Hibernation

Answers: chipmunks, squirrels, raccoons, skunks, fox

- **Hibernation is a state of inactivity, in which an animal's heart rate, body temperature, and breathing rate are decreased in order to conserve energy through the cold months of winter. A similar state, known as estivation, occurs in some desert animals during the dry months of summer.**

- **Hibernation is a technique that animals have developed in order to adapt to harsh climates.**
- **When food is scarce, an animal may use up more energy maintaining its body temperature and in searching for food than it would receive from consuming the food.**
- **Hibernating animals use 70 to 100 times less energy than when active, allowing them to survive until food is once again plentiful.**

- **Many animals sleep more often when food is scarce, but only a few truly hibernate.**
- **Hibernation differs from sleep in that a hibernating animal shows a drastic reduction in metabolism, and then awakes relatively slowly. (Metabolism is the process by which cells in an organism break down compounds to produce energy.)**
- **By contrast, a sleeping animal decreases its metabolism only slightly, and can wake up almost instantly if disturbed.**
- **Also, hibernating animals do not show periods of rapid eye movement (REM), the stage of sleep associated with dreaming in humans.**

Hibernation

- **Winter sleep or winter dormancy**

- **May be shallow or deep.**
-
- **In Hibernation there is extreme drop in body temperature ,the physiological processes become extremely slow, hence energy is saved.**

- **Who shows hibernation ?**

-- Monotremes,rodents,bats, mainly mammals.

- **Hibernation occurs in form of annual cycle and is governed by hormones.**
- **In this the thermo regulator is set to low temp.($2^{o}c$),Heat conservation mechanism is turned off ,animal enters in to deep sleep.**

Preparation for hibernation

- Many physiological changes occur as preparation
- Fat accumulates during favourable season. The fat has low melting point.
- Some animals store food in their nest. e. g.Hamster.

Animals prepare for hibernation in the fall by storing enough food to last them until spring. Birch mouse accomplish this task by filling their burrows with food, which they consume during periodic arousals from hibernation throughout the winter.

- **Most animals, however, store energy internally, as fat. A woodchuck in early summer may have only about 5 percent body fat. However, as fall approaches, changes occur in the animal's brain chemistry that cause it to feel hungry and to eat constantly. As a result, the woodchuck's body fat increases to about 15 percent of its total weight.**

- **In other animals, such as the dormouse, fat may comprise as much as 50 percent of the animal's weight by the time hibernation begins.**

- **A short period of fasting usually follows the feeding frenzy, to ensure that the digestive tract is completely emptied before hibernation begins.**

– Endocrine changes occur.

a) Hedge hog shows increase in insulin and thyroxin.

b) Pituitary has imp. role -pituitarin injection causes hibernation in Hamster.

c) Adrenal also is imp. – adrenalectomy leads to failure of hibernation in Hamster. (But in hibernating Hamster adrenal activity is low.) Also if NA is injected there is no thermogenic response.

d) Thus endocrine factors are important but their mechanism is complex.

- **T_b of hibernating animals drops down slowly usually at a rate 2-4 ^{o}c per hour.**
- **Vasodilatation occurs and the muscle tone reduces.**

During hibernation

- **Tb falls down**
- **Heart rate reduces significantly**
- **In ground squirrel it is 200-400 / min whereas in hibernating ground squirrel it is 7-10 beats / min.**
- **Beats become irregular. Heart remains functional at low temp. & it is not sensitive to vagus inhibition.**
- **Respiratory rate of animal drops. There is a drop in cardiac output. In ground squirrel it reduce to 1/65 as compared to normal**.

