Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.

Enduring understanding 2.C:
Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis.

Essential knowledge 2.C.2: Organisms respond to changes in their external environments.

a. Organisms respond to changes in their environment through behavioral and physiological mechanisms.

To foster student understanding of this concept, instructors can choose an illustrative example such as:

-Photoperiodism and phototropism in plants

-Hibernation and migration in animals

-Taxis and kinesis in animals

-Chemotaxis in bacteria, sexual reproduction in fungi

-Nocturnal and diurnal activity: circadian rhythms

-Shivering and sweating in humans

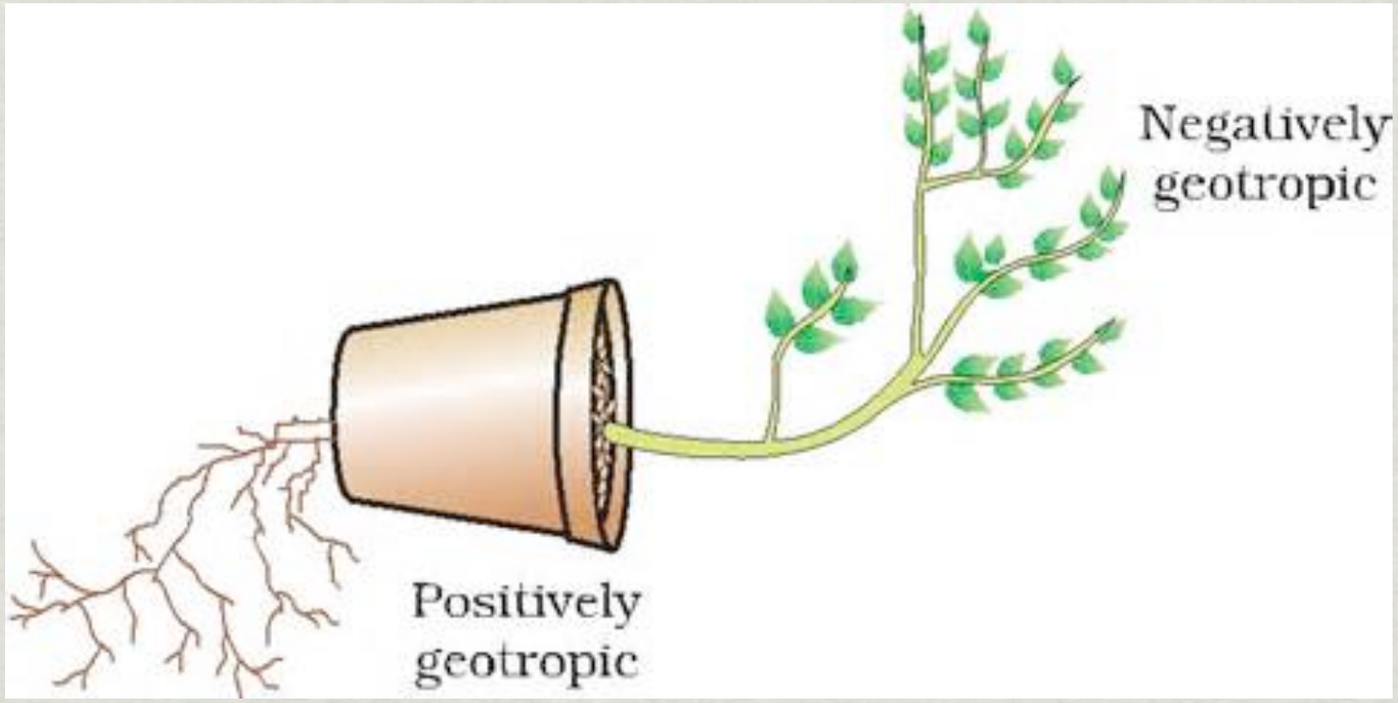
✘ No specific behavioral or physiological mechanism is required for teaching the above concept. Teachers are free to choose the mechanism that best fosters student understanding.

