

Seasonal Changes – Advanced Training

Theme: Plants and Animals have amazing strategies to adapt & prepare for the winter

*** ADV = Advanced info**

Welcome: Here today to discover some ways that plants animals and insects prepare for seasonal changes. They have amazing ways to deal with the coming of winter.

I. Intro - The Coming of a Fall/Winter

A. The Signs of a new season

- How can we tell that it is a new season?
 - Weather changes, leaves change color, shorter day length, look at our calendar
- How can plants, animals and insects tell that it is fall time? (do plants have eyes?)
 - Have internal clocks that tell them when to start seasonal changes (will explain in more detail later). The “clocks” plants and animals have are sensitive to light information.
- Show diagram of the sun and explain how the angle of light changes in the fall/winter (Adv)

B. Preparations for Fall/Winter

- How do we prepare for fall/winter?
 - Wear different clothing, eat different foods, carve pumpkins, heat our homes, drink hot cocoa...
- How do plants and animals prepare for winter without our modern luxuries?
 - Do they curl up under the covers, buy a winter jacket? (for kids)
 - Migration/hibernation/active/bodily changes
(We will explore these concepts on our hike)

Activity options:

- 1. Read aloud *How the Turtle Flew South for the Winter*** from Keepers of the Earth – best for younger audiences - using turtle & bird puppet (find story laminated in the winter ecology box).
- 2. Winter Survival Tag** – best for older groups (4th grade and up) – need a large space to run like the Chautauqua Green (find this game in the winter ecology box)
- 3. Monarch Mania dice game** – best for older group, can be done at the beginning or end of a program.
- 4. Lunch for a Bear Game from Growing Up Wild** – for younger audience – need a larger space – after playing this game, you can sing the Song “The Bear Went Over the Mountain” (find this in the winter ecology box)

C. Fall/Winter Stresses

- What challenges does winter bring to plants/animals?
(snow, cold, radiation, energy, wind)

Way to remember by acronym S-C-R-E-W (Adv)

D. Who are some of the plants, animals and insects here on OSMP that will need to prepare?

Activity = Who am I – using seasonal change animals & items from the winter ecology box. Try to Match up with the item (eg: white out, airplane ticket, hat, lites out).

II. Plants

A. How do they know when to start preparing (Adv)

- Phytochrome helps trigger seasonal change responses in the plant (changing colors, losing leaves and hardening).
- Phytochrome is capable of responding to light information and communicating that information via chemical messages, behaving like a hormone to switch critical processes on or off.
- It's like an "alarm clock" that triggers the trees winterizing process before the cold comes.

B. How do plants prepare for winter?

1. Change colors/Reveal colors – Deciduous trees

- Shortening days and cool nights trigger the growth of a corky membrane at the base of the leaf stem, preventing the flow of nutrients into the leaf.
- plants to stop producing chlorophyll and photosynthesis stops
- green pigment fades while yellow and/or orange pigments remain.

Demonstration = use green jacket as prop and have a yellow or orange shirt underneath (explain revealing not changing concept)

Yellow = Xanthophylls Orange = Carotenoids Reds and purples = Anthocyanin (Adv)

Demonstration = use cut out leaves in yellow, orange & red (find in winter ecology box).

* red pigments are caused by anthocyanins – chemical substances in the sap. If the sap is acidic, leaves become bright red, if the sap is less acidic, the leaves become purple. Anthocyanins form when high sugar concentrations react with proteins in the sap.