- **In some species the blood is collected in spleen which rises in size so also erythrocyte count & haemoglobin level rises & clotting time is prolonged.**
- **Nervous system remains active even at 9^0C the brain shows response to peripheral stimuli.**
- **Magnesium content of serum becomes high in hibernating hedgehog**

- **During hibernation the overall metabolic rate is 20-1000 times slower. Inspite of this there is a weight loss in the animal which can be from 10-30%.**
- **The hibernating animals show resistance to adverse condition (other than temp.)**
- **Ex. When hibernating ground squirrel is exposed to ionising radiations there are no ill effect seen during hibernation. However when they arouse the in effects are apparent.**

- **Hibernating animals have a unique ability to prevent drop in the temp. which can be serious. If the body temp. becomes very low the animal shows arousal, they feed & again hibernate. In some animals for this purpose there is cyclical arousing. Ground squirrel wakes up after every 11 days where as hamsters also wake up every few days, feed & hibernate**.

Control of Hibernation

- **Hypothalamus plays an important role in hibernation.**
- **Posterior hypothalamus is important for hibernation & anterior is important for arousal.**
- **In a hibernating ground squirrel if posterior hypothalamus is damaged, it fails to hibernate & if anterior hypothalamus is damaged it fails to arouse.**

Arousal or Waking up :

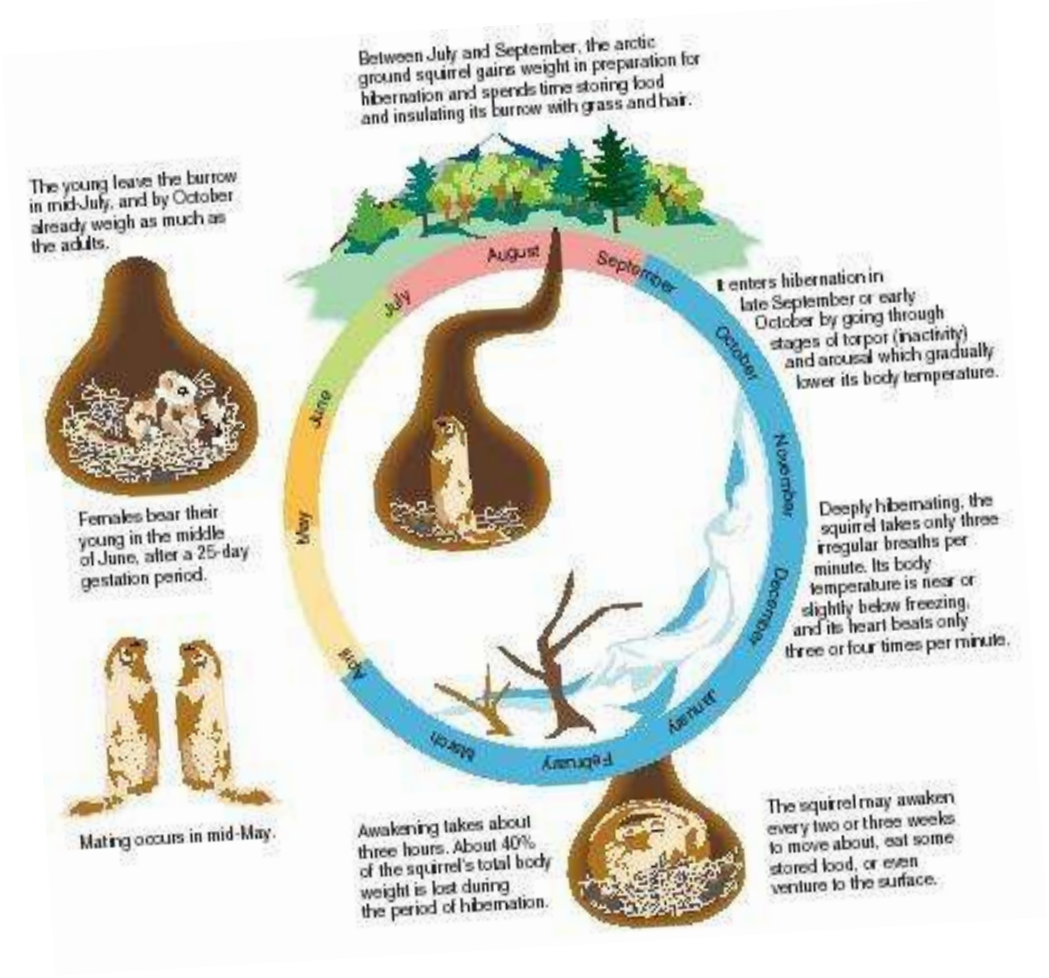
- **Waking up is very fast in the animal.**
- **A bat is kept for 144 days in refrigerator become active when taken out.**
- **In ground squirrel the temp. rises from 4^0C – 35^0C in 4 hrs.**
- **In Birch mouse the temp. rises from 1^0C /min. In this arousal process the animals are helped by specialized tissue known as brown adipose tissue. It produces heat like a furnace in very high amount.**

