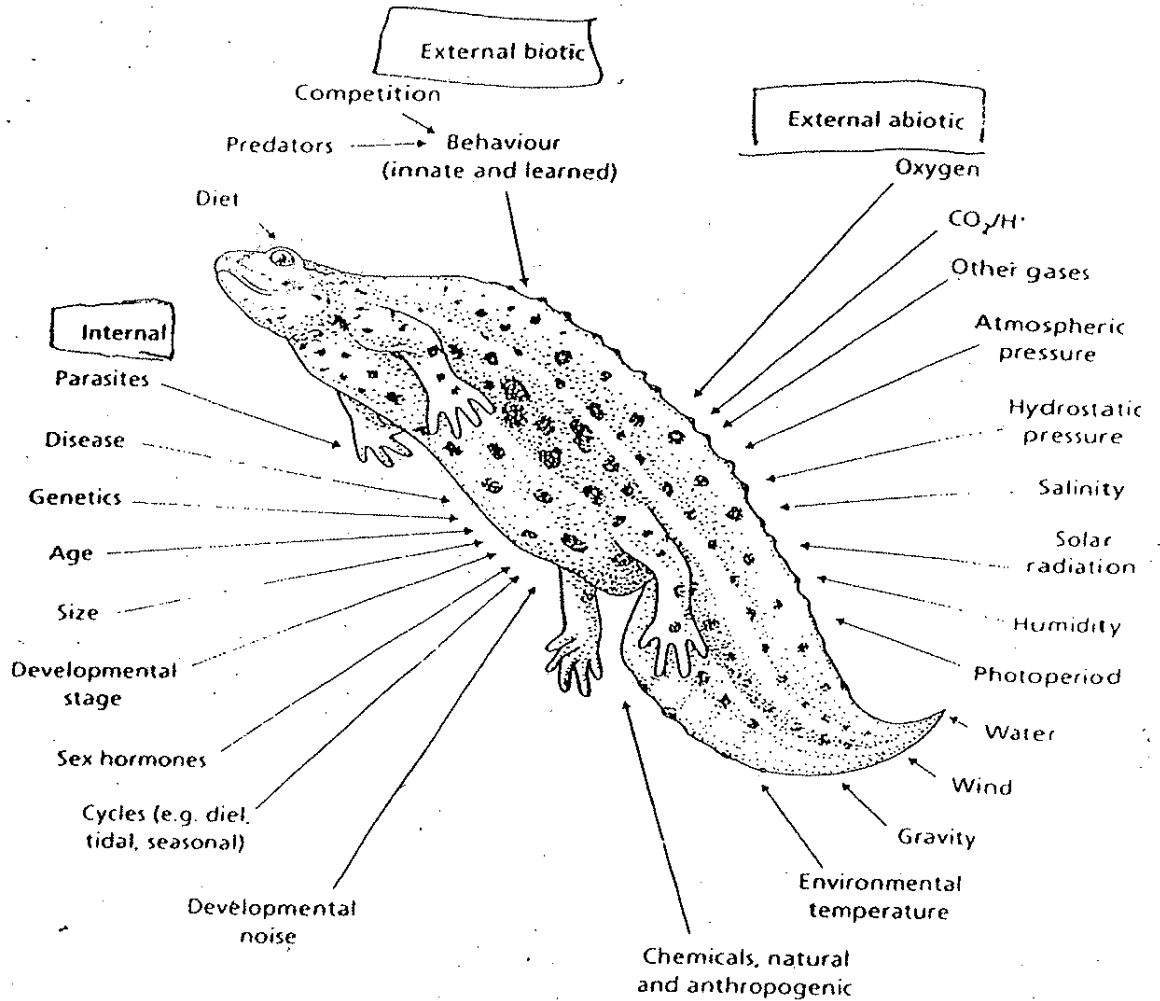# Ideas for animal biology research projects

Fig. 2.29 Summary of the types of factors that could potentially result in within-individual variation in a particular physiological trait. The quantity, quality, duration of exposure and rate of change in each of these with time can influence the extent and nature of the variation as can the method of measurement, capacity for acclimation/acclimatization and the interrelationships between controlling and lethal factors

