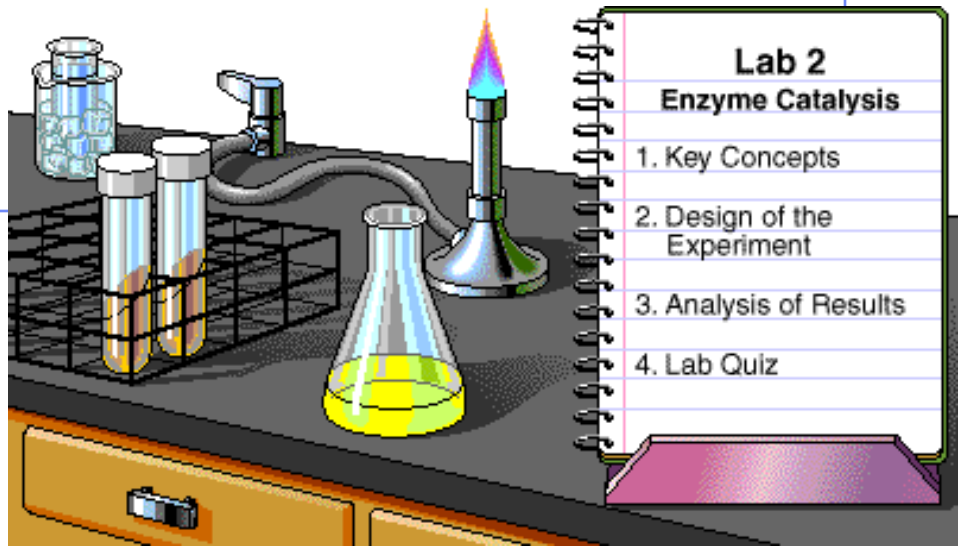
AP Biology

Lab Review



Lab 1: Natural Selection

- **Description**
  - To breed Wisconsin Fast Plants for three generations and carry-out artificial selection for plants with high numbers of trichomes (hairs) on their leaves.

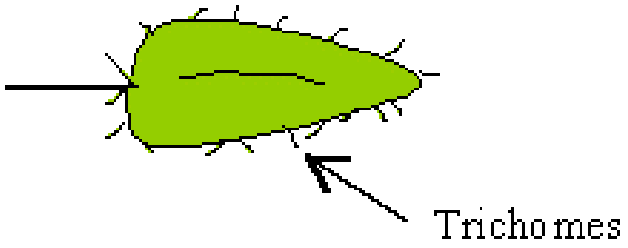
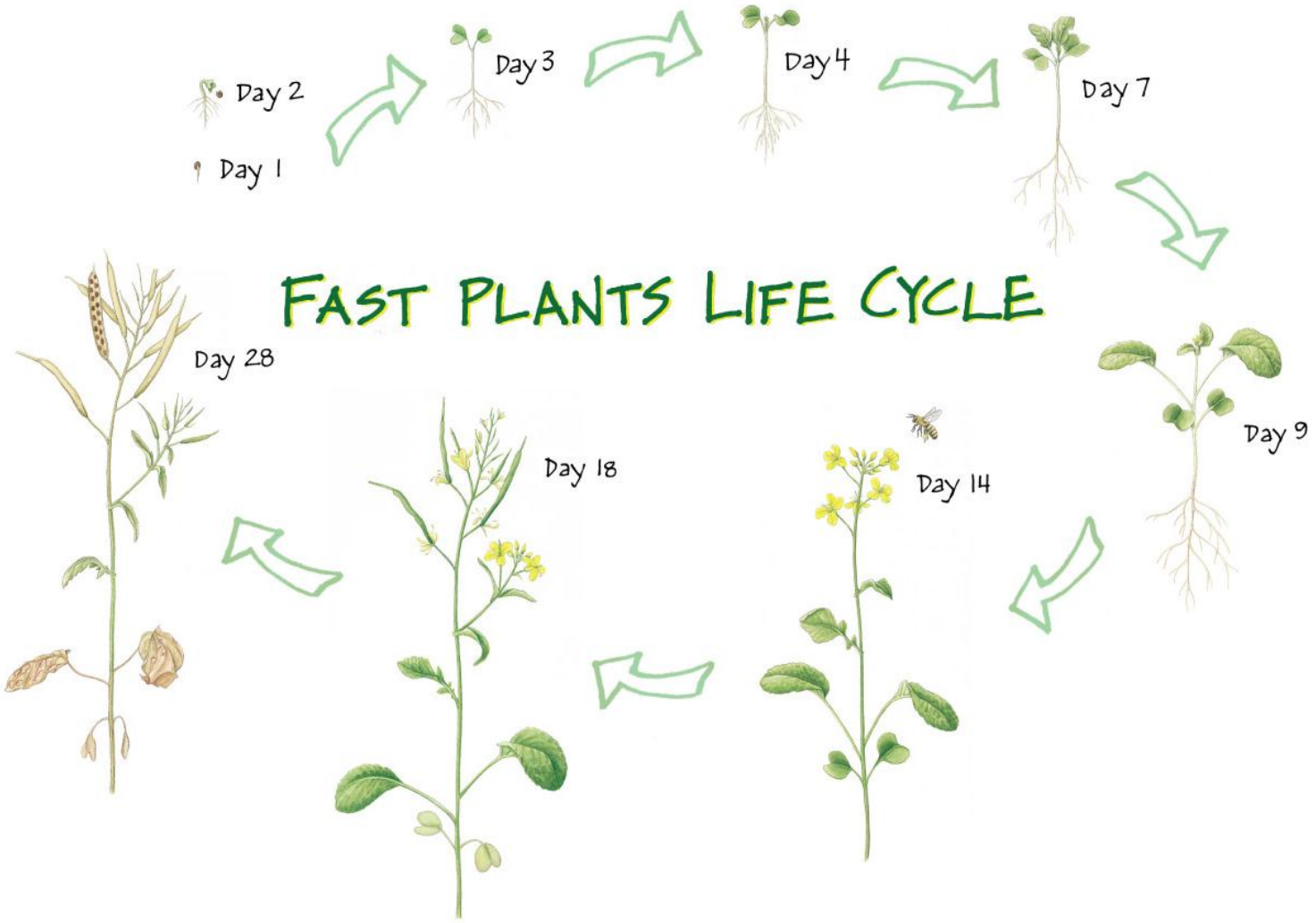


Figure 7. The plants here are 7–12 days old.

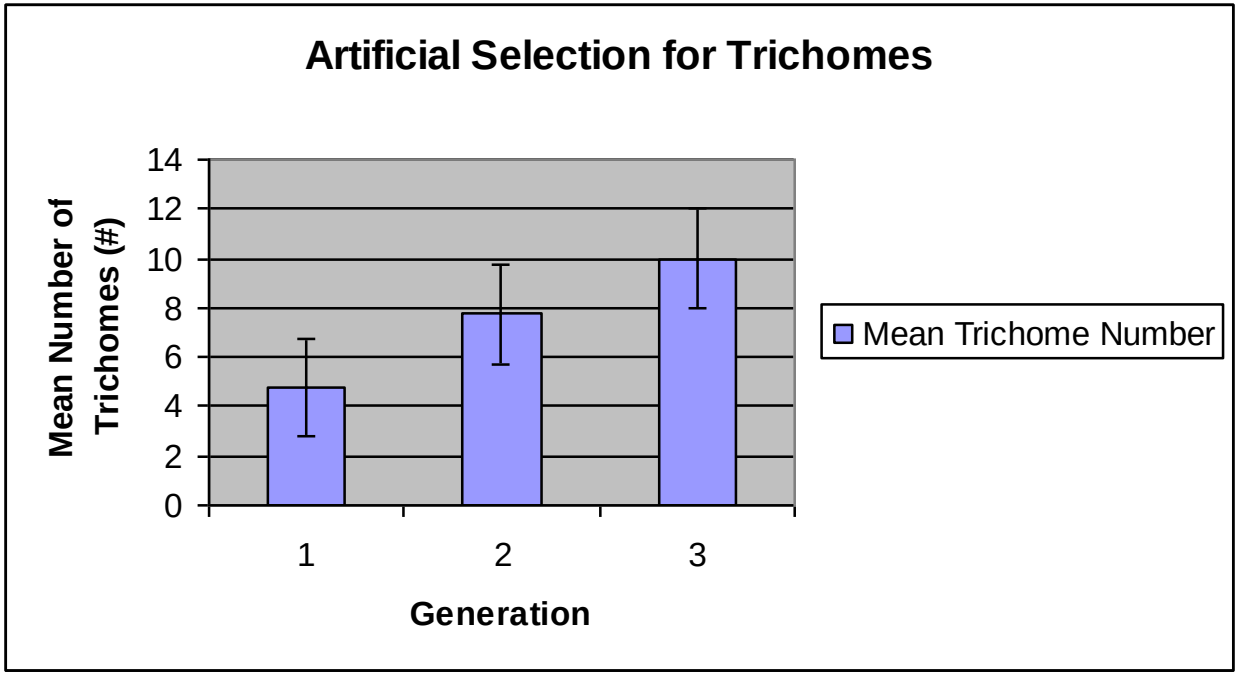
Lab 1: Natural Selection



FAST PLANTS LIFE CYCLE

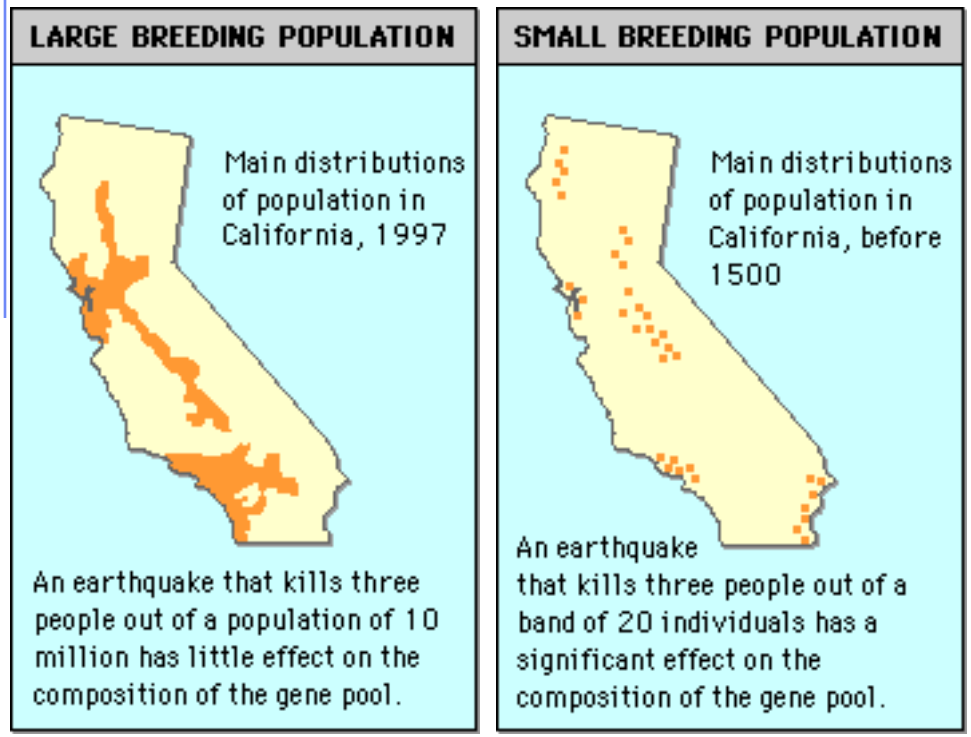
Lab 1: Natural Selection

- **Cross pollinate plants with the highest number of trichomes for three generations.**

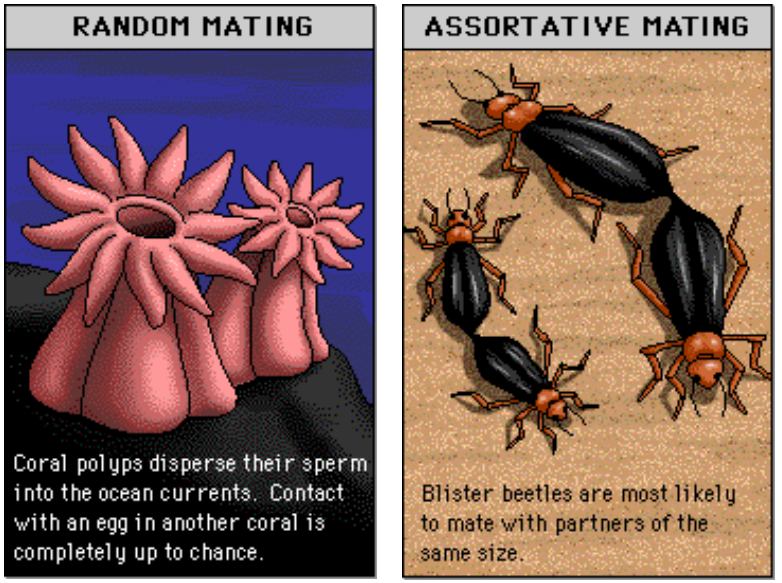


Lab 2: Population Genetics

size of population & gene pool



random vs. non-random mating

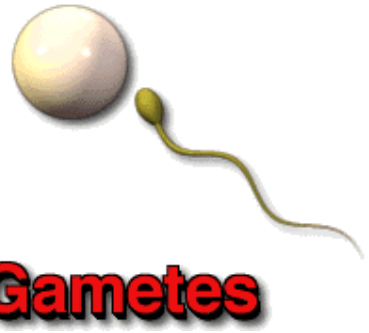


Lab 2: Population Genetics

- **Description**
  - Students created an excel spreadsheet to look at allele frequencies changed over generations.
  - Students then were given different situations (i.e. selection, etc.) and asked to alter their spreadsheet to show how it changed the frequencies.