Arousal or Waking up

- **Usually the stimulus for arousal is changed season & warming of ta. All the are stimulator or super cooling also acts as stimulator for arousal.**
- **When the stimuli reach, a series of process takes place.**
- **Due to stimuli peripheral blood vessels contract (vasoconstriction).**
- **So blood flow towards thoracic muscle causing warming.**

- **So also autonomous stimuli are send to BAT (Brown Adipose Tissue) & it is activated by nor-epinephrine.**
- **Due to which oxidation of triglycerides or unsaturated fats starts to release large amount of heat .**
- **Heart rate become faster then respiratory rate rises leading to arousal.**

Hibernation
Arctic ground squirrel



Hibernation

- Bear

Some scientific purists say bears don't hibernate, because their body temperature doesn't fall below 20 degrees Celsius. But it does enter a state of extremely slow metabolism and heart rate during the winter.

Ground squirrel

The 13-lined ground squirrel is a hibernator that lives across much of North America. This critter forms a spherical shape to minimize heat loss.

- Echidna emerging from hibernation

Hibernation

- Black bear hiber?'
- nating in a den

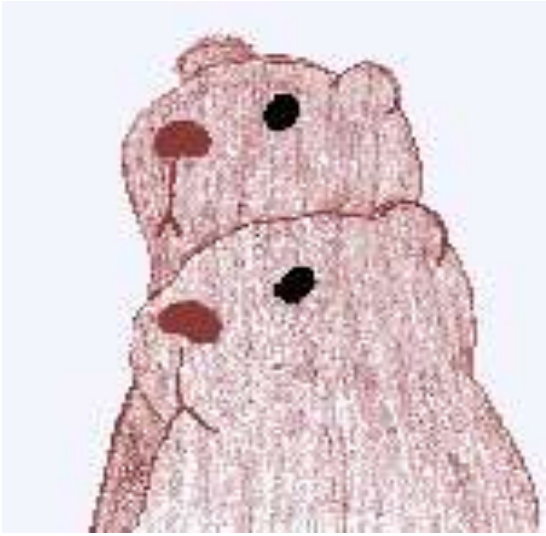
- 'Hello, reception, can I have a wake-up call in spring please

"Hello, reception, can I have a wake-up call in spring please?"

'Before you go toodling off with the boys, you're going to help me with the spring cleaning!'

Ground hogs- Woodchuck

- When groundhogs begin hiberation, they are a little more plump than usual. There is 1 to 2 cm of fat underneath the skin and body of a groundhog when they are ready to hibernate. The groundhog lives on that fat during a hibernation which it gained the previous fall. It uses up between 1/3 to 1/2 of that fat.
- Of course groundhogs need a place to sleep, so like their cousins, the prairie dogs, groundhogs live in underground dens or burrows.



- **Groundhogs sometimes have two dens. One for the winter and one for the summer. The summer dens are dug in open fields or clearings. The winter dens are dug in the middle of the woods where it is more protected. The groundhog digs its den in well-drained soil so it will stay dry. Every groundhog begins by digging a tunnel for their den. Then they go on to making a room for hiberation and sometimes a toilet room.**
- **Groundhogs begin to hibernate about the middle of September in northern areas. In the southern areas of their range in the United States, they may begin hibernation in late October.**