RESPONDING TO THE ENVIRONMENT

- Responses at the intracellular level involve proteins.
  - Responses at this level, usually comes down to some change in protein activity or synthesis.
- **Responses at the organismal level involves taxes and tropisms.**
  - **Mobile organisms move towards or away from stimuli.**
  - **Stationary organisms change their pattern of growth or development in response to stimuli**

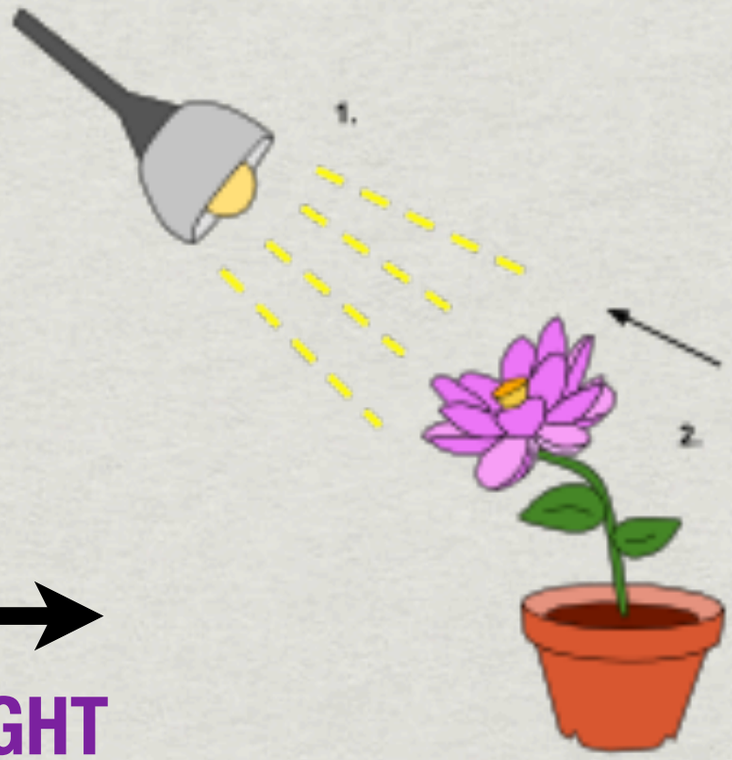
Responses at the organismal level involve taxes and tropisms

- **Tropisms:** growth of an organism (usually a plant) in response to a stimulus, positive tropisms show growth toward stimulus while negative tropisms are away from the stimulus.



RESPONDING TO GRAVITY

GRAVITROPISM



PHOTOTROPISM

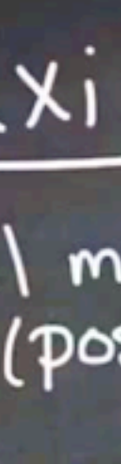
RESPONDING TO LIGHT

Responses at the organismal level involve taxes and tropisms

- **Taxis:** is an innate behavioral response by an organism with motility towards or away from a stimulus, positive taxes move toward stimulus while negative taxes are away from the stimulus..

Taxis vs. Kinesis

- directional movement towards (positive) or away from (negative) a stimulus
  - chemical
  - light
  - food
  - magnetic
  - etc.



- random movement in response to a stimulus
  - non directional

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Photoperiodism

- The term "photoperiodism" was coined to describe a plant's ability to flower in response to changes in the photoperiod: the relative lengths of day and night. Because flowers produce seeds, flowering is crucially important for the plant to complete its life cycle.

KEY BIOLOGICAL PROCESS: Photoperiodism

1

Early summer. Short periods of darkness induce flowering in long-day plants, such as iris, but not in short-day plants, such as goldenrod.

