

# BIOLOGICAL CLOCK & LIEBIG'S LAW OF MINIMUM

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# Biological Rhythms or Biorhythms

- A behavior that occur in organisms after specific interval of time is called Biological Rhythms. E.g.
  - ✓ Birds sings in the early morning.
  - ✓ Bats fly at night rather than during the day.
  - ✓ Most humans sleep at night and are active in the daytime.
  - ✓ Breeding, hibernation, and migration occur on a yearly cycle.
  - ✓ Stomata open and close just about every 24 hours.

# Biological Rhythms

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graph TD; A[Biological Rhythms] --- B[Circadian Rhythms]; A --- C[Circannual Rhythms]
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## Circadian Rhythms

Rhythms with a period of about 24 hours are called circadian rhythms or diurnal rhythms

Such as sleep movement of Bean leaves, opening and closing of stomata and circadian migration of organisms to top of sea at night

## Circannual Rhythms

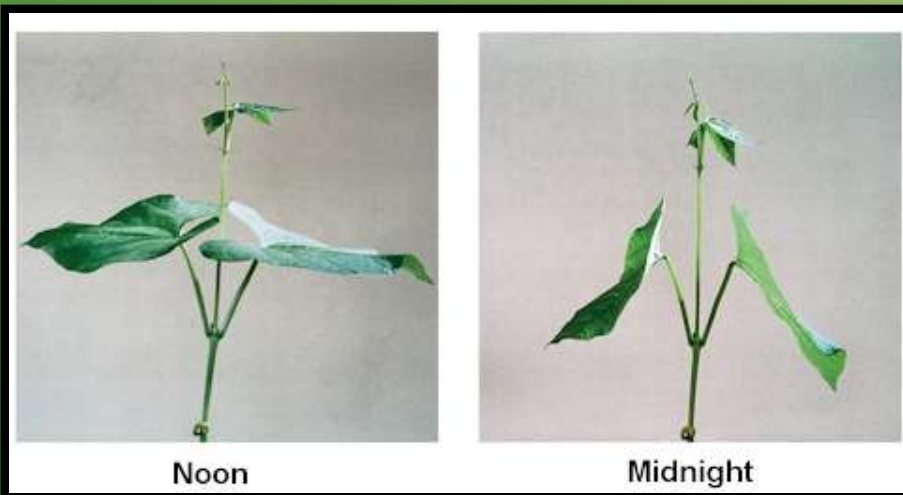
A circannual cycle is a biological process that occurs in living creatures over the period of approximately one year.

Such as breeding, hibernation, and migration in animals occur on a yearly cycle.



During winter Monarch butterflies in thousands start migrating from US and Canada to Mexico covering distance of nearly three thousand miles. This is a repeated process. This is an example of circannual rhythm.

Migration of birds is a seasonal movement which is also an example of circannual rhythm.



Sleep movement of bean leaf is an example of circadian rhythm. This repeats every 24 hours.

# Why Biological Rhythms??

- The organisms come across environmental changes that are cyclical in nature such as days, tides, seasons etc.
- Many organisms maintain internal rhythm or clock to predict the onset of periodic changes and keep them predict the onset of periodic changes and keep them prepared for these changes



A rhythm has developed in oysters. Oysters open their shells for feeding when the tide is in and close them when the tide is out to protect themselves from predators.

# How are Biological Rhythms Controlled??



There may be an internal (endogenous) rhythm that progresses the organism's behavior.

This is free running behavior.

Driven by a Biological clock

For example: sleeping and awakening is controlled from hypothalamus

**Biological clock** is an innate mechanism that controls the physiological activities of an organism which change on a daily, seasonal, yearly, or other regular cycle.

There may be direct response to various changes in the external (exogenous) stimuli.

For example: Bird's migration



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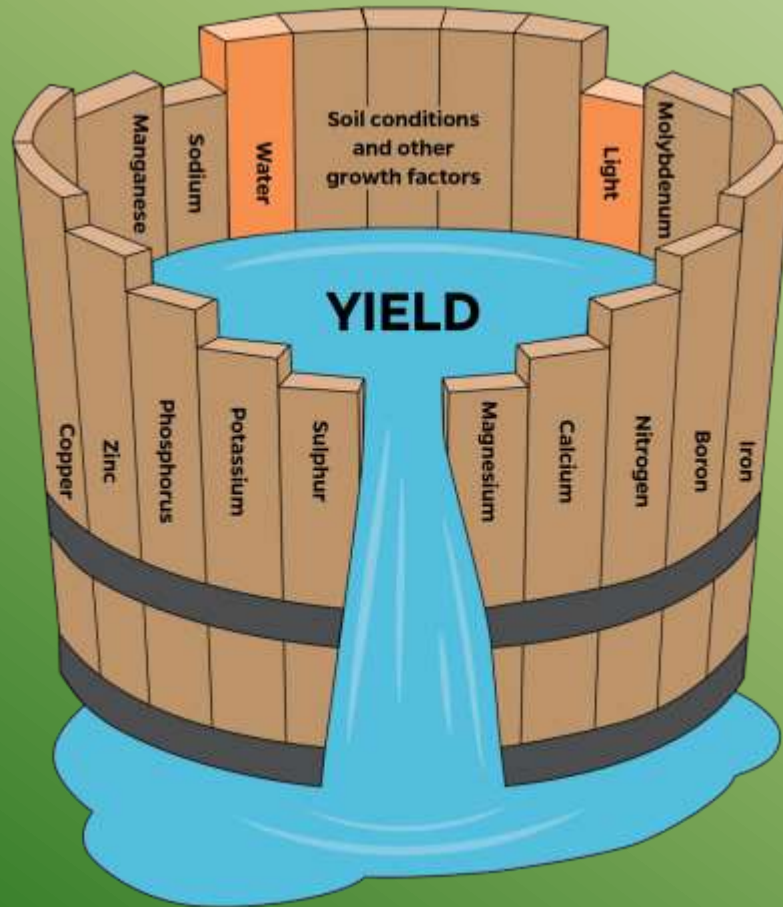
- The rhythms are in one's genes but the environment influences the rhythms to some extent.
- Timing of behavior results from a combination of effects of rhythmical internal processes and timed events of the environment.
- Basic period of clock is innate. Ervin Bunning of University of Tübingen, Germany has shown that exposure of fruit fly *Drosophila* to constant condition for 15 consecutive generation fails to eliminate the essentially 24 hours rhythm of this insect. Circadian rhythm is proved in this case.

# Liebig's Law of Minimum

- In the 19th century, the German scientist Justus von Liebig formulated the “Law of the Minimum,” which states that yield is proportional to the amount of the most limiting nutrient, whichever nutrient it may be. From this, it may be inferred that if the deficient nutrient is supplied, yields may be improved to the point that some other nutrient is needed in greater quantity than the soil can provide, and the Law of the Minimum would apply in turn to that nutrient.




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Liebig's Barrel: Liebig used the image of a barrel with unequal planks to explain how plant growth is limited by the element in shortest supply, just as the level of water in the barrel is limited by the shortest plank.

The planks represents the nutrients. The shortest plank determines how much the barren can hold. It doesn't matter how high the other planks reach. In he same way one nutrient at a time will limit growth.



Thank you