BIORHYTHMS

Biology is RHYTHMICAL!!

- frogs singing at night
- spiders building webs a.m. & destroying them p.m.
- beating of our hearts
Being “REGULAR”
Some Terminology:

**CYCLE** - repeating unit of activity that constitutes the rhythm.

**PERIOD** - time required to complete a cycle.

**PHASE** - any recognizable portion of a cycle that can be named and has significance.

**AMPLITUDE** - magnitude of observed changes during cycles.
Activity (bites/hour)

Rhythm Properties

EXAMPLE: Eating Rhythm
Annual Rhythm of Testis Size

Cycle
Period
Phase
Amplitude

Red crossbill

[Graph showing monthly testis length fluctuations from February to October]

Testis length (mm)

Month

## Common Bio-Rhythms

<table>
<thead>
<tr>
<th>RHYTHM</th>
<th>PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tidal</td>
<td>12.4 h</td>
</tr>
<tr>
<td>Circadian</td>
<td>~ 24 h</td>
</tr>
<tr>
<td>Lunar</td>
<td>28 d</td>
</tr>
<tr>
<td>Circannual</td>
<td>~ 12 months</td>
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</tbody>
</table>
Nature’s most amazing biorhythm?

Hints: * animal is an insect

* period is a large prime number!!
Whole generations buried for 13 or 17 years… only to emerge simultaneously.

Emerge from soil, climb onto tree & transform to adult

Eat/mate/die w/in 6 weeks!!

Eggs laid in trees ... hatched nymphs enter soil & feed on tree roots for 13 or 17 yrs
Cicada-Bob .... Tasty and nutritious!!
Vocabulary: **zeitgeber** & **entrainment**

Environmental cues that animals use to be rhythmic are called **ZEITGEBERS** ("time givers").

When a rhythm somehow get matched to environmental cycles: **ENTRAINMENT**

**2 most important zeitgebers??**

**LIGHT & TEMPERATURE**
CIRCADIAN RHYTHMS

“Diurnal” Animals
  day-active
  night inactive

“Nocturnal” Animals
  day-inactive
  night-active
DAYS

Bright & warm  Great Zeitgeber

Obvious

Reliable
NIGHTS

Dark & cool
Obvious
Reliable

Great Zeitgeber
Factors in being a Diurnal vs Nocturnal Animal

Sensory ability

Temperature requirements

Safety
Meet the **naked mole rat** (Africa):

Lives in underground tunnels
Colony of NMRs

Are they rhythmic??
CIRCANNUAL RHYTHMS --- rhythms of about a year.

Long-living animals may divide year into …

- active & inactive phases
- breeding & nonbreeding phases
- feeding & nonfeeding phases

Zeitgebers?
EXAMPLE: Small mammals in Pennsylvania

- high SA:VOL → high heat loss
- high metabolic rate
- winter: cold & food scarcity

Solution? Hibernate

EXAMPLE: American robin

- same problems

Solution? Migrate
TIDAL RHYTHMS -- about a 12 hr period.

Fiddler crabs feed on tidal flats during low tide & stay in burrow during high tide.

Zeitgeber?
QUESTIONS:

Do animals simply “read” zeitgebers??

Or ... do they reside **within** the animal??

Vocabulary:

**Endogenous rhythm**

**Exogenous rhythm**
Rhythms based on “reading” zeitgebers are **EXOGENOUS**.

An exogenous rhythm disappears when environmental cues are eliminated.

Rhythms not requiring environmental cues are **ENDOGENOUS**.

Endogenous rhythms are controlled by a **BIOLOGICAL CLOCK**.

Generalization: Most biorhythms are both endo- and exo-
Endogenous Rhythm in a Hibernator

Golden-mantled ground squirrel: 4 year experiment

From birth: no environmental cues
  abundant food
  constant darkness/temperature
BIOLOGICAL CLOCKS

Endogenous rhythms require a Biological Clock …

What are they? Where are they?

Expected clock location??

BRAIN
Model for Environment/CLOCK interaction

Sunlight or other environmental cues → Sensory receptors → Pacemaker

Clock setting pathway

Clock mechanism

Observed rhythms
- Locomotory patterns
- Feeding behaviors
- Hormone release patterns
- Other rhythms

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