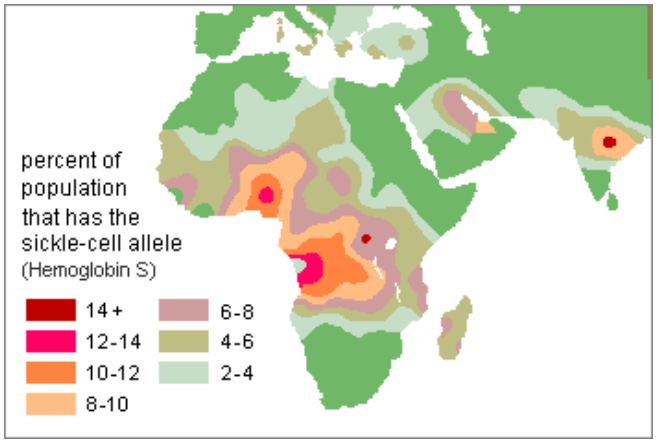
Lab (Not AP): Population Genetics

- **Description**
  - simulations were used to study effects of different parameters on frequency of alleles in a population
    - selection
    - heterozygous advantage
    - genetic drift



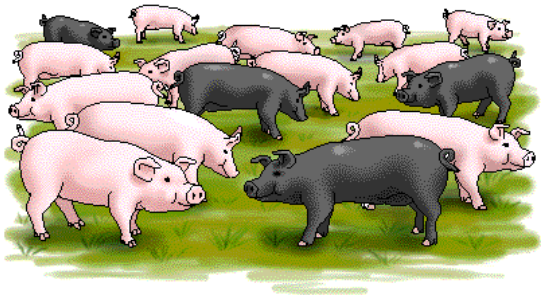
Lab 2: Population Genetics

- **Concepts**
  - **Hardy-Weinberg equilibrium**
    - $p + q = 1$
    - $p^2 + 2pq + q^2 = 1$
    - **required conditions**
      - large population
      - random mating
      - no mutations
      - no natural selection
      - no migration
  - **gene pool**
  - **heterozygous advantage**
  - **genetic drift**
    - founder effect
    - bottleneck



Lab 2: Population Genetics

- **Conclusions**
  - **recessive alleles remain hidden in the pool of heterozygotes**
    - **even lethal recessive alleles are not completely removed from population**
  - **know how to solve H-W problems!**
    - **to calculate allele frequencies, use $p + q = 1$**
    - **to calculate genotype frequencies or how many individuals, use, $p^2 + 2pq + q^2 = 1$**



Lab 2: Population Genetics

- **ESSAY 2008B-3.**
- **Evolution is one of the unifying themes of biology. Evolution involves change in the frequencies of alleles in a population. For a particular genetic locus in a population, the frequency of the recessive allele (*a*) is 0.4 and the frequency of the dominant allele (*A*) is 0.6.**
  - **(a) What is the frequency of each genotype (*AA*, *Aa*, *aa*) in this population? What is the frequency of the dominant phenotype?**
  - **(b) How can the Hardy-Weinberg principle of genetic equilibrium be used to determine whether this population is evolving?**
  - **(c) Identify a particular environmental change and describe how it might alter allelic frequencies in this population. Explain which condition of the Hardy-Weinberg principle would not be met.**

Lab 3: Comparing DNA Using BLAST

- **Description**
  - **Part I: draw a cladogram based on gene and protein similarities among four different species**
  - **Part II: BLAST to compare gene sequences from an "unknown" fossil to extant gene sequences.**
    - **placed that organism on a cladogram with known living organisms.**

Lab 3: Comparing DNA Using BLAST

- **Concepts**
  - **Cladogram**
    - **Used to show evolutionary relationships between organisms**
  - **BLAST**
    - **NCBI**
    - **Compare genetic sequences**

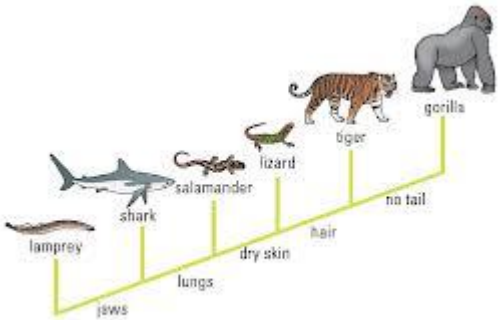
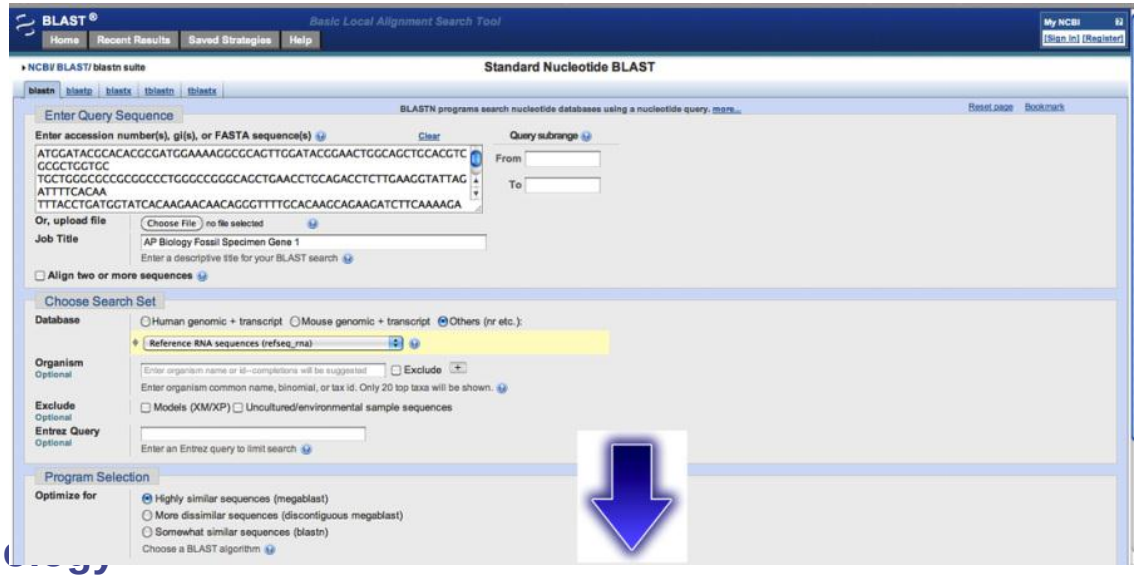


Figure 2. Cladogram of Several Animal Species



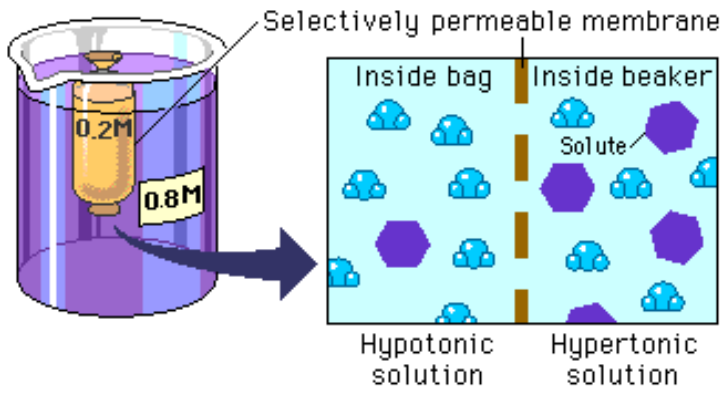
Lab 3: Comparing DNA Using BLAST

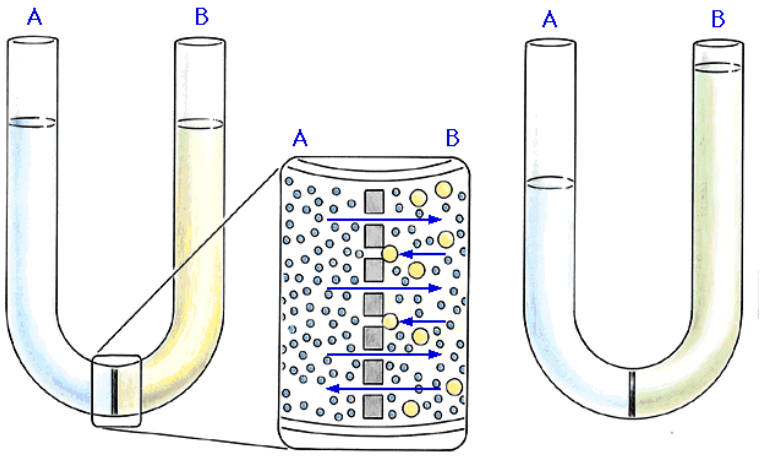
- **ESSAY 2009**
- **Phylogeny is the evolutionary history of a species.**
- **(a) The evolution of a species is dependent on changes in the genome of the species. Identify TWO mechanisms of genetic change, and explain how each affects genetic variation.**
- **(b) Based on the data in the table below, draw a phylogenetic tree that reflects the evolutionary relationships of the organisms based on the differences in their cytochrome c amino-acid sequences and explain the relationships of the organisms. Based on the data, identify which organism is most closely related to the chicken and explain your choice.**
- **(c) Describe TWO types of evidence—other than the comparison of proteins—that can be used to determine the phylogeny of organisms. Discuss one strength of each type of evidence you described.**

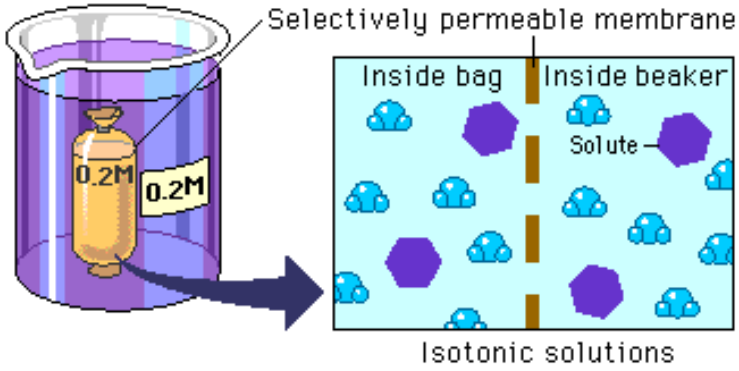
THE NUMBER OF AMINO ACID DIFFERENCES IN CYTOCHROME *c AMONG VARIOUS ORGANISMS*

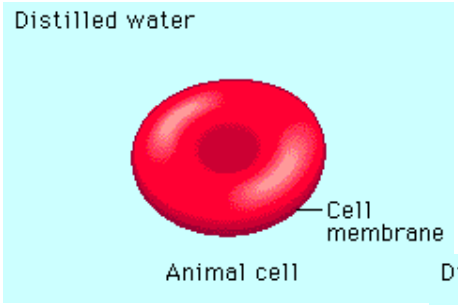
	Horse	Donkey	Chicken	Penguin	Snake
Horse	0	1	11	13	21
Donkey		0	10	12	20
Chicken			0	3	18
Penguin				0	17
Snake					0

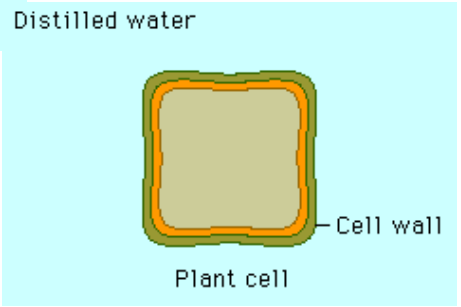
Lab 4: Diffusion & Osmosis





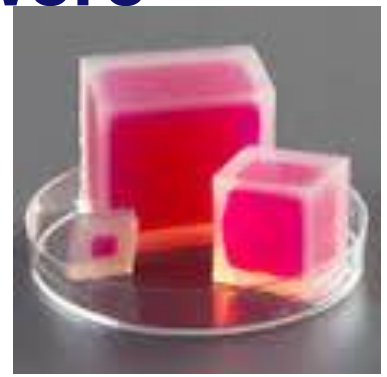






Lab 4: Diffusion & Osmosis

- **Part I- Diffusion in Agar Cubes**
- **Overview: Various size cubes of phenolphthalein agar were placed in NaOH and then diffusion rates were calculated.**



- **V = L x W x H**
- **V diffused = V_t – V not pink**
- **% diffusion = V diffused/ V_t x 100**
- **SA of a cube = L x W x # of sides, surface area/volume ratio.**

Lab 4: Diffusion & Osmosis

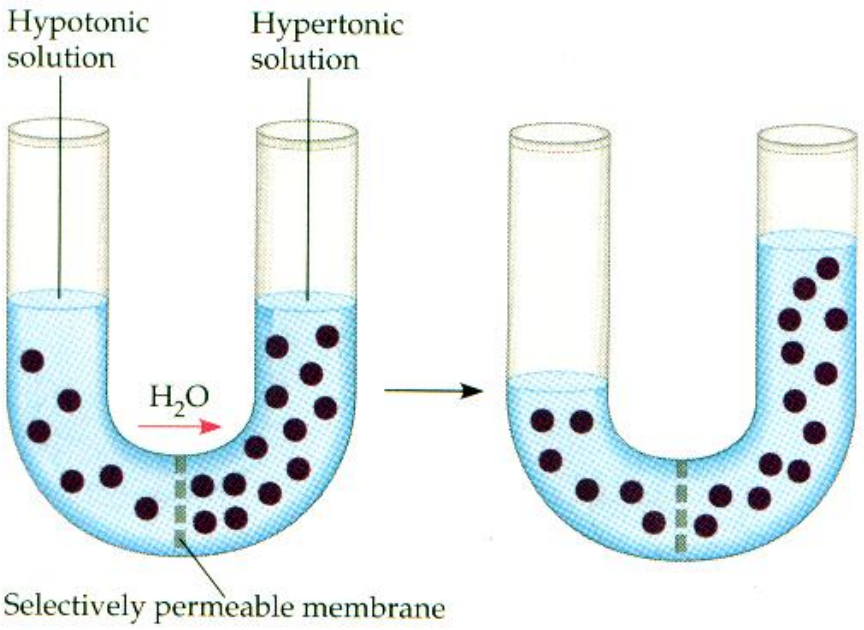
- **Part II- Potato Cores**
  - potato cores in sucrose solutions
  - determining solute concentration of different solutions

Lab 4: Diffusion & Osmosis

- **Part III- Design Your Own Experiment (Dialysis Bags)**
- **Overview: Students were provided with dialysis bags, colored sucrose solutions of unknown molarities, and basic lab equipment to use to design an experiment on how to determine the molarities of the colored solutions.**

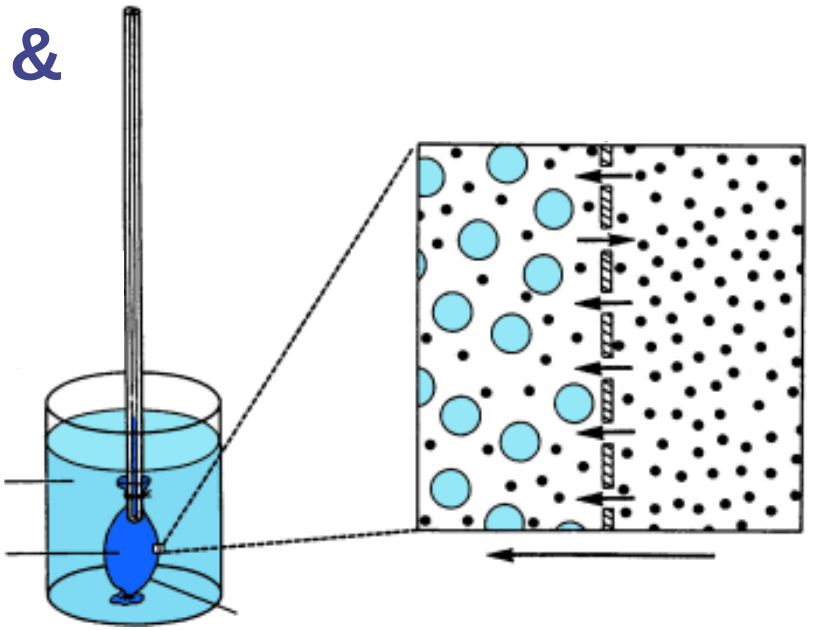
Lab 4: Diffusion & Osmosis

- Concepts
  - semi-permeable membrane
  - diffusion
  - osmosis
  - solutions
    - hypotonic
    - hypertonic
    - isotonic
  - water potential



Lab 4: Diffusion & Osmosis

- **Conclusions**
  - water moves from high concentration of water (hypotonic=low solute) to low concentration of water (hypertonic=high solute)
  - solute concentration & size of molecule affect movement through semi-permeable membrane



Lab 4: Diffusion & Osmosis

ESSAY 1992

A laboratory assistant prepared solutions of 0.8 M, 0.6 M, 0.4 M, and 0.2 M sucrose, but forgot to label them. After realizing the error, the assistant randomly labeled the flasks containing these four unknown solutions as flask A, flask B, flask C, and flask D.

Design an experiment, based on the principles of diffusion and osmosis, that the assistant could use to determine which of the flasks contains each of the four unknown solutions.

Include in your answer:

a. **a description of how you would set up and perform the experiment;**
b. **the results you would expect from your experiment; and**
c. **an explanation of those results based on the principles involved.**

Be sure to clearly state the principles addressed in your discussion.