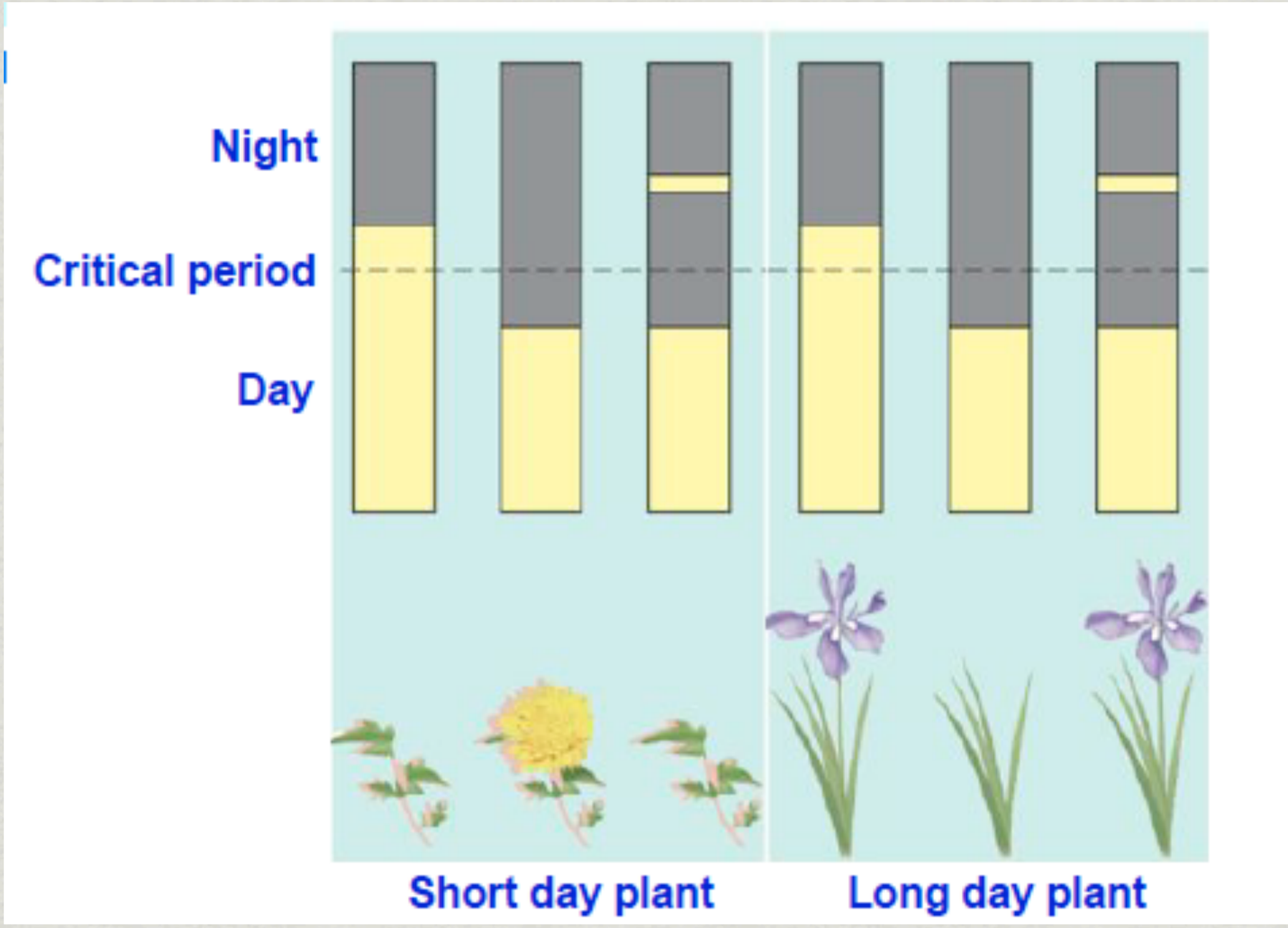
2

Late fall. Long periods of darkness induce flowering in short-day plants, such as goldenrod, but not in long-day plants, such as iris.

3

Interrupted night. If the long night of winter is artificially interrupted by a flash of light, the goldenrod will not bloom and the iris will.