2. Leaf Dropping

- The colored leaves don't stay on the trees right? Unattach when the wind blows
- Done to conserve water
- Also gives trees less surface area for snow to accumulate (snow loading)
- The process of leaf separation is called leaf abscission. (Adv)
- Leaf scars replace the point where the leaf was attached to a stem and cork blocks the entry by harmful fungi, and prevents water loss from the stems (Adv)
- Dropping leaves also prevents water loss (evaporation) out of the stomata (Adv)

Demonstration: leaf in the freezer (shows how cells that freeze damage the plant)

3. Hardening

- A process to resist and to tolerate the effects of freezing (like antifreeze in a car)
- Rapid freezing can kill plants that would have survived a slow cooling to the same or even lower temperature

Analogy: What does a soda can do when it freezes??? Imagine a tree..... (Adv)

Plants harden in 3 stages: (Adv)

1. Stage One (triggered by phytochrome clock)

- Growth ceases, carbs move to roots
- Water is moved to the outside of the cell to grow ice crystals in spaces between cells.
- Chemical changes in cells lower the cells' freezing point (like antifreeze) 23-14 degrees

2. Stage Two

- Water in the cells is replaced with sugar molecules

- Further hardening – 4 or – 22 degrees

3. Stage Three

- Formation of ice with smooth rather than rough edges (vitrification)
- Hardening down to – 112 degrees

4. Some stay green

- (Douglas fir, Ponderosa pine)... but stay inactive (photosynthetic dormancy)
- Conical shape of trees discourages snow loading. Most of the snow accumulates on the ends of branches and then drops onto ground
- Waxy scales and needles resistant to drying

Activity = show how snow falls on P.pine vs. deciduous

5. Some plants survive/over winter as seeds

- Some flowers, plants, grasses

IV. ANIMALS

Intro: Many different sized animals prepare for winter, who would need to be more careful of freezing, smaller animals or larger animals?

Activity = The Benefit of Big (freezer activity)

In the winter ecology box there are 3 different sized bottles, one mule deer, weasel & mouse and you can talk about which would freeze first.

Terms – Some animals love the snow, some tolerate it, and some fear it.

Chion – Greek word for snow

Chionophiles - snow lovers

Chionophobes - snow fearers

Chionophores - snow toleraters

A. How do animals know when to prepare for winter? (Adv)

- Pineal gland is the “timekeeper” or alarm clock
- It is a club shaped organ usually found in the midline of the brain where the cerebral hemisphere and cerebellum come together
- It is photoreceptive to light (even when surgically removed) Adv
- Acts as an endocrine gland – secretes chemical products in the blood (melatonin) a hormone that regulates a # of processes.
- Melatonin – a key player in seasonal change. It is synthesized at night and its quantity in the bloodstream provides direct information to other tissues regarding day length/night length

B. How do animals/insects prepare for winter? They have many strategies and not all mammals, insects, birds have the same strategy.

1. Migration

- Not easy 50% of body wt. as fat needed – birds will need to put on extra fat and build their flight muscles
- Migration is mainly about food – when the store runs out of groceries, the animals migrate to a supermarket that still has food on the shelves.
- Complete Migration = A species nests in the northern hemisphere and then migrates south for the winter. (adv)
- Day length or night length is the primary trigger for bird migration
- Some use sun, stars, or earths magnetic field as a compass (Adv)

Horizontal (plane ticket) – explain migration (takes lots of E)

a. Broad-Tailed Hummingbird –

- In Colorado Rockies for Summer and fly to wintering grounds in central Mexico and further

b. Monarch Butterflies– fly to Central Mexico fir forests

- a long and arduous trip

Observation – picture

c. Canada Geese -

- Some fly from Arctic Circle and winter here. Some summer here and winter further south and some stay here all year long.
- Counter Current – veins and arteries in legs are very close to help warm up cold blood and cool down the warm blood. Use the vein/artery prop in the winter ecology box.

Observation – picture of geese migrating

Activity – migration hop scotch (talk about struggles)

More Examples

b. Bald Eagles – For some, Colorado is their southern range – come here to eat Prairie dogs

Amazing examples: (Adv)

a. Swainson's Hawk - Nests in Colorado's Eastern Plains and Front Range grasslands in summer and travel more than 6,000 miles to the pampas grasslands of Argentina (their winter range)

b. Arctic Tern – The champion migratory of all animals travels 10,000 miles from the North Pole to the South Pole each fall, then back again for the breeding season.