Lab 5: Photosynthesis

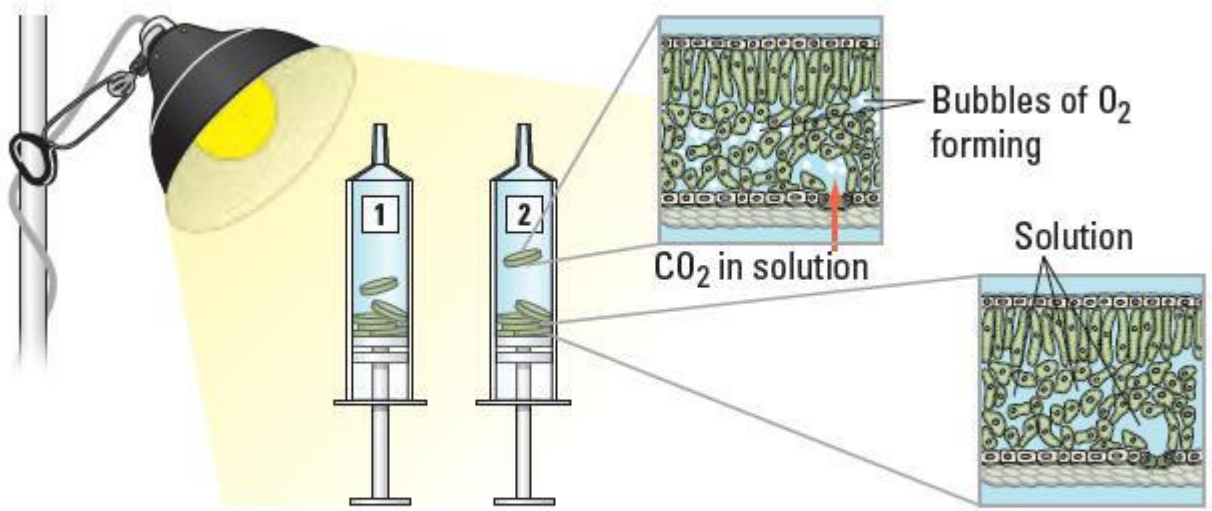
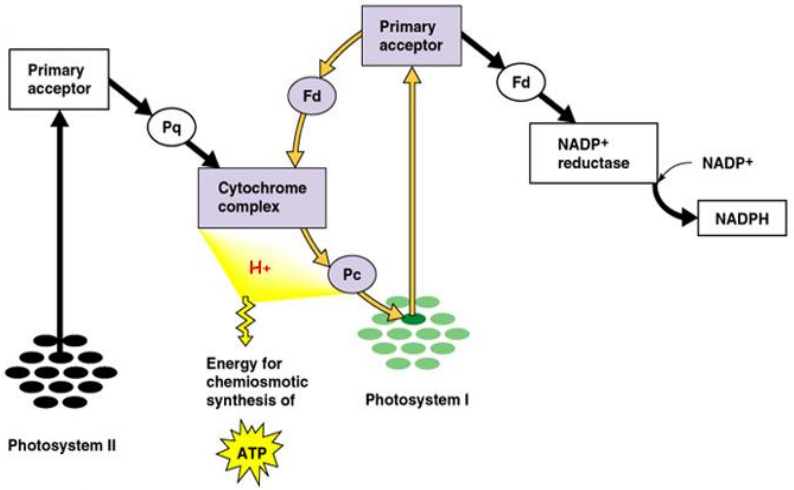


Figure 3. Photosynthesis at Work

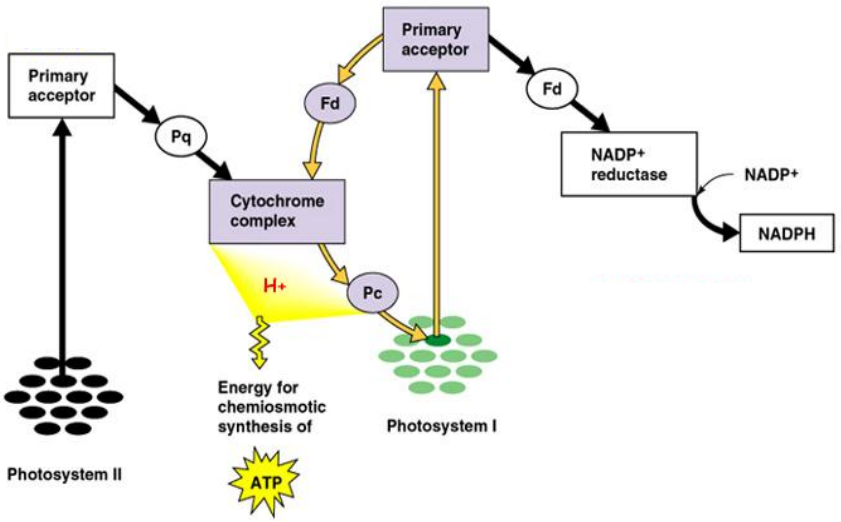
Lab 5: Photosynthesis

- **Description**
  - Spinach cut out disks were placed in two different syringes (bicarbonate and without)
  - photosynthetic rate was calculated by measuring the number that floated over time.
  - Students then designed their own experiment to see what factors affected photosynthesis.



Lab 5: Photosynthesis

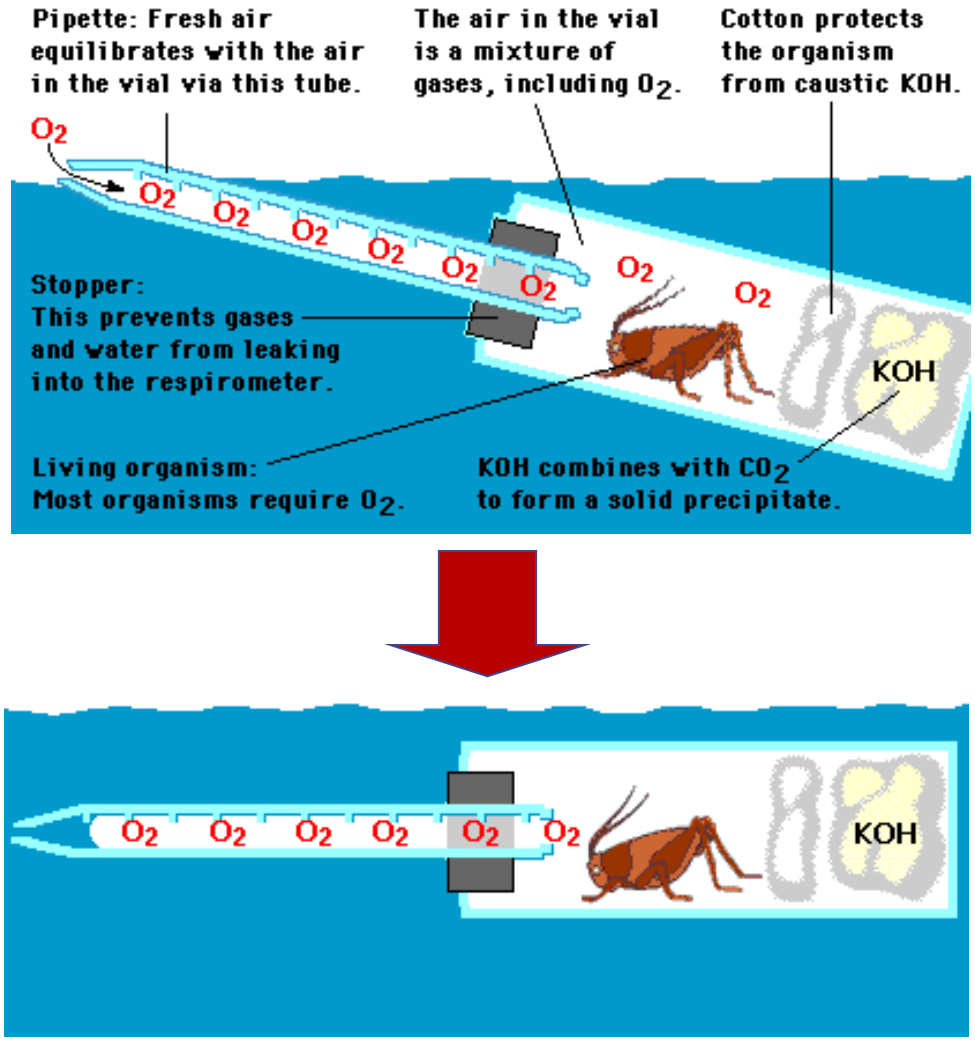
- **Concepts**
  - Photosynthesis
  - ET_{50} = the point at which 50% of the leaf disks are floating
  - inverse relationship between rate and ET_{50}
  - We graphed $1/ET_{50}$ in this lab.
  - experimental design
    - IV: presence of bicarbonate
    - DV: number of disks floating



Lab 5: Photosynthesis

- **ESSAY 1999-1:**
- **The rate of photosynthesis may vary with changes that occur in environmental temperature, wavelength of light, and light intensity. Using a photosynthetic organism of your choice, choose only ONE of the three variables (temperature, wavelength of light, or light intensity) and for this variable**
- **design a scientific experiment to determine the effect of the variable on the rate of photosynthesis for the organism;**
- **explain how you would measure the rate of photosynthesis in your experiment;**

Lab 6: Cellular Respiration

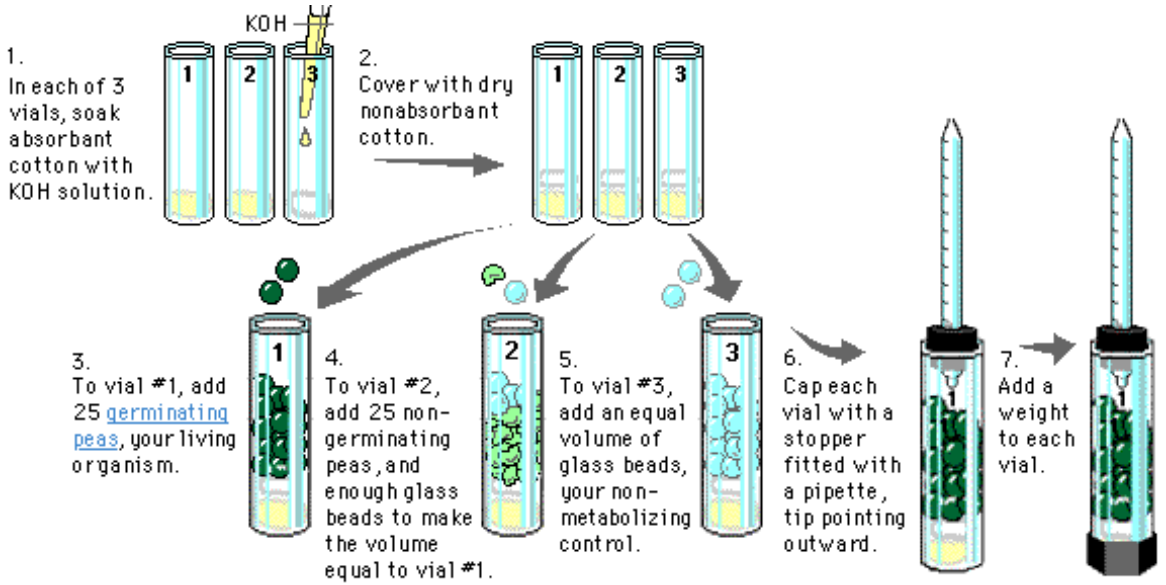


Lab 6: Cellular Respiration

- **Description**
  - using respirometer to measure rate of O_2 production by pea seeds
    - non-germinating peas
    - germinating peas
    - effect of temperature
    - control for changes in pressure & temperature in room
  - Design experiment to determine other factors that affect cell respiration (type of seed, age of seed, etc.)

Lab 6: Cellular Respiration

- Concepts
  - respiration
  - experimental design
    - control vs. experimental
    - function of KOH
    - function of vial with only glass beads

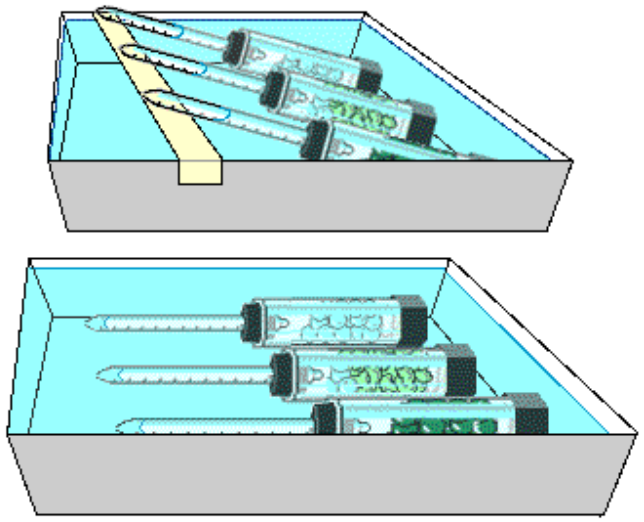


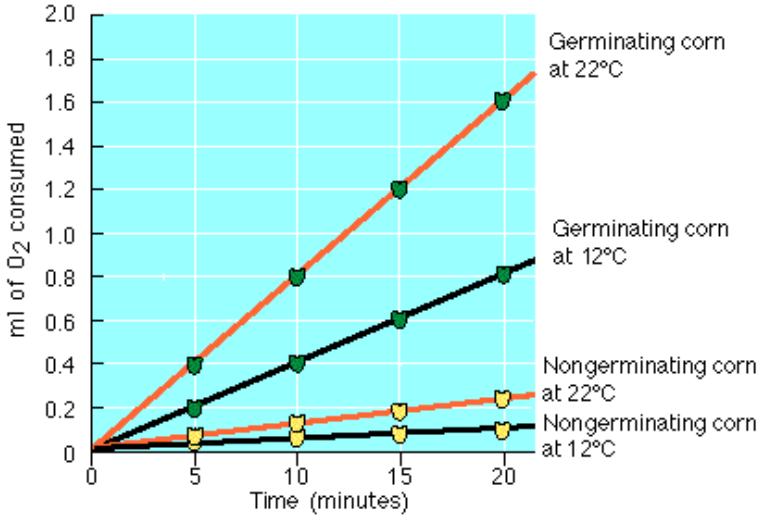
Lab 6: Cellular Respiration

- **Conclusions**
  - ↓temp = ↓respiration
  - ↑germination = ↑respiration

calculate rate?

1. Place three respirometers in a water bath at 10°C with the tips of the pipettes resting on a sling above the water level. Allow several minutes for them to equilibrate.
2. Lower the tips of the pipettes into the water.
3. Take an initial reading from each respirometer.
4. Take readings from each respirometer at 5 minute intervals for the next 15 minutes.
5. Use the second set of three vials to measure the rate of respiration in a 25°C bath.





Lab 6: Cellular Respiration

ESSAY 1990

The results below are measurements of cumulative oxygen consumption by germinating and dry seeds. Gas volume measurements were corrected for changes in temperature and pressure.

Cumulative Oxygen Consumed (mL)					
Time (minutes)	0	10	20	30	40
Germinating seeds 22°C	0.0	8.8	16.0	23.7	32.0
Dry Seeds (non-germinating) 22°C	0.0	0.2	0.1	0.0	0.1
Germinating Seeds 10°C	0.0	2.9	6.2	9.4	12.5
Dry Seeds (non-germinating) 10°C	0.0	0.0	0.2	0.1	0.2

a. Plot the results for the germinating seeds at 22°C and 10°C.

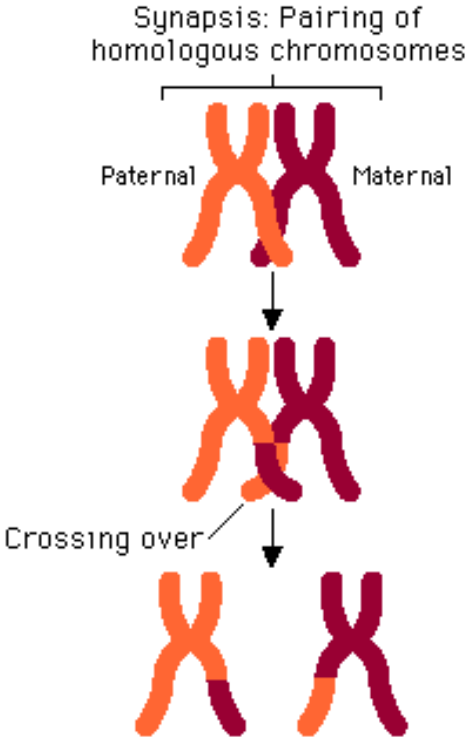
b. Calculate the rate of oxygen consumption for the germinating seeds at 22°C, using the time interval between 10 and 20 minutes.