Research
Ideas

1. physiology

how does temperature affect physiological function
- e.g. temp. acclimation affects many functions
- e.g. heart rate in Daphnia, cockroaches
- e.g. respiratory rate in fish, tadpoles
- e.g. metabolism in any ectotherm
- e.g. call rate in crickets

how does temperature affect development
- e.g. is metamorphosis affected by temp (lotsa different insects; aquatic, terrestrial)
- e.g. hatching in brine shrimp versus temp

pH affects on animals
- e.g. distribution, mortality of invertebrates
- e.g. development of brine shrimp or aquatic insects

light cycle, quality of light
- e.g. do animals prefer certain wavelengths (color) of light
- e.g. does light cycle influence temp. tolerance, development

pollutants
- e.g. oil, cigarette smoke, ethanol, other drugs? on heart rate, mortality

moisture
- e.g. distribution

quality of substrate and distribution

humidity
- e.g. water loss rates of various insects or amphibians under diff. conditions or different parts of life cycle

microhabitat preferences of animals
- e.g. gradients of temp, salinity, moisture, pH, light

taxis in animals (orienting toward or away from environmental variable)
osmoregulation in marine worms

2. scale

how big are cells?

consequences of growth
- e.g. if the mass of an animal doubles what happens to its heart rate, respir rate, metabolism, jump distance

growth in humans - what % is head to leg in various age groups versus other animals like Limulus, ?

Think about your research in terms of a question.
- What is the relationship between... ?
- What is the effect of... ?
- How does the animal respond when... ?

What will you measure?

What might a graph of your data look like?

RESEARCH ANIMALS (not an exhaustive list)

<u>Amphibians</u>
Frogs
Toads
salamanders
Tadpole

<u>Fish</u>
Goldfish
Medaka embryos
Siamese fighting fish

<u>Crustaceans</u>
Crayfish
Daphnia
Various other species

<u>Insects</u>
Fruit flies
Cockroaches
Crickets
Ants

<u>Miscellaneous</u>
Earthworms
Roundworms (*C. elegans*)
Rotifers
Humans
Snails
Marine invertebrates (difficult to obtain and maintain)

<u>Observing animals in the field</u>
Squirrels
Chipmunks
Birds

<u>Variables</u>

H₂O or air

species (*Rana* and *Bufo*)

duration of exertion

temperature

?? cutaneous (skin - covered)

<u>things we can measure</u>

time to acclimate

time to exhaust

time to recover

breathing rate (nares vs flanks) → exhaustion vs rest,
affect ratio?

jump distance

Temperature is one of the major environmental influences on the physiology of animals. The rates at which most enzymatic reactions occur (including oxidative phosphorylation and the Krebs cycle) are profoundly affected by temperature. However, some reactions are more thermally dependent than others. Ectotherms are animals who have few physiological means of regulating body temperature and typically take on the temperature of their environment. The variation in thermal dependence of various reactions of Ectotherms critically affects their lives.

The extent of thermal dependence of a reaction can be calculated using an equation derived from the *Arrhenius equation* (see text pp. 567-569) called the Q_{10} *equation* or *van't Hoff's* Q_{10} *equation*. The Q_{10} describes the relationship between a reaction at one temperature (T_1) and the same reaction at a temperature which differs from the first temperature by 10° ($T_1 + 10°$):

$$Q_{10} = \frac{N_{(T_1 + 10)}}{N_{(T_1)}} \qquad (1)$$

where $N_{(T_1 + 10)}$ is the reaction rate at temperature ($T_1 + 10$) and $N_{(T_1)}$ is the reaction rate at temperature (T_1).

Much to the chagrin of physical chemists, this equation has also been used to gain insight into the extent to which the whole body metabolic rate of ectotherms is dependent on temperature. If the metabolic rate of a frog is 40 μl O_2 h⁻¹ at 15 °C and 80 μl O_2 h⁻¹ at 25 °C, then the Q_{10} for metabolic rate in frogs is 2.0. That is, the metabolic rate doubles with an increase of 10°C. What does a Q_{10} of 1.0 mean? Well, if the rates were the same regardless of the temperature $Q_{10} = 1.0$ and the metabolism is thermally independent. Sometimes the Q_{10} of an animal is one thing over one range of temperatures, and another over another range of temperature. Theses numbers give us insights into the capabilities of ectotherms under varying thermal conditions. Sometimes, we cannot measure metabolism at precise 10° intervals so a more general form of equation 1 is:

$$Q_{10} = \left(\frac{N_2}{N_1} \right)^{10/(T_2 - T_1)} \qquad (2)$$

This equation is much more user friendly in its logarithmic form:

$$\log Q_{10} = \frac{10 (\log N_1 - \log N_2)}{T_1 - T_2} \qquad (3)$$

where N_1 and N_2 are metabolic rates at temperatures T_1 and T_2, respectively. (Yes, you can use natural logs if you prefer).

Cool things to do with amphibians