Another Viewpoint



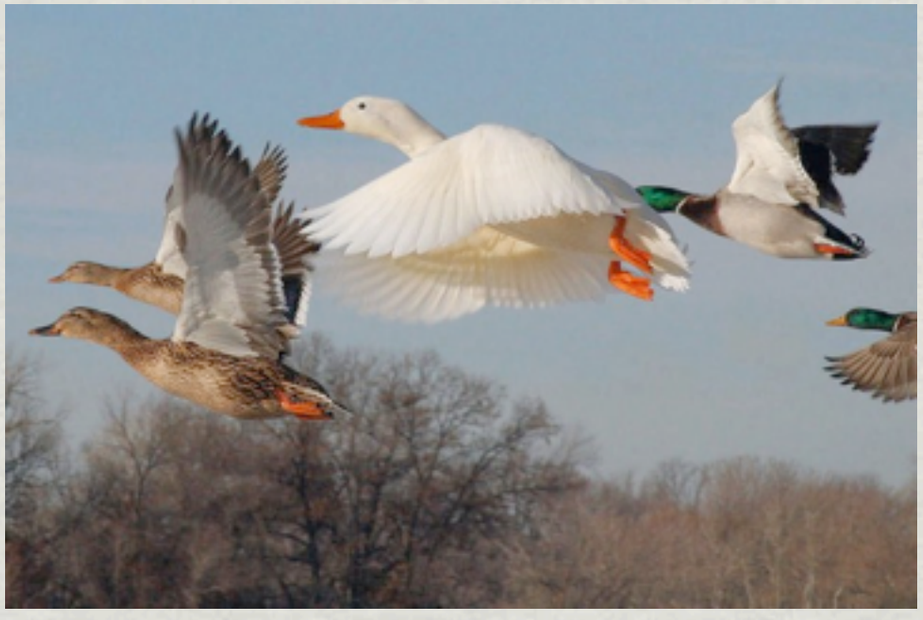
Migration

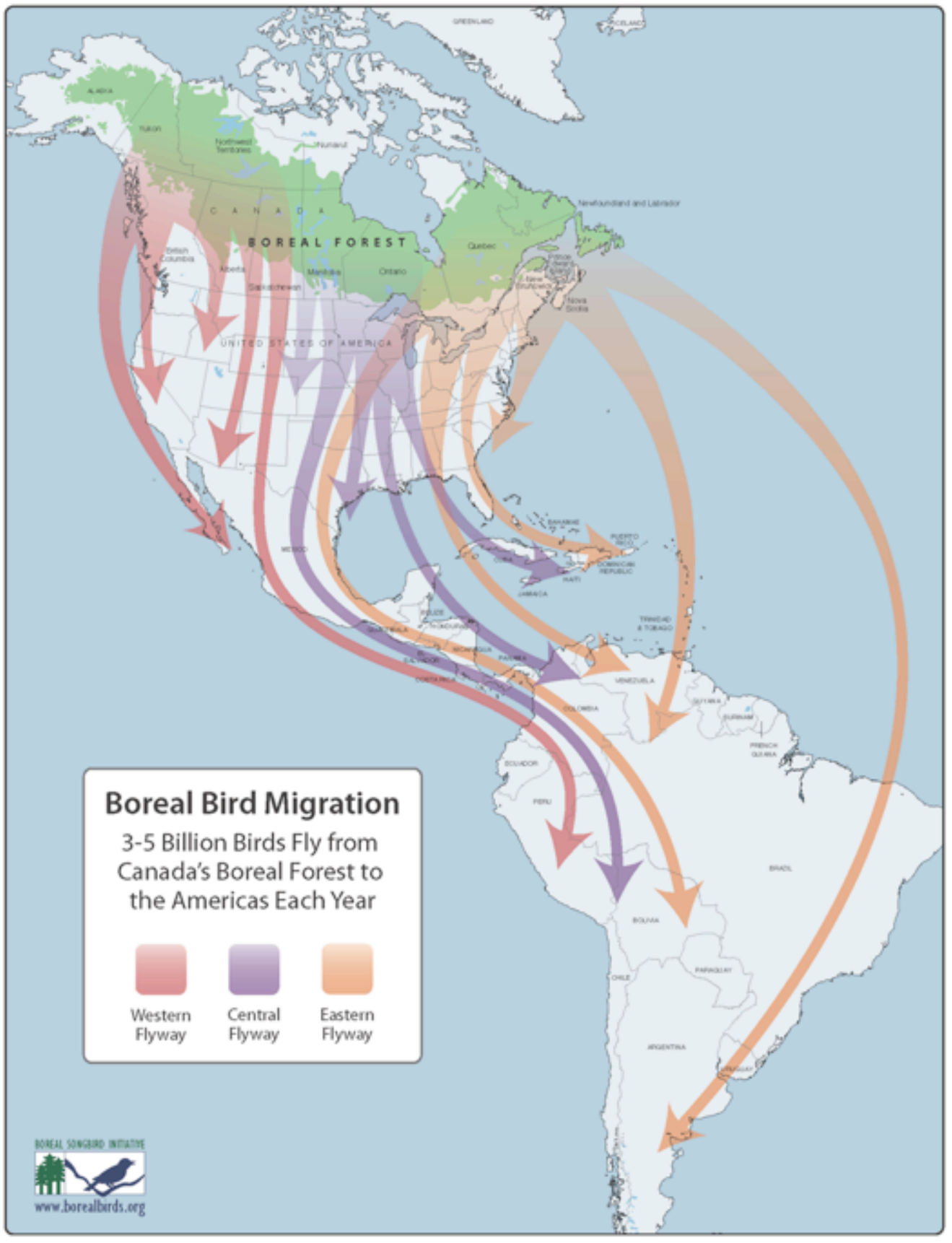
- The timing of migration seems to be controlled primarily by changes in day length. Migrating birds navigate using celestial cues from the sun and stars, the earth's magnetic field, and probably also mental maps.