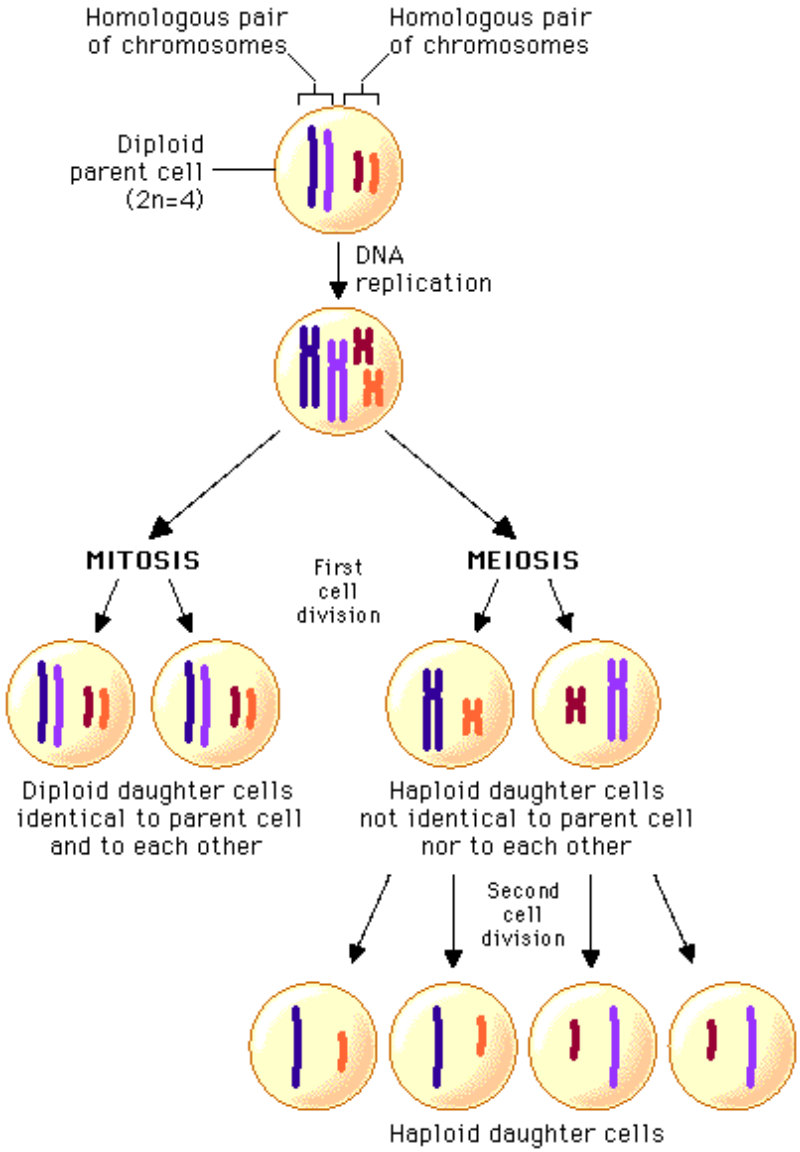
c. Account for the differences in oxygen consumption observed between:

   1. germinating seeds at 22°C and at 10°C
   2. germinating seeds and dry seeds.

d. Describe the essential features of an experimental apparatus that could be used to measure oxygen consumption by a small organism. Explain why each of these features is necessary.

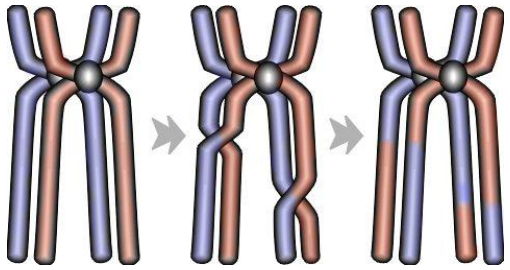
Lab 7: Mitosis & Meiosis





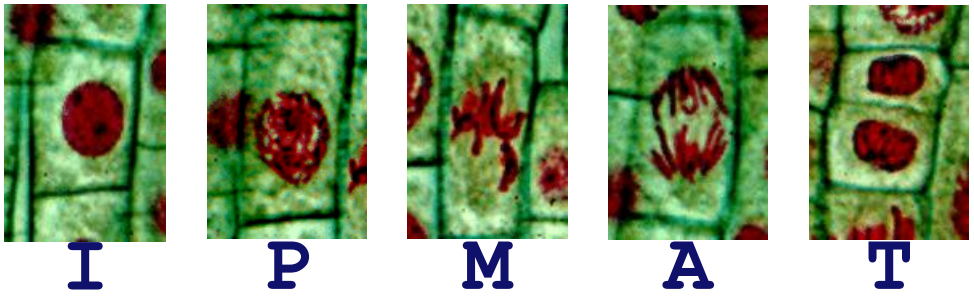
Lab 7: Mitosis & Meiosis

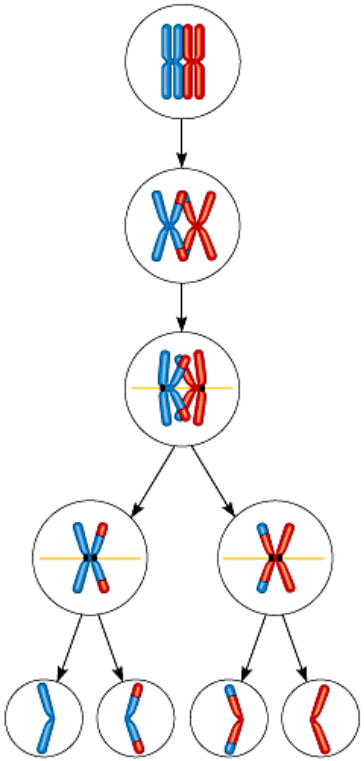
- **Description**
  - **Two treatment groups of plant root tips were compared**
    - **one group was treated with lectin (increases cell division)**
    - **the other was a control group that had not been treated with lectin (we used cards for these).**
    - **Chi-square analysis was used**



Lab 7: Mitosis & Meiosis

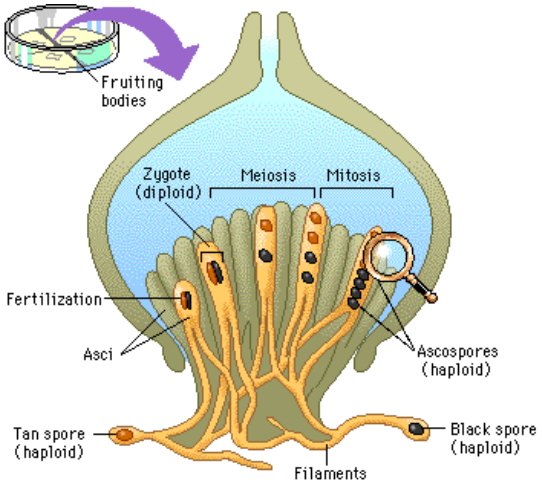
- Concepts
  - mitosis
    - interphase
    - prophase
    - metaphase
    - anaphase
    - telophase
  - meiosis
    - meiosis 1
      - separate homologous pairs
    - meiosis 2
      - separate sister chromatids
  - crossing over
    - in prophase 1





Lab 7: Mitosis & Meiosis

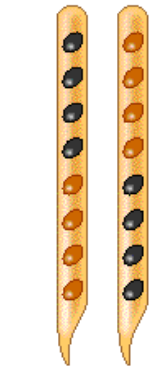
- **Description**
  - crossing over in meiosis
    - farther gene is from centromere the greater number of crossovers
    - observed crossing over in fungus, *Sordaria*
      - arrangement of ascospores



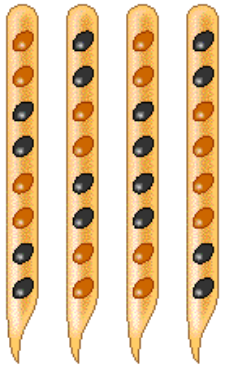
Sordaria analysis

$$\%\ \text{crossover} = \frac{\text{total crossover}}{\text{total offspring}}$$

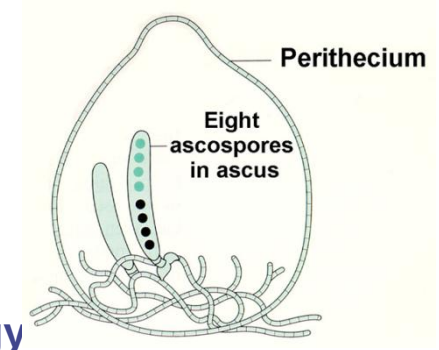
$$\text{distance from centromere} = \frac{\%\ \text{crossover}}{2}$$

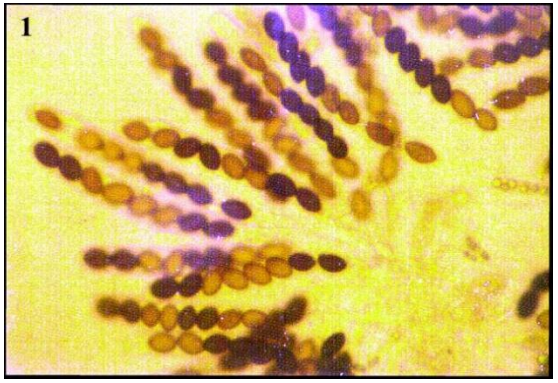


A. No crossing over



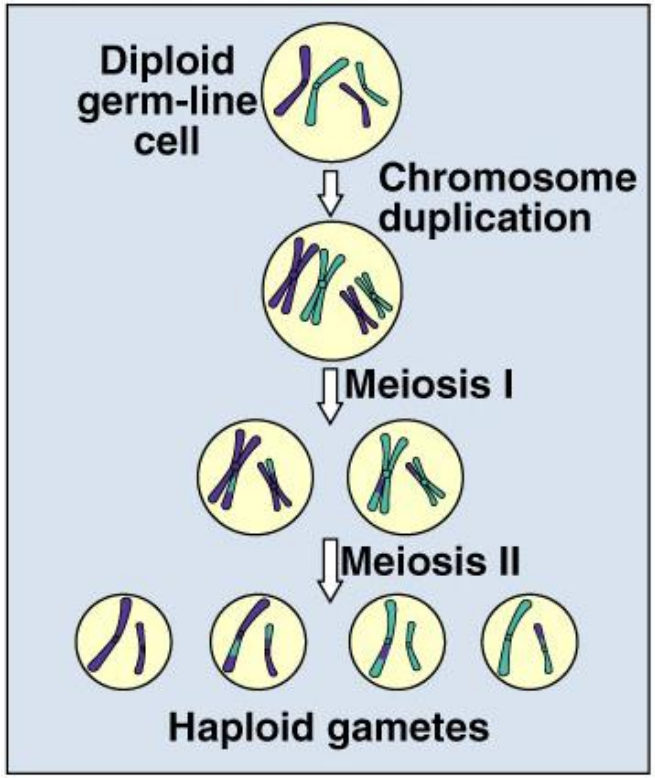
B. Crossing over during meiosis





Lab 7: Mitosis & Meiosis

- Conclusions
  - Mitosis
    - cell division
      - growth, repair
      - making clones
    - longest phase = interphase
    - each subsequent phase is shorter in duration
  - Meiosis
    - reduction division
      - making gametes
      - increasing variation
    - crossing over in Prophase 1



Lab 7: Mitosis & Meiosis

ESSAY 1987

Discuss the process of cell division in animals. Include a description of mitosis and cytokinesis, and of the other phases of the cell cycle. Do not include meiosis.

ESSAY 2004

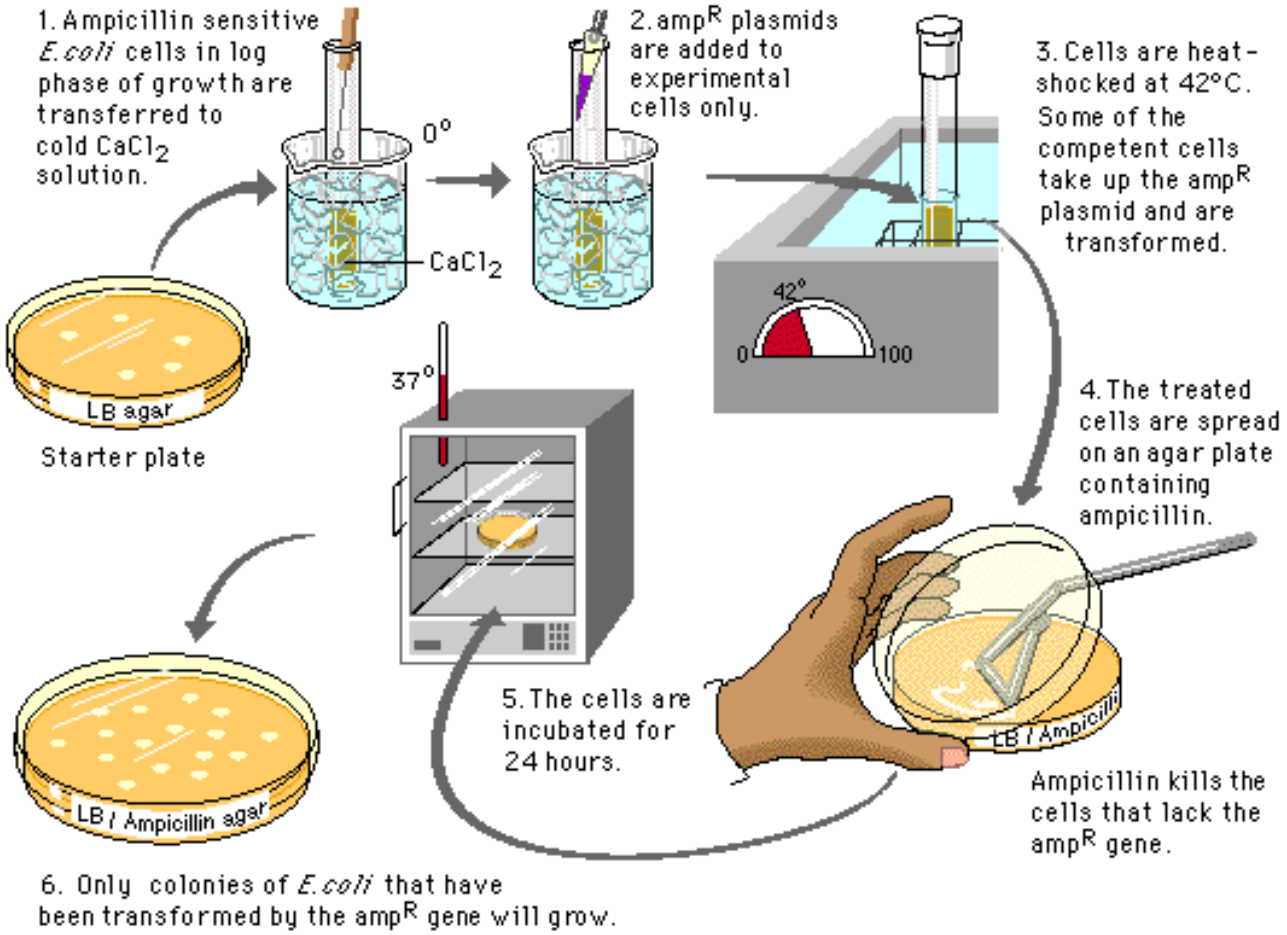
Meiosis reduces chromosome number and rearranges genetic information.

a. Explain how the reduction and rearrangement are accomplished in meiosis.

