PHOTOTROPISM
Another adaptation against shade is to grow on top of the competition like WILD CUCUMBER,
they have THIGMOTROPIC TENDRILS that attach to other plants like vines

TRILLIUMS have another solution to the shade problem: bloom before the trees open up in spring
They have a short blooming period. Many species of SPRING EPHEMERALS(means short lifespan) grow in deciduous forests
bloodroot, ductman's breeches, spring beauties, trout-lillies, mitreworts all bloom early
The biggest problem with this is frost & no pollination aid (the bugs aren't around coz it's too cold)

Another adaptation is losing leaves, CORALROOTS are orchids that live like scavengers
They have helping mycorrhizae associated w other plants
these plants are thus referred to as MYCOHETEROTROPHS (plant that gets food from fungus, doesn't make its own) not AUTOTROPHS
The Indian pipe wildflower has no need for sunlight, has mycorrhizal associations
It gets nutrients (CARBON PRODUCTS) from living plants, it's a parasitic mycoheterotroph.

16. WEDNESDAY NOVEMBER 4TH

Dwarf rattlesnake are both photosynthetic plants and they get carbon products from other plants via mycorrhizae
Many shade-dwelling orchids do this, they are called MIXOTROPHS.
The cancerroot has no leaves and no mycorrhizae.
It gets its nutrition by using its roots to track chemicals released by host plants when trying to attract mycorrhizae
Because of this specialisation it is called a HOLOPARASITE
Witch's broom are patches of abnormal growth on trees. They can be caused by a variety of things but the most common is a wildflower seed landing on the stem, penetrates the stem and steals food from the tree
The dwarf mistletoe is a HOLOPARASITE, because it directly attaches to another plant and steals from it

Problem: too much sunlight
Adaptation: leaves with small surface area. grow at a 45degree angle (like the buttercup)
Sand dunes are extremely sunny and hot places.
Plants often have leaves that are highly DISSECTED, these kinds of leave have a reduced surface area
Plants are like animals in very many ways, including the drive to attain genetic immortality through reproduction

Two types of reproductions: Asexual versus Sexual
Downside to asexual reproduction is no variation, higher chances of dying out
External vs. internal fertilisation
Frogs and fish use external fertilisation. Frogs use a position called AMPLEXUS to stimulate the female.
Freshwater Sponges (filter feeders) reproduce internally by absorbing sperm released into the water
Sponges are HERMAPHODITIC.
CLAMS also send their sperm into the water, they are also hermaphroditic and never meet their mate,
they spew sperm out and hope for the best. Hermaphroditism is an advantage because it doubles an animal's chances of reproducing
Slugs, snails and eartworms are also hermaphroditic. If the animal is sedentary, chances are they are hermaphroditic
Sedentary or slow moving animals double their chances of reproducing
Snow fleas (SPRINGTAILS) use internal fertilisation yet many species never meet their mates.
Internal fertilisation does not mean they must have penetrative intercourse
Many male springtails leave SPERMATOPHORES on the ground for the female to pick up

SLugs have a love dart", they pierce each other to deliver sperm
Love darts, or any sperm delivery system, are called INTROMITTENT ORGANS

Male spiders insert their sperm with special mouthparts, called PALPS or PEDIPALPS
They use their mouths to insert sperm into female genitalia
Male snakes have two intromittent organs called HEMIPENES
Mammals deliver sperm into the female with the aid of the penis, much more successful rate of reproduction
Many be used for stimulation which may help w female ovulation in some species
When needed, a penis is usually inflated
When not needed, a penis is usually stored away. This is important because of the risk of injury for terrestrial animals
For aquatic mammals and birds, the member could create drag - which is why bitds don't have penises

As most birds don't have a penis, they press their CLOACAS together - this is called a CLOACAL KISS
Some mammals have another form of erection support (besides water or blood), they have a penis bone called a BACULUM

How do animals meet a potential mate?

Barnacles (found on rocks and whales) are HERMAPHRODITES, they have a "wandering" penis that can be up to 40x their body length
Many animals find a mate not by chance but by looking one aka advertising themselves
Auditory advertisements
Non-vocal advertisements
Vocal advertisements
Visual advertisements

Wood peckers use their bills to DRUM, all wood peckers have a different sound from each other
Ruffed grouse also drum but not with their bills, they use their wings beating them fast enough to create a loud sound
They do this on a favourite, specially selected DRUMMING LOG th
Snipes make non-vocal sounds with their TAILS - WINNOWING
Crickets and grasshoppers make courtship sounds by rubbing wings and/or legs together

STRIDULATION is the act of rubbing body parts together to make sounds
Tree crickets use leaves as amplifiers
Band-winged grasshoppers CREPITATE
Cicadas use TYMBALS. They have plates on their lower abdomen, muscles push on these very fast, the plates pop back into place
making the noise.

Sounds can also be produced vocally, they have their own built-in amplifier
Male toads and frogs have EXTENSIBLE THROAT SACS that act as RESONATING CHAMBERS
Toads have one vocal sac, some frogs have two

17. MONDAY NOVEMBER 9TH

Both female and male frogs have a TYMPANUM, male frogs have larger tympanums for the sake of competition
Birds also advertise with VOCALISATIONS - birds don't have a voice box, they make sounds internally
Sound is made at the trachea and lungs(bronchi) junction - the SYRINX
The syrinx is why birds can sing two songs at a time, they can control each bronchi independently
Song has two main functions and many warblers sing two diff. songs
1) advertising ownership of territory
2) Advertise to attract a mate
Some birds have the same song for both functions
Female choice is a major part of sexual selection and a driving force for evolution
During the RUT (moose mating period), cow moose call to attract bulls
Bulls also vocalise and make non-vocal sounds by THRASHING their antlers
Sound carries a long distance, predators and parasitoids can hear you
& cheaters called SATELLITE MALES can exploit these efforts

Visual advertisements most noted in birds and ducks
Sexual dymorphism
Wilson's phalarope is one of the few species where the female looks prettier and the males choose the mate,
however they mate, then the female leaves the male with the eggs and he's charged with raising the offspring by himself
Phalaropes are POLYANDROUS - females have multiple males

Females choose males on the basis of appearance
Female mallards choose males with the greenest heads <-- it reveals health and age
Female house finches choose the most brightly coloured males, colour is acquired through diet

Good foragers will be good at feeding offspring

Atlantic puffin bills are ORNAMENTS, they are badges of maturity or status
the grooves in the bill take two years to grow, the females chose males w two or more grooves

Horns and andtlers are different, horns are formed from compressed hair. Antlers are made from bone tissue.
Antlers are ornaments, they change size and shape w/ age, they reveal something to the observer
The points of antlers are called tines & the flat parts are called palms
Antlers are shed every winter and grow back the next year. Velvet covers the antlers as they grow to provide blood supply
Moose antler bone is the fastest growing bone in the world, grown in the space of one summer
Size indicate age, symmetry and other deformities (like cracked antler) indicate health or social status
Antler displays can defuse aggression
Moose learn who's who by SPARRING, playful sparring occurs after the rut is over
Through sparring, bulls learn that antler size refelects stature - strength and dominance
Antlers are a product of SEXUAL SELECTION & rejected bull moose can get aggressive during the rut, some even piercing the cows' side

Visual advertising can include elaborate RITUALISED DISPLAYS
Many ducks like the Hooded Meganser, use head displays.
Male ruffed grouse use NECK RUFF and TAIL DISPLAYS
Some animals have AERIAL DISPLAYS ie: midges