- Migration is the regular seasonal movement, often north and south, undertaken by many species of birds. Bird movements include those made in response to changes in food availability, habitat, or weather.

- Large scale climate changes, as have been experienced in the past, are expected to have an effect on the timing of migration. Studies have shown a variety of effects including timing changes in migration, breeding as well as population variations.

Migration




GREENLAND
ICELAND
ALASKA
Yukon
Northwest Territories
Nunavut
CANADA
BOREAL FOREST
British Columbia
Alberta
Saskatchewan
Manitoba
Ontario
Quebec
Newfoundland and Labrador
Nova Scotia
UNITED STATES OF AMERICA
MEXICO
BAHAMAS
PUERTO RICO
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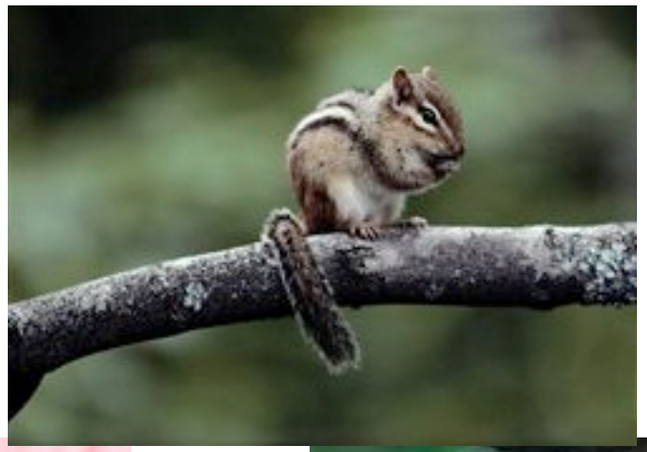
Hibernation

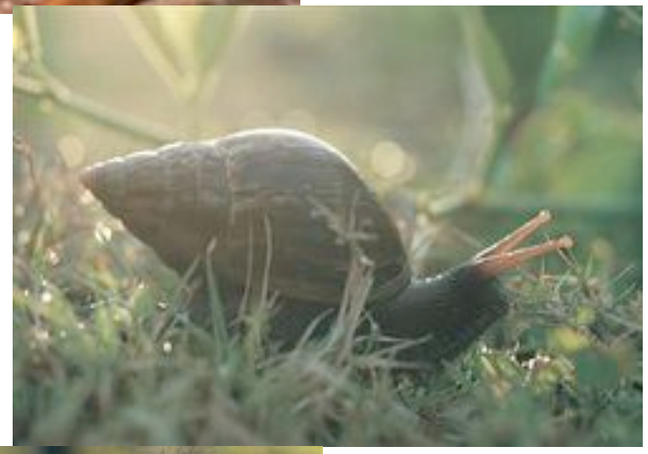
- Hibernation is a state of inactivity and metabolic depression in endotherms.

- Hibernation refers to a season of heterothermy that is characterized by low body temperature, slow breathing and heart rate, and low metabolic rate.

- Hibernation during the summer months is known as aestivation.

Hibernation





Remember This?

Hibernation & Respiration Efficiency

- There are times when respiration inefficiency is actually favored...during hibernation!

Hibernation & Respiration Efficiency

- A hibernating animal needs to generate heat, without making ATP, throughout the winter
- If hibernating animals continued to use simple cell respiration, it would eventually shut down.
  - ATP would build up in the cells because animal is inactive, as ATP builds a feedback loop would shut down respiration thus stopping ATP production AND HEAT PRODUCTION
- Hibernating animals have brown fat, a cell with many mitochondria that have a unique structure that allows them to carry out respiration without making ATP!

Learning Objectives:

LO 2.21 The student is able to justify the selection of the kind of data needed to answer scientific questions about the relevant mechanism that organisms use to respond to changes in their external environment. [See SP 4.1]

LO 2.42 The student is able to pose a scientific question concerning the behavioral or physiological response of an organism to a change in its environment. [See SP 3.1]