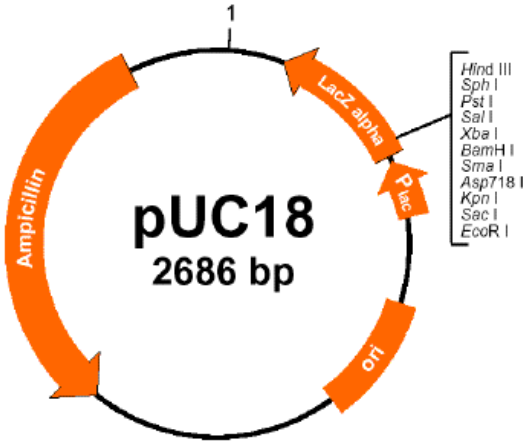
b. Several human disorders occur as a result of defects in the meiotic process. Identify ONE such chromosomal abnormality; what effects does it have on the phenotype of people with the disorder? Describe how this abnormality could result from a defect in meiosis.

c. Production of offspring by parthenogenesis or cloning bypasses the typical meiotic process. Describe either parthenogenesis or cloning and compare the genomes of the offspring with those of the parents.

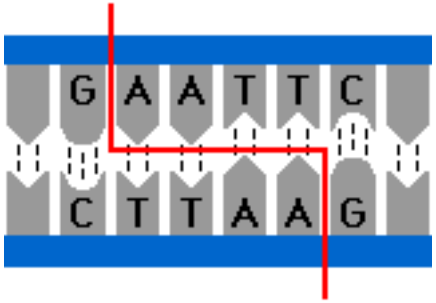
Lab 8: Molecular Biology



Lab 8: Molecular Biology

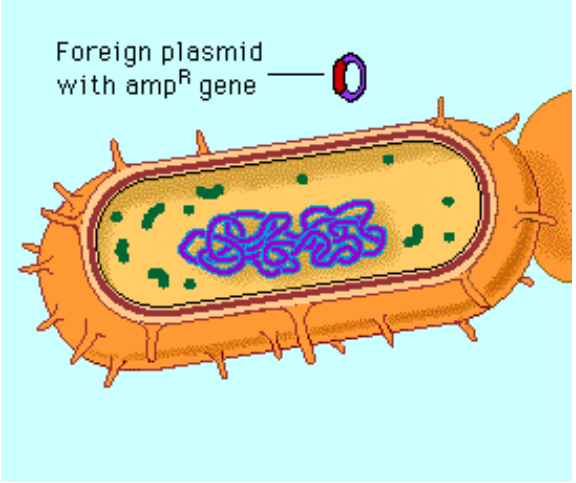


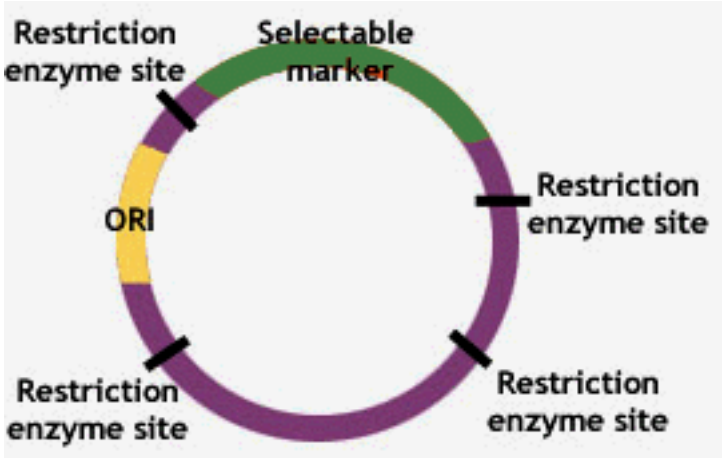
- **Description**
  - **Transformation**
    - **insert foreign gene in bacteria by using engineered plasmid**
    - **also insert ampicillin resistant gene on same plasmid as selectable marker**



Lab 8: Molecular Biology

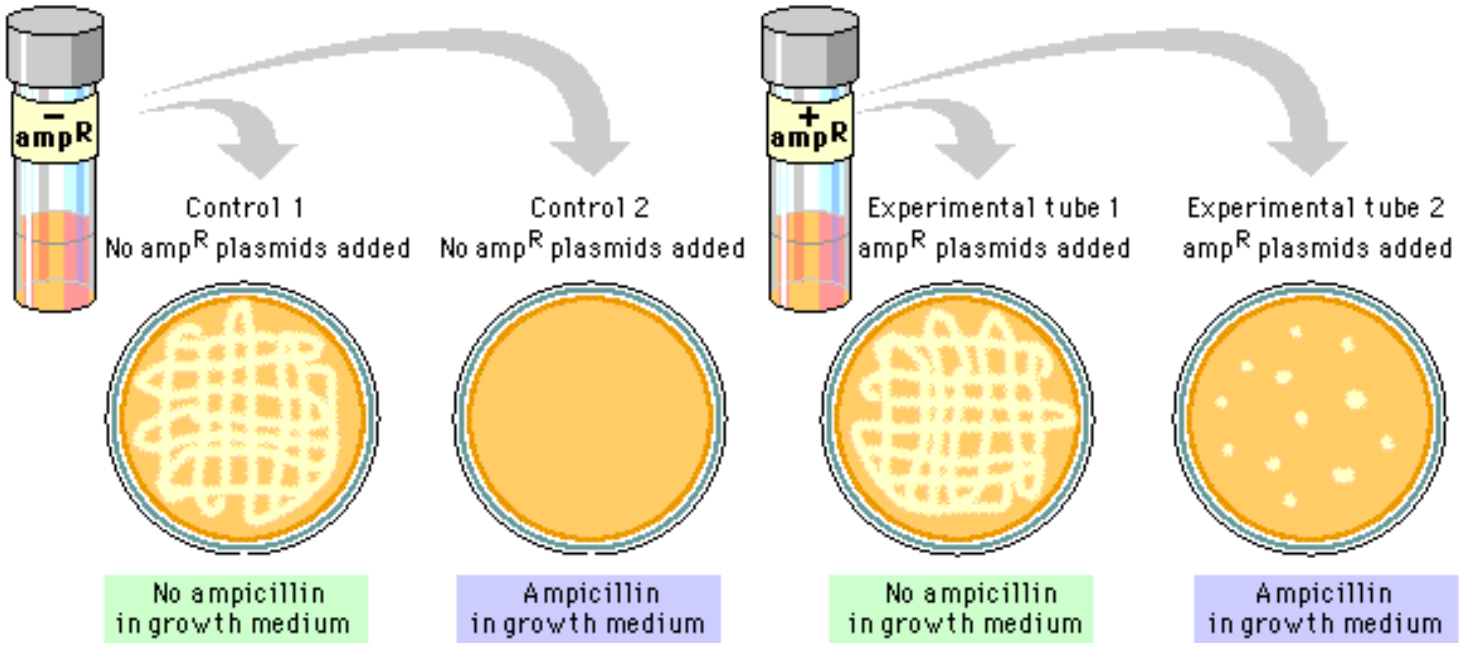
- **Concepts**
  - transformation
  - plasmid
  - selectable marker
    - ampicillin resistance
  - restriction enzyme





Lab 8: Transformation

- **Conclusions**
  - can insert foreign DNA using vector
  - ampicillin becomes selecting agent
    - no transformation = no growth on amp$^+$ plate



Lab 8: Molecular Biology

ESSAY 2002

The human genome illustrates both continuity and change.

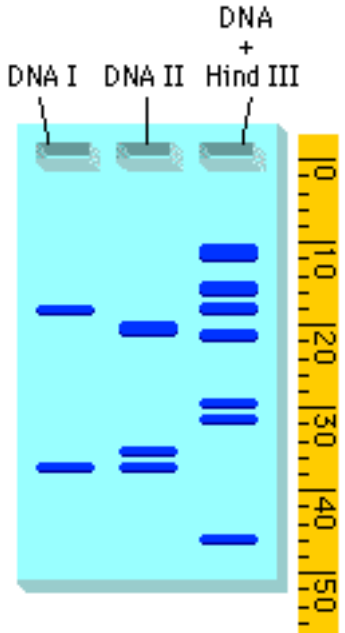
a. Describe the essential features of two of the procedures/techniques below. For each of the procedures/techniques you describe, explain how its application contributes to understanding genetics.

- **The use of a bacterial plasmid to clone and sequence a human gene**
- **Polymerase chain reaction (PCR)**
- **Restriction fragment polymorphism (RFLP analysis)**

b. All humans are nearly identical genetically in coding sequences and have many proteins that are identical in structure and function. Nevertheless, each human has a unique DNA fingerprint. Explain this apparent contradiction.

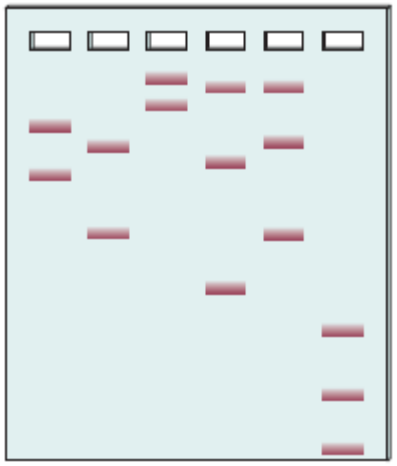
Lab 9: Molecular Biology

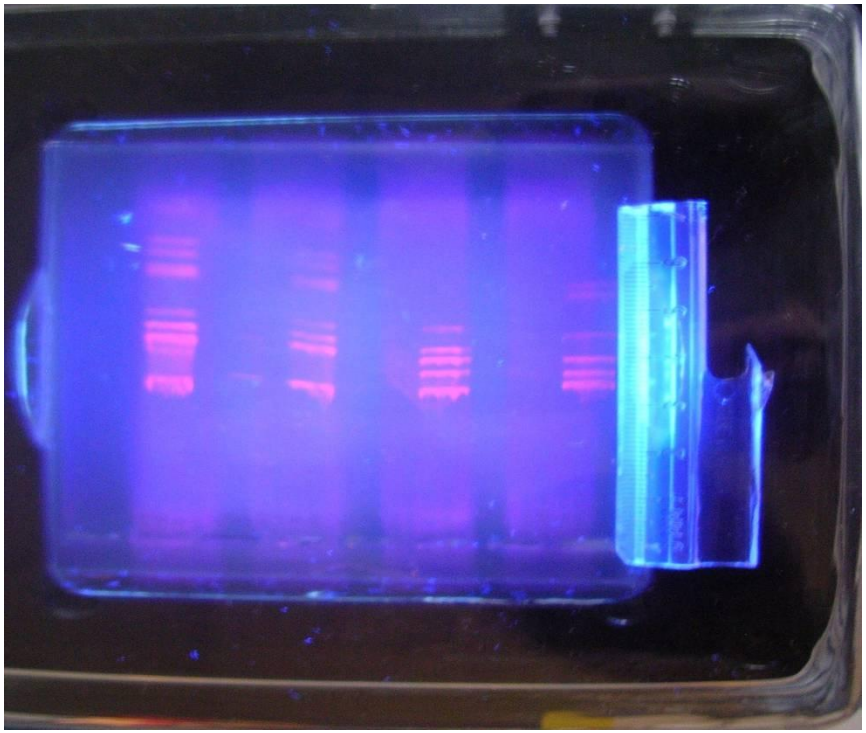
- Gel electrophoresis
  - cut DNA with restriction enzyme
  - fragments separate on gel based on size
  - A cancer patient was tested to see if the DNA from her breast, blood, surrounding tissue and a control group.
    - one hit = carrier; two hit= cancer



Lab 9: Molecular Biology

- **Concepts**
  - restriction enzyme
  - gel electrophoresis
    - DNA is negatively charged
    - smaller fragments travel faster

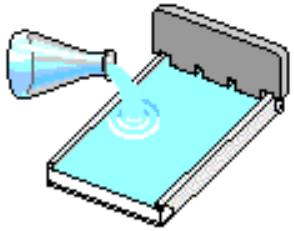




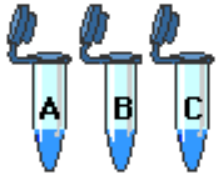
Lab 9: Gel Electrophoresis

- **Conclusions**

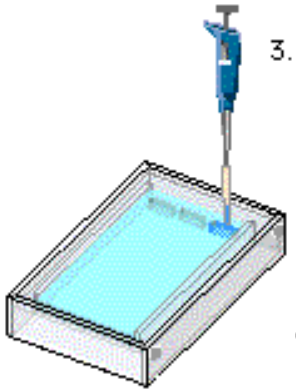
1. Make gel.



2. Obtain prepared DNA samples.

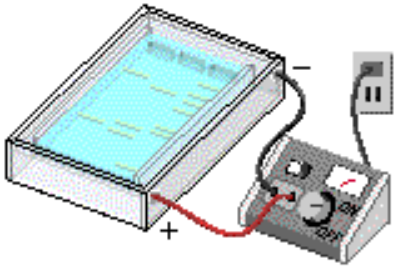


3. Load samples into gel.



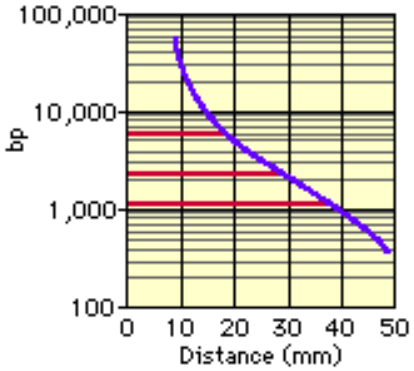
DNA = negatively charged

4. Separate fragments by electrophoresis.

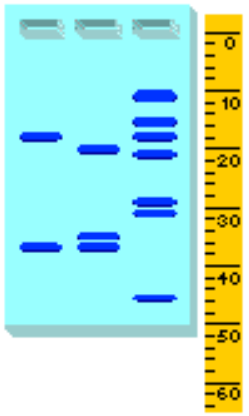


correlate distance to size

6. Prepare a standard curve. Determine fragment sizes.



5. Stain DNA fragments and measure distances.

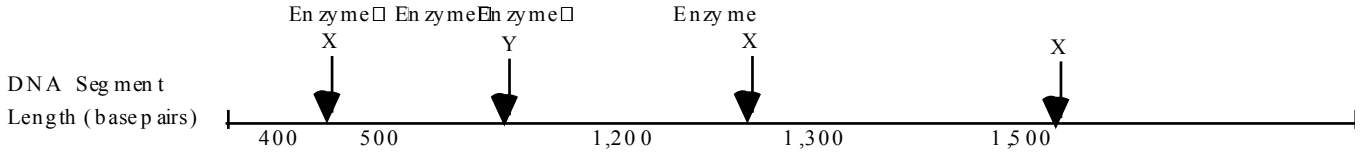


smaller fragments travel faster & therefore farther

Lab 9: Molecular Biology

ESSAY 1995

The diagram below shows a segment of DNA with a total length of 4,900 base pairs. The arrows indicate reaction sites for two restriction enzymes (enzyme X and enzyme Y).



a. <u>Explain</u> how the principles of gel electrophoresis allow for the separation of DNA fragments

b. <u>Describe</u> the results you would expect from electrophoretic separation of fragments from the following treatments of the DNA segment above. Assume that the digestion occurred under appropriate conditions and went to completion.

   I. DNA digested with only enzyme X
   II. DNA digested with only enzyme Y
   III. DNA digested with enzyme X and enzyme Y combined
   IV. Undigested DNA

c. <u>Explain</u> both of the following:

   1. The mechanism of action of restriction enzymes
   2. The different results you would expect if a mutation occurred at the recognition site for enzyme Y.