Vertical

- Vertical (stepping down) from treeline to lower elevations. Traveling down 5,000 ft down in elevation is like migrating 1,500 miles to Central Mexico
- Deer, elk, moose, bighorns (migrate down in that order)
- Timing is crucial so that they do not have to walk through snow depth (adv)

2. Hibernation/Torpor

- Explain debate between hibernation and torpor
- Hibernation = Lights out. A state of deep torpor. Animal stops eating and drinking, its heart plummets to a few beats a minute, blood flow becomes a trickle and activity ceases.
- Torpor = lighter sleep. Both short and long winter and summer periods of inactivity when an animal's metabolic rate declines dramatically.

a. Black Bear

- Fall behavior (need to eat), wait till snow storm to go in den (trees, rocks, caves)
- Do they go to the bathroom? No urinating/defecating until spring Fecal Plug
- have perfected hibernation (99% success rate)
- Body temp falls 6-7 degrees below normal body temp (100 – 88)
- Delayed implantation (Nov) and then birth in the den in January

b. Golden Mantled Ground Squirrel

- Temp drops from 98 to 34 degrees and its heart shows a deep reduction

- Heart beat goes from 4 beats per second to 1 beat per 6 seconds (have kids clap out)
 - cache nuts to eat on days when they are awakened every few days to weeks
 - Hibernate in underground burrows with chambers for nurseries
- GAME – Clapping hands to mimic heart beat from summer to winter

c. Lady bird beetle

- Aggregate in large numbers on Green Mountain
- Not sure if it is to follow a food source (aphids), following pheromones, sunlight on Mountain tops, or an advantage for next season's mating season? Still a mystery.
- Wintering in large aggregation may make it easier to mate in the spring.

3. Change body (temp or perm)

- Long tail weasel (white out)
 - Molt to white color (keep black tip on tail)
 - Stay above snow and keep a frenetic level of activity throughout the winter.
 - They must consume 40% of their weight daily to keep their metabolic fires burning.
 - Can kill prey twice their size - hunt by smell
- Snow Shoe Hare
 - Changes color from brown to white
- Ptarmigan
 - Molts feathers to blend in with snow
- Lynx
 - Permanently have large feet to walk well on the snow

4. Remain Active/Tolerate

- Mule Deer
 - Foot loading – The amt. of wt. on a given area of the foot
low foot loading = great travel ease
 - eat whenever they can and save in the chambers of their stomach (tupperware!)
 - Drop their antlers to conserve E
 - Follow the same path in the snow (tailing)
 - Bed during the day, eat at night
 - Yarding

Activity – Follow the leader in snow – to see which is more difficult, walking alone in snow, or following the leader.

Prop – Bring antlers for kids to feel how heavy

b. Chickadees

- fluff up their feathers, sometimes grow a more dense cover of feathers
- Shivering by using brown fat
- Huddling together in groups (saves overall E)
- Hide in tree cavities

Activity - play the huddle game – just have the students huddle in a circle for a few seconds to stay warm

Activity – Make an animal in cross section: Have the students make a circle, the students in the center become the core and they say core area (“stay warm!”), the next ring of students represent the fat and they say (“energy!”), and the students in the outer part of the circle represent the fur, and they say (“insulation!”)!

5. Die (some bees and insects)
 - Some die of winter severity 31-90% of population (starvation, malnutrition, disease, and predation)
 - Some adults die and survive in larva stage

V. Wrap-up –

Activity: Place out the winter props: white out, plane ticket, antifreeze, etc and have each student stand next to the one that they represent.

How can we help wintering plants, animals and insects survive the winter?

- A. don't disturb or chase them because it requires energy
- B. don't investigate holes
- C. don't feed them (especially bears and trash)
- D. keep dogs on leash
- E. Don't pick flowers/take anything for OSMP because it is a home or food source
- F. Buy in Boulder