Lab 10: Energy Dynamics

- **Description**
  - **Part I: Net primary productivity of Fast Plants-**
    - **Data was given on fast plants that were grown over 14 days.**
    - **Dry mass was divided by wet mass to obtain biomass.**
    - **Bio mass was multiplied by 4.35 kcal to obtain net primary productivity per 10 plants and divided by 10 to get NPP per day per plant.**

Lab 10: Energy Dynamics

- **Description**
  - **Energy flow between plants and butterfly larvae**
    - **brussel sprouts and caterpillars were massed before and after 3 days of caterpillar consumption.**
    - **Biomass (dry/wet) and energy constant were used to calculate how much energy from plant was used in cell respiration and how much was lost as water.**
      - **PLANT ENERGY CONSUMED PER INDVIDUAL**
      - **ENERGY PRODUCTION PER INDIVDUAL**
      - **FRASS ENERGY (energy lost in poo)= RESPIRATION ESTIMATE**

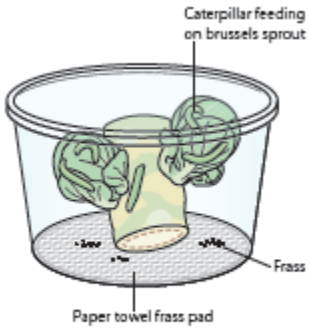
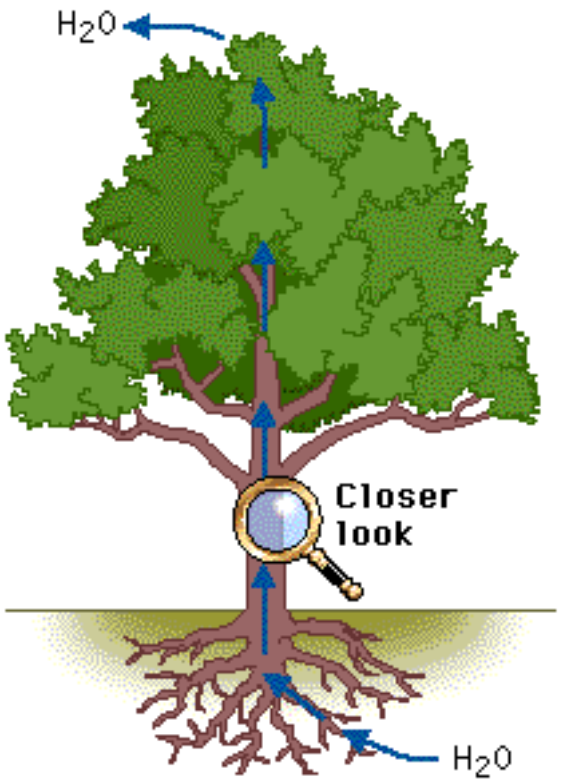
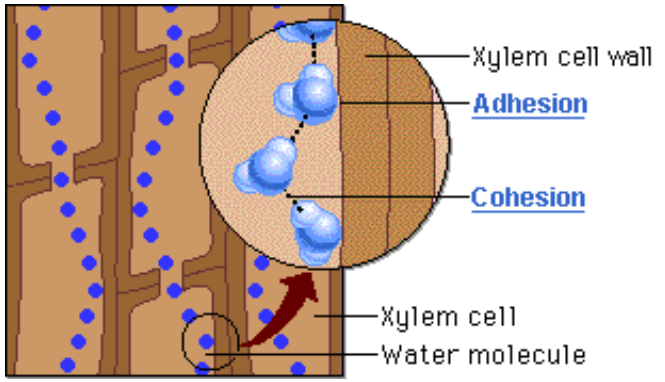
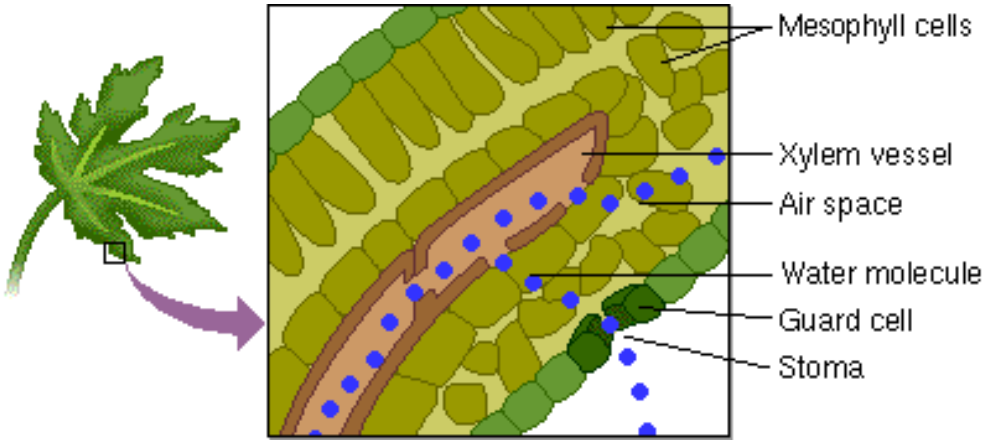


Figure 4. Brassica Barn

Lab 11: Transpiration







Lab 11: Transpiration

- **Description**
  - test the effects of environmental factors on rate of transpiration
    - temperature
    - humidity
    - air flow (wind)
    - light intensity
  - Part I: Put whole plants in four different environments to determine water loss via transpiration over four days

Lab 11: Transpiration

- **Description**
  - **Part I: Put whole plants in four different environments to determine water loss via transpiration over four days**
  - **Part II: Determine the surface area of the leaf and average stomata per square millimeter.**

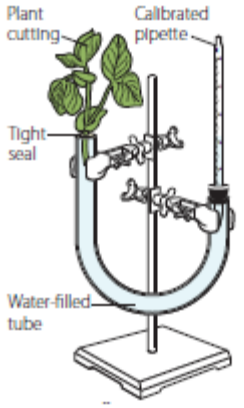
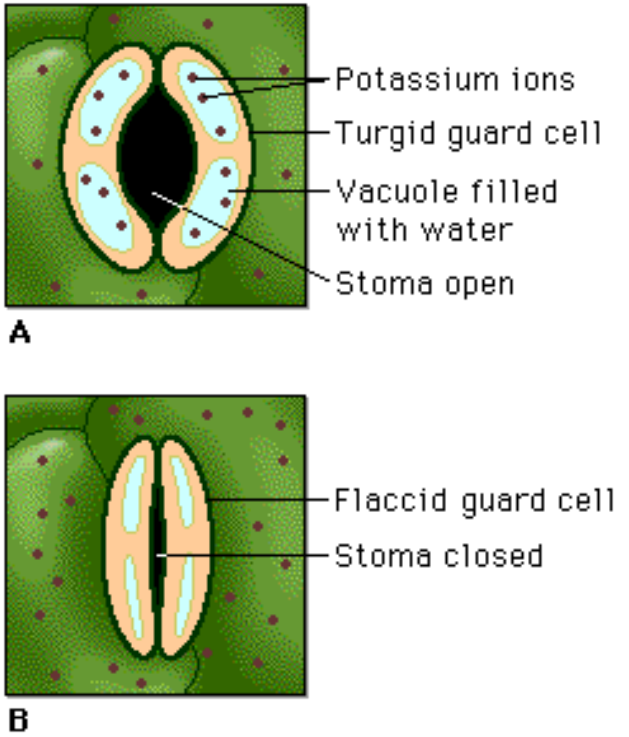
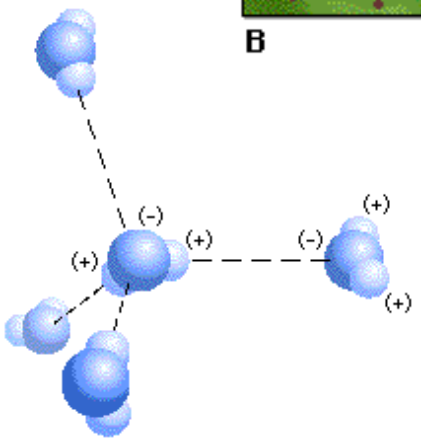


Figure 2. Potometer Assembly

Lab 11: Transpiration

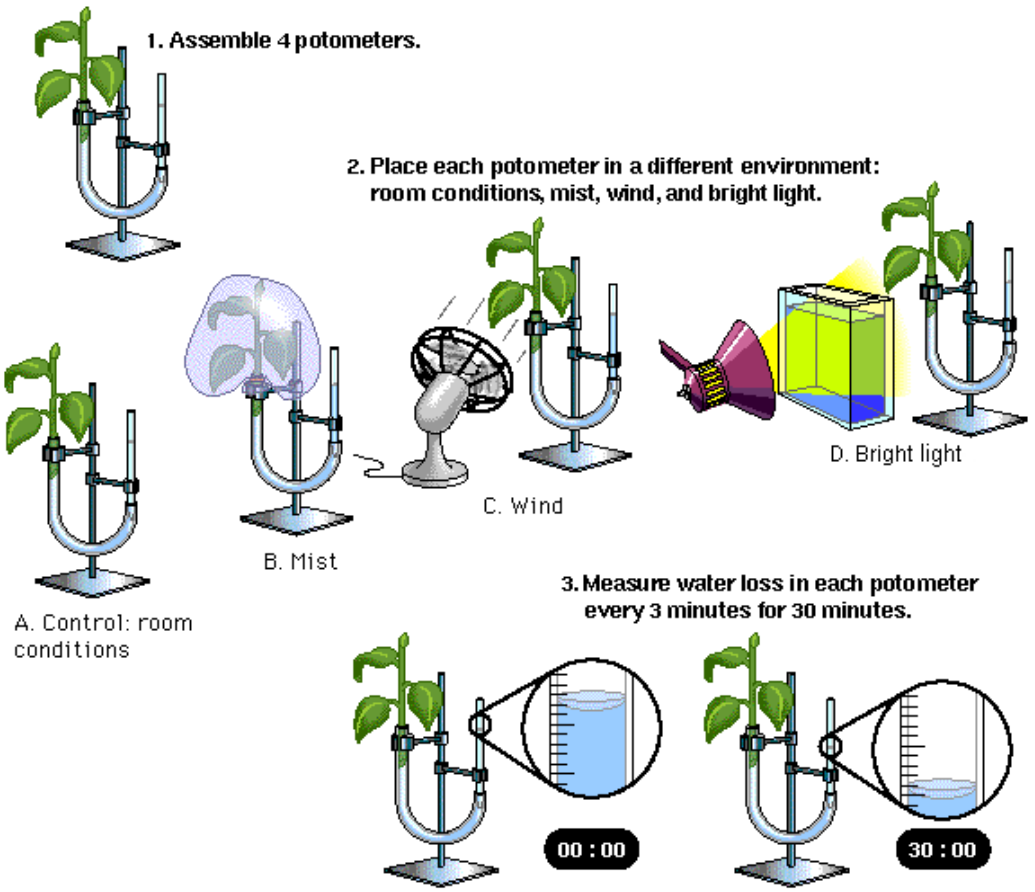
- **Concepts**
  - transpiration
  - stomates
  - guard cells
  - xylem
    - adhesion
    - cohesion
      - H bonding

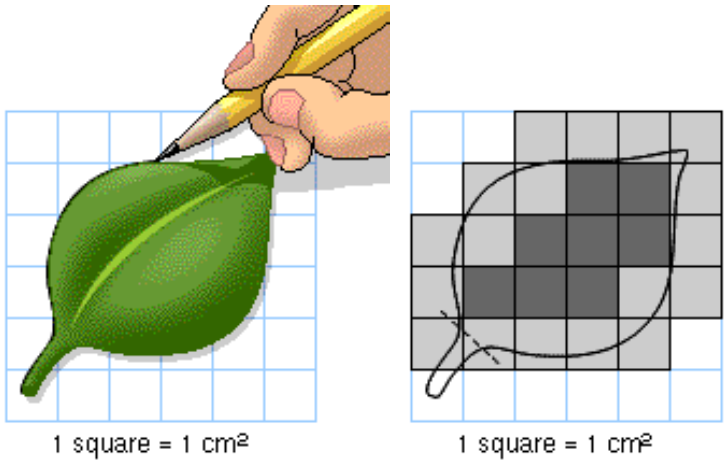




Lab 11: Transpiration

- **Conclusions**
  - ↑transpiration
    - ↑ wind
    - ↑ light
  - ↓transpiration
    - ↑ humidity





Lab 11: Transpiration

ESSAY 1991

A group of students designed an experiment to measure transpiration rates in a particular species of herbaceous plant. Plants were divided into four groups and were exposed to the following conditions.

Group I:	**Room conditions (light, low humidity, 20°C, little air movement.)**
Group II:	**Room conditions with increased humidity.**
Group III:	**Room conditions with increased air movement (fan)**
Group IV:	**Room conditions with additional light**

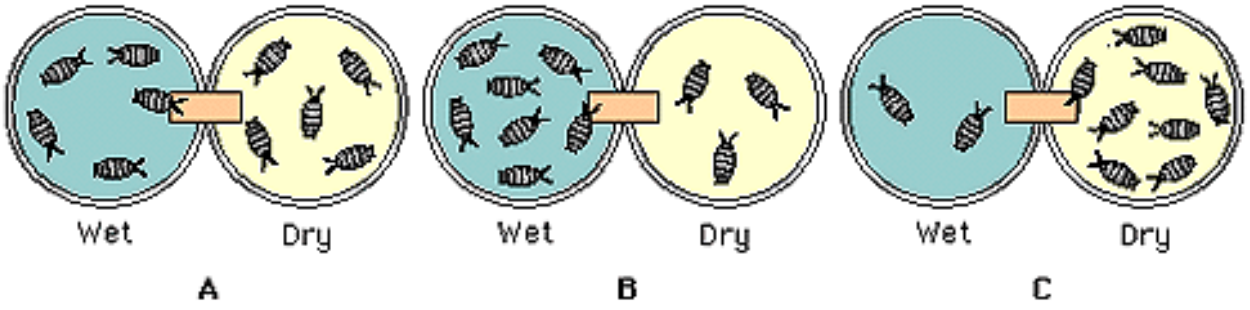
The cumulative water loss due to transpiration of water from each plant was measured at 10-minute intervals for 30 minutes. Water loss was expressed as milliliters of water per square centimeter of leaf surface area. The data for all plants in Group I (room conditions) were averaged. The average cumulative water loss by the plants in Group I is presented in the table below.

Average Cumulative Water Loss by the Plants in Group I	
Time (minutes)	**Average Cumulative Water Loss ($mL\ H_2O/cm^2$)**
10	**3.5×10^{-4}**
20	**7.7×10^{-4}**
30	**10.6×10^{-4}**

1. **Construct and label a graph using the data for Group I. Using the same set of axes, draw and label three additional lines representing the results that you would predict for Groups II, III, and IV.**
2. **Explain how biological and physical processes are responsible for the difference between each of your predictions and the data for Group I.**
3. **Explain how the concept of water potential is used to account for the movement of water from the plant stem to the atmosphere during transpiration.**

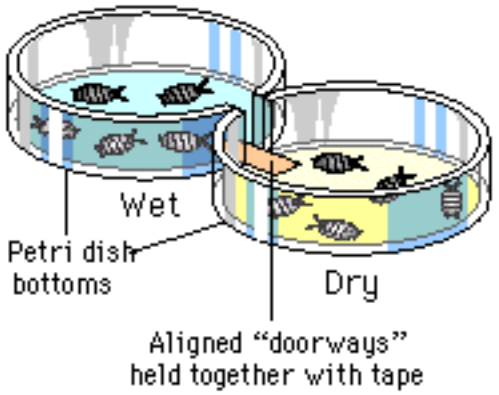
Lab 12: Animal Behavior

- **Description**
  - set up an experiment to study behavior in an organism
    - *Betta* fish agonistic behavior
    - Drosophila mating behavior
    - pillbug kinesis



Lab 12: Animal Behavior

- **Concepts**
  - innate vs. learned behavior
  - experimental design
    - control vs. experimental
    - Hypothesis
    - which factors affect pill bug behavior and taxis.
  - choice chamber
    - temperature
    - humidity
    - light intensity
    - salinity
    - other factors

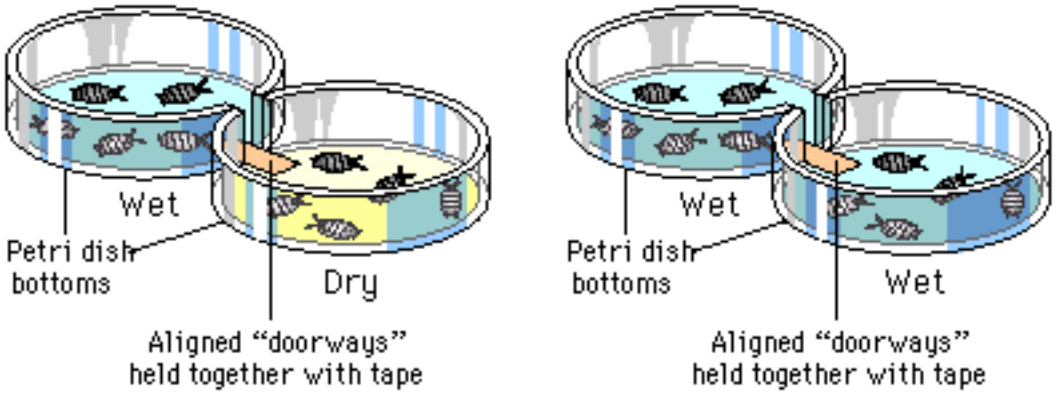


Lab 12: Animal Behavior

- **Hypothesis development**
  - **Poor:**
    I think pillbugs will move toward the wet side of a choice chamber.
  - **Better:**
    If pillbugs prefer a moist environment, then when they are randomly placed on both sides of a wet/dry choice chamber and allowed to move about freely for 10 minutes, most will be found on the wet side.

Lab 12: Animal Behavior

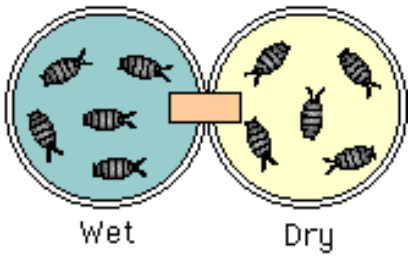
- **Experimental design**



	EXPERIMENT		CONTROL	
	Left compartment	Right compartment	Left compartment	Right compartment
MOISTURE	wet	dry	wet	wet
LIGHT	25 Watts	same	same	same
FILTERPAPER	#1 Whatman	same	same	same
TEMPERATURE	20°C	same	same	same
NUMBER OF BUGS AT START	5	same	same	same

Sample size

Sample size too small.



Sample size better.

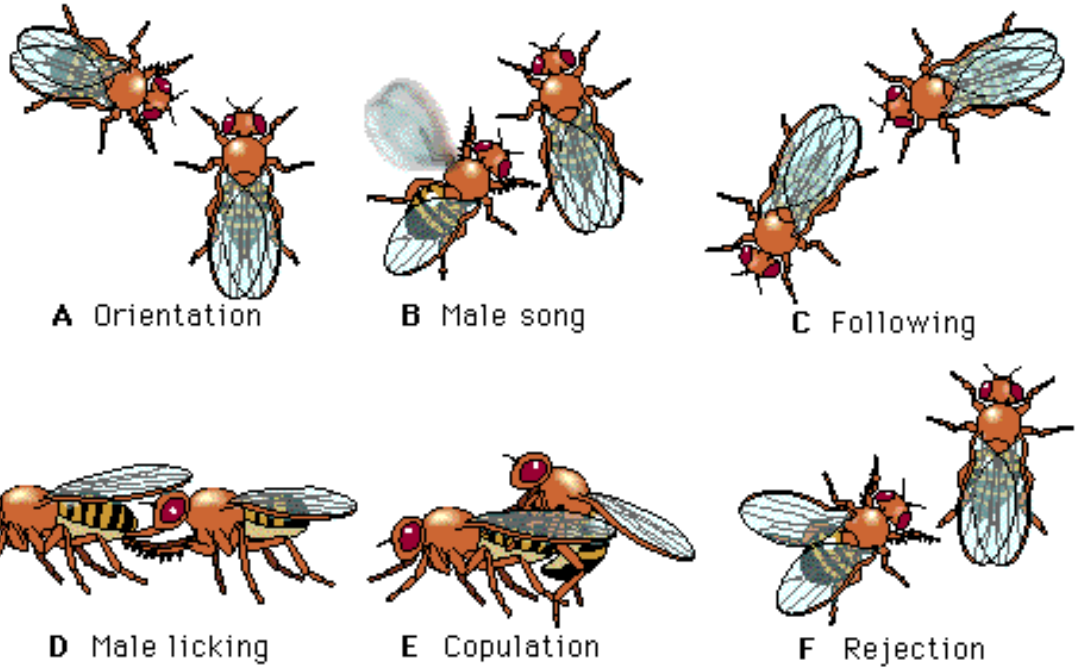
Lab 12: Animal Behavior

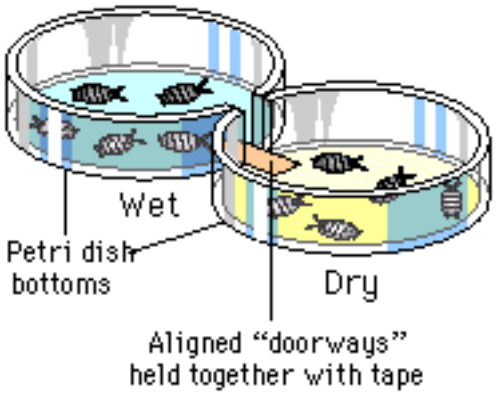
- **Experimental design**

Figure 2. Choice Chamber

Figure 1. Determining the Sex of Fruit Flies

Lab 12: Animal Behavior





Lab 12: Animal Behavior

ESSAY 1997

A scientist working with *Bursatella leachii*, a sea slug that lives in an intertidal habitat in the coastal waters of Puerto Rico, gathered the following information about the distribution of the sea slugs within a ten-meter square plot over a 10-day period.

time of day	12 mid	4am	8am	12 noon	4pm	8pm	12 mid
average distance between individuals	8.0	8.9	44.8	174.0	350.5	60.5	8.0

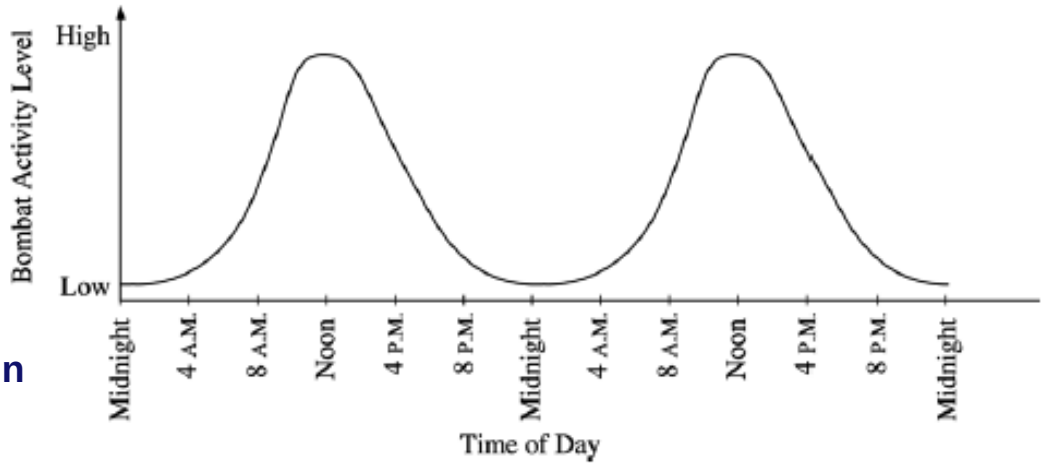
a. For the data above, provide information on each of the following:
   - Summarize the pattern.
   - Identify three physiological or environmental variables that could cause the slugs to vary their distance from each other.
   - Explain how each variable could bring about the observed pattern of distribution.

b. Choose one of the variables that you identified and design a controlled experiment to test your hypothetical explanation. Describe results that would support or refute your hypothesis.

Lab 12: Animal Behavior

ESSAY 2002

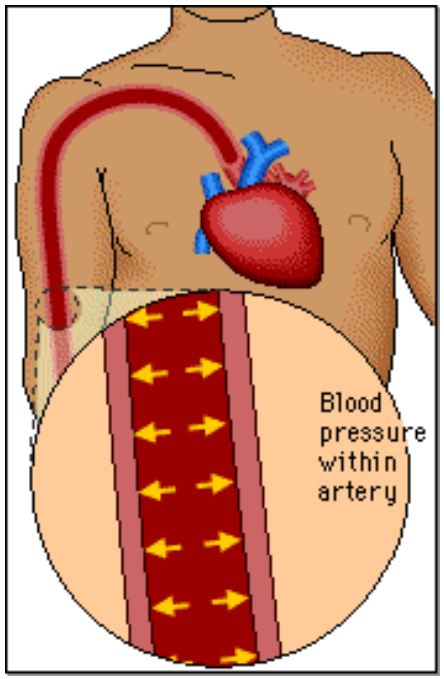
The activities of organisms change at regular time intervals. These changes are called biological rhythms. The graph depicts the activity cycle over a 48-hour period for a fictional group of mammals called pointy-eared bombats, found on an isolated island in the temperate zone.

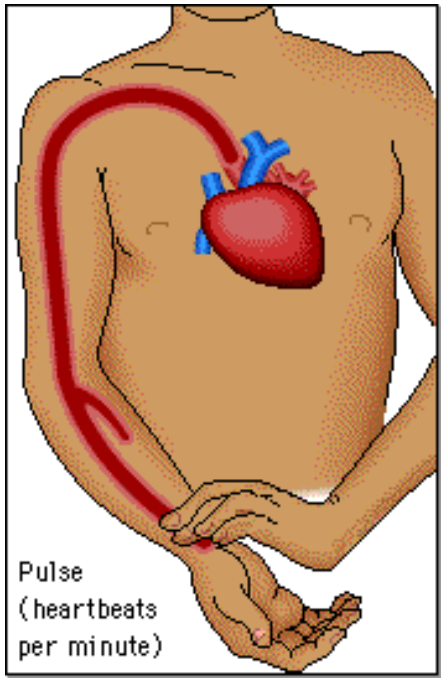


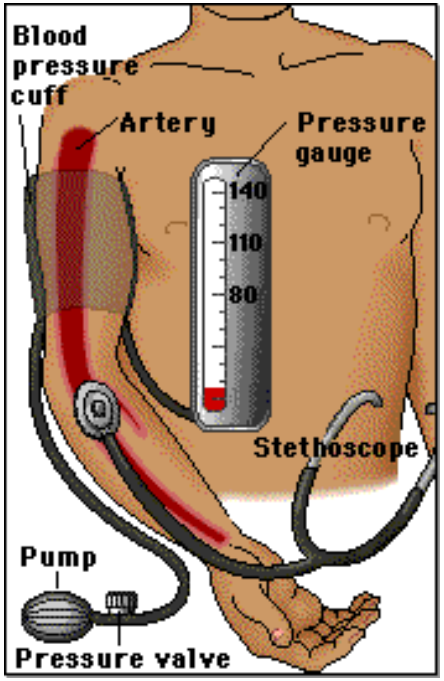
a. Describe the cycle of activity for the bombats. Discuss how three of the following factors might affect the physiology and/or behavior of the bombats to result in this pattern of activity.
   - temperature
   - food availability
   - presence of predators
   - social behavior

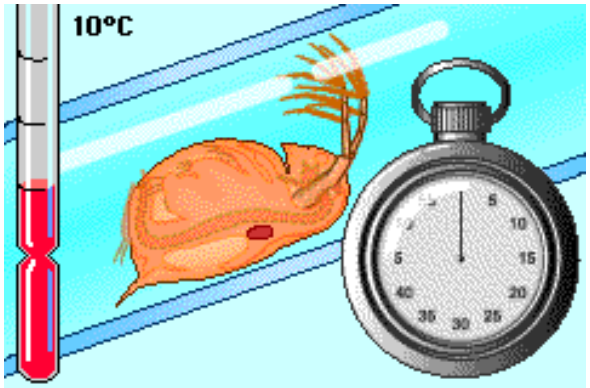
b. Propose a hypothesis regarding the effect of light on the cycle of activity in bombats. Describe a controlled experiment that could be performed to test this hypothesis, and the results you would expect.

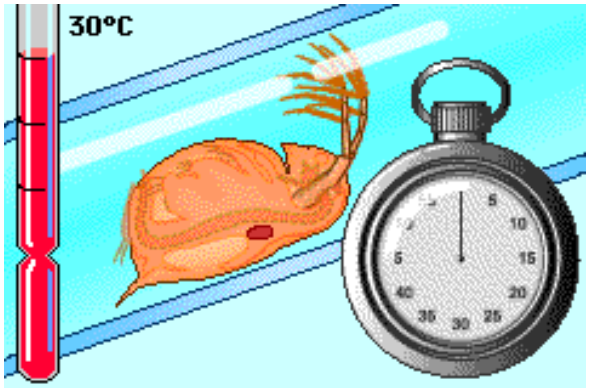
Lab : Circulatory Physiology





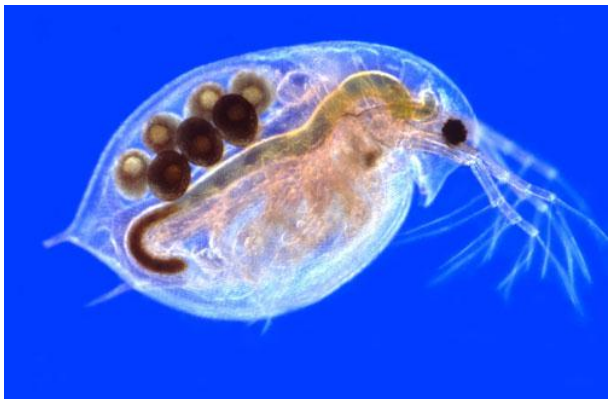






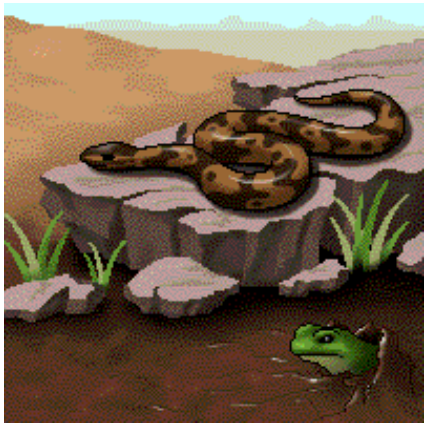
Lab : Circulatory Physiology

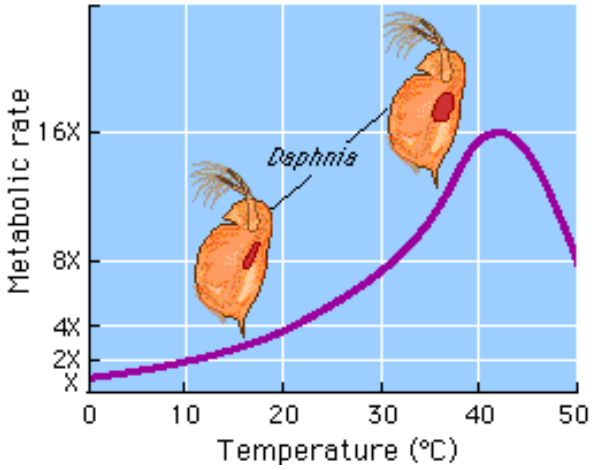
- **Description**
  - study factors that affect heart rate
    - body position
    - level of activity
  - determine whether an organism is an endotherm or an ectotherm by measuring change in pulse rate as temperature changes
    - Daphnia



Lab : Circulatory Physiology

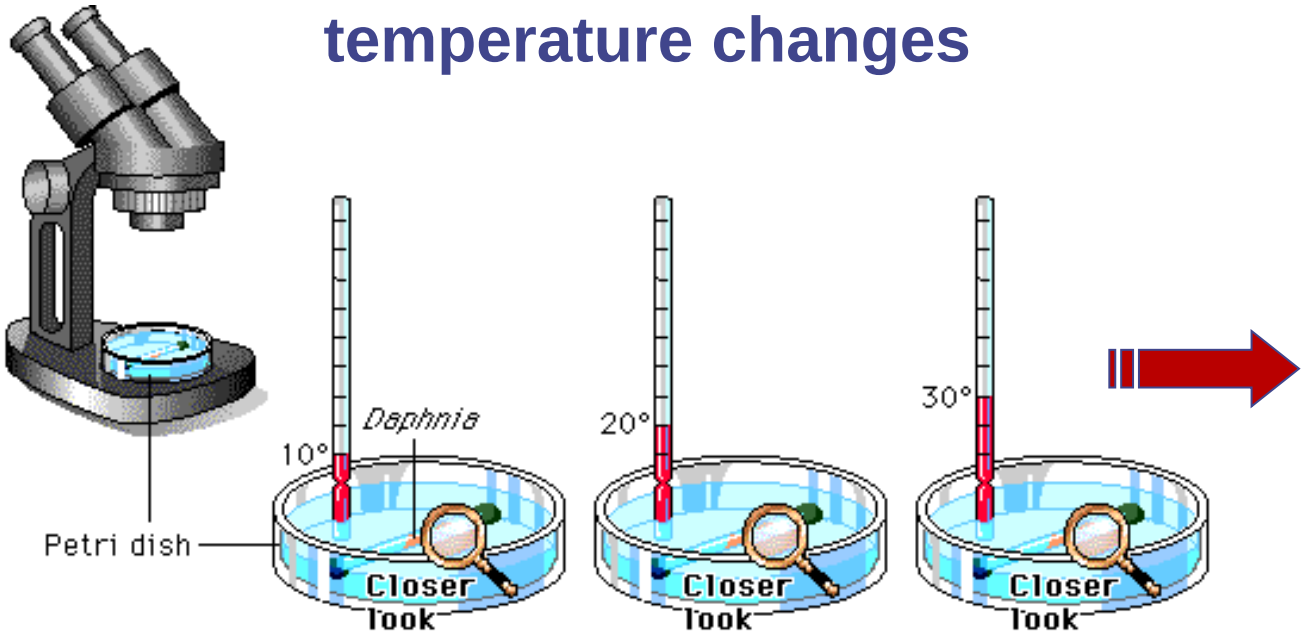
- **Concepts**
  - thermoregulation
  - endotherm
  - ectotherm
  - Q_{10}
    - measures increase in metabolic activity resulting from increase in body temperature
    - Daphnia can adjust their temperature to the environment, as temperature in environment increases, their body temperature also increases which increases their heart rate

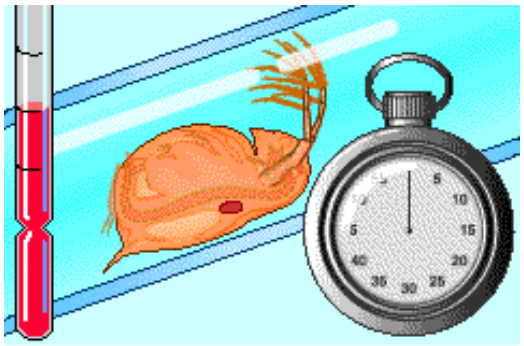




Lab : Circulatory Physiology

- **Conclusions**
  - **Activity increase heart rate**
    - **in a fit individual pulse & blood pressure are lower & will return more quickly to resting condition after exercise than in a less fit individual**
  - **Pulse rate changes in an ectotherm as external temperature changes**





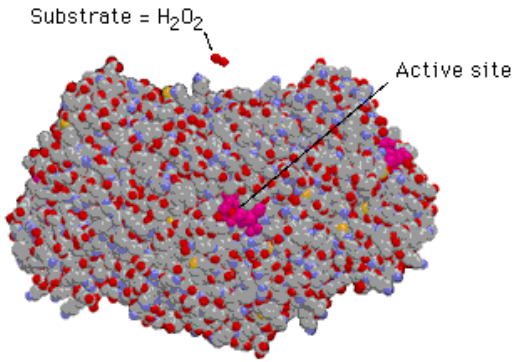
Lab 13: Enzyme Catalysis

Lab 13: Enzyme Catalysis

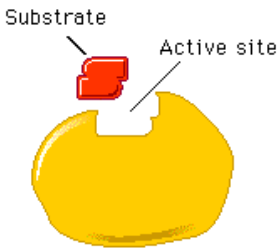
- **Description**
  - measured factors affecting enzyme activity
  - $H_2O_2 \xrightarrow{\text{peroxidase}} H_2O + O_2$
  - measured rate of O_2 production
  - Used guaiacol as an indicator
  - Design experiment to determine what other factors affect enzyme reaction (light, temperature, pH or concentrations).

Lab 13: Enzyme Catalysis

- **Concepts**
  - substrate
  - enzyme
    - enzyme structure
  - product
  - denaturation of protein
  - experimental design
    - rate of reactivity
      - reaction with enzyme vs. reaction without enzyme
    - optimum pH or temperature
      - test at various pH or temperature values



Molecular model of catalase

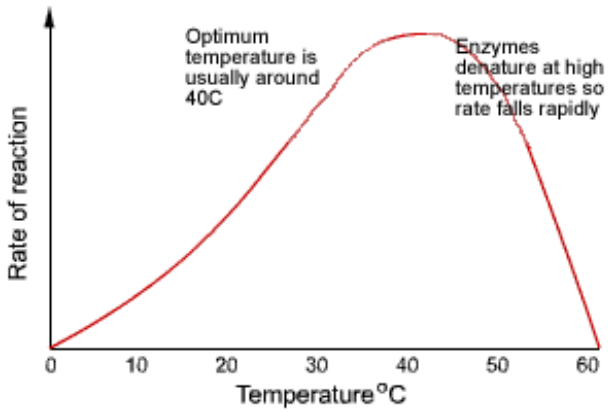


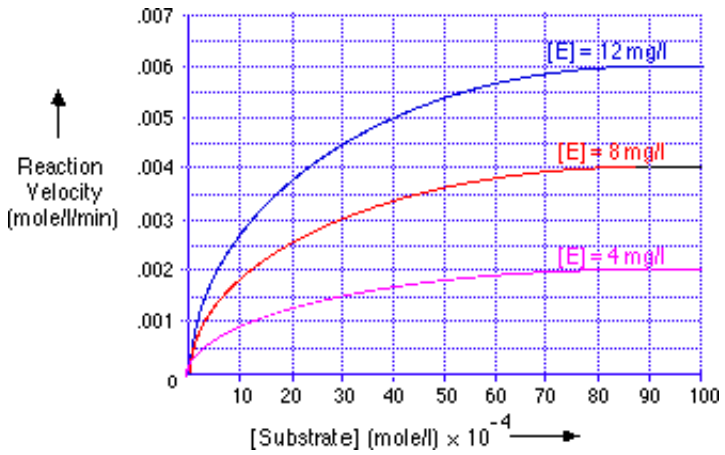
Schematic model of an enzyme

Lab 13: Enzyme Catalysis

- **Conclusions**
  - **enzyme reaction rate is affected by:**
    - **pH**
    - **temperature**
    - **substrate concentration**
    - **enzyme concentration**

calculate rate?

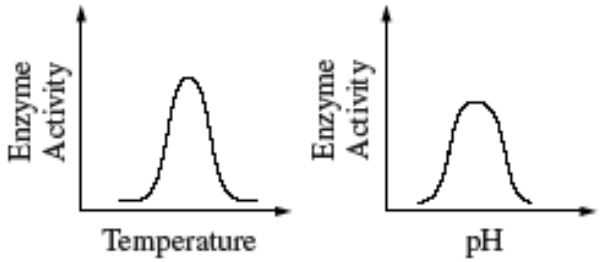




Lab 13: Enzyme Catalysis

ESSAY 2000

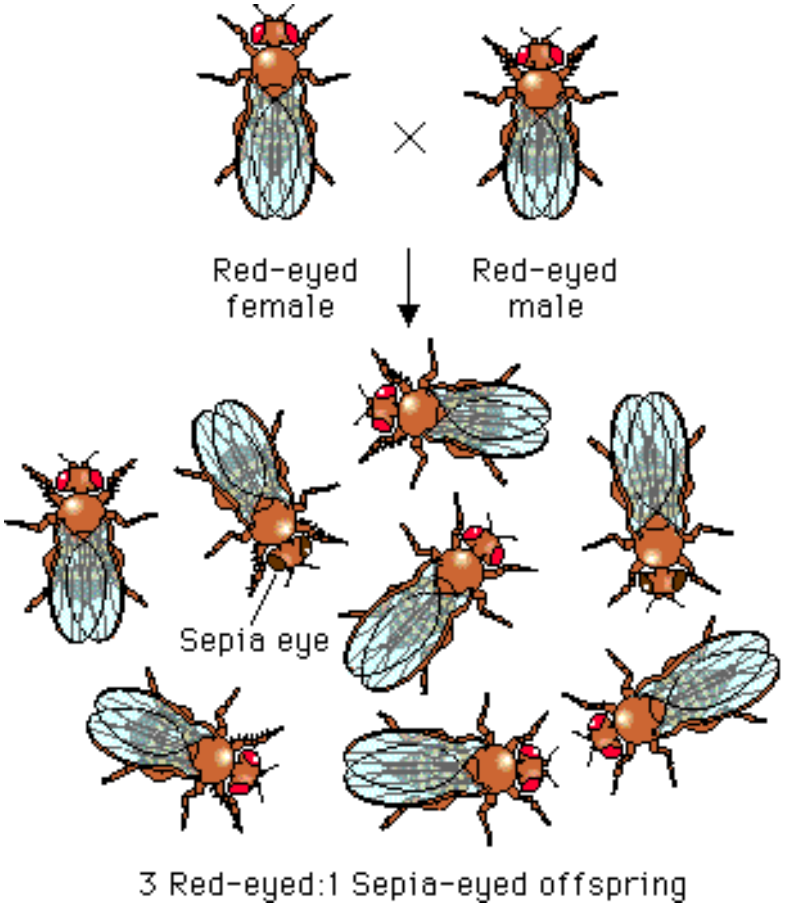
The effects of pH and temperature were studied for an enzyme-catalyzed reaction. The following results were obtained.



a. How do (1) temperature and (2) pH affect the activity of this enzyme? In your answer, include a discussion of the relationship between the structure and the function of this enzyme, as well as a discussion of ho structure and function of enzymes are affected by temperature and pH.

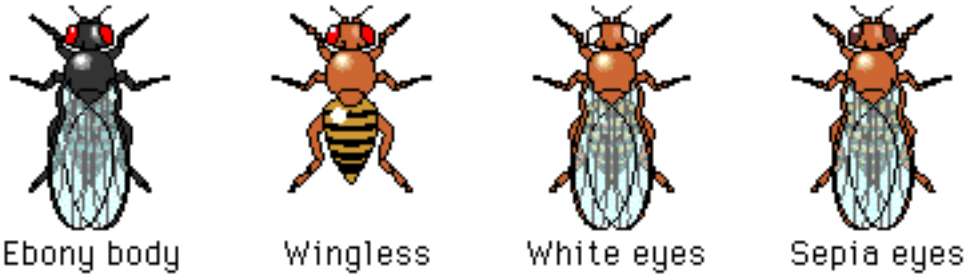
b. Describe a controlled experiment that could have produced the data shown for <u>either</u> temperature or pH. Be sure to state the hypothesis that was tested here.

Lab : (Not AP) Genetics (Fly Lab)



Lab: Genetics (Fly Lab)

- **Description**
  - given fly of unknown genotype use crosses to determine mode of inheritance of trait



Lab: Genetics (Fly Lab)

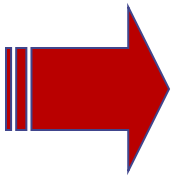
- **Concepts**
  - phenotype vs. genotype
  - dominant vs. recessive
  - P, F1, F2 generations
  - sex-linked
  - monohybrid cross
  - dihybrid cross
  - test cross
  - chi square

Lab: Genetics (Fly Lab)

- **Conclusions: Can you solve these?**

Case 1

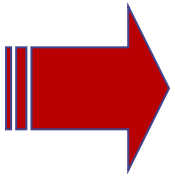
F_1 RESULTS	OBSERVED PHENOTYPES AND NUMBERS
	Red eyes
♂ MALES	12 
♀ FEMALES	8 



	OBSERVED PHENOTYPES AND NUMBERS	
F_2 RESULTS	Red eyes	Sepia eyes
♂ MALES	19 	4 
♀ FEMALES	12 	9 

Case 2

F_1 RESULTS	OBSERVED PHENOTYPES AND NUMBERS
	Red eyes
♂ MALES	12 
♀ FEMALES	8 



	OBSERVED PHENOTYPES AND NUMBERS	
F_2 RESULTS	Red eyes	White eyes
♂ MALES	12 	8 
♀ FEMALES	21 	

Lab: Genetics (Fly Lab)

ESSAY 2003 (part 1)

In fruit flies, the phenotype for eye color is determined by a certain locus. E indicates the dominant allele and e indicates the recessive allele. The cross between a male wild type fruit fly and a female white eyed fruit fly produced the following offspring

	Wild-Type Male	Wild-Type Female	White-eyed Male	White-Eyed Female	Brown-Eyed Female
F-1	0	45	55	0	1

The wild-type and white-eyed individuals from the F1 generation were then crossed to produce the following offspring.

	Wild-Type Male	Wild-Type Female	White-eyed Male	White-Eyed Female	Brown-Eyed Female
F-2	23	31	22	24	0

a. **Determine the genotypes of the original parents (P generation) and explain your reasoning. You may use Punnett squares to enhance your description, but the results from the Punnett squares must be discussed in your answer.**

b. **Use a Chi-squared test on the F2 generation data to analyze your prediction of the parental genotypes. Show all your work and explain the importance of your final answer.**

c. **The brown-eyed female of the F1 generation resulted from a mutational change. Explain what a mutation is, and discuss two types of mutations that might have produced the brown-eyed female in the F1 generation.**

Lab: Genetics (Fly Lab)

ESSAY 2003 (part 2)

Probability (p)	Degrees of Freedom (df)				
	1	2	3	4	5
.05	3.84	5.99	7.82	9.49	11.1

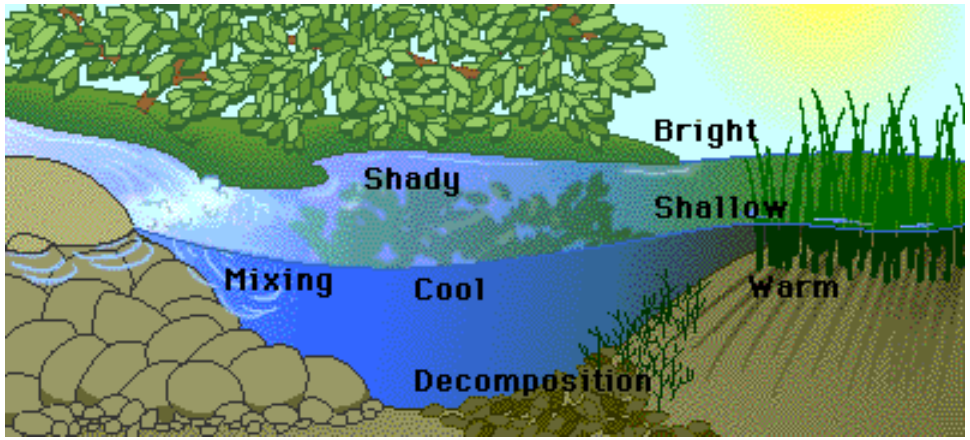
The formula for Chi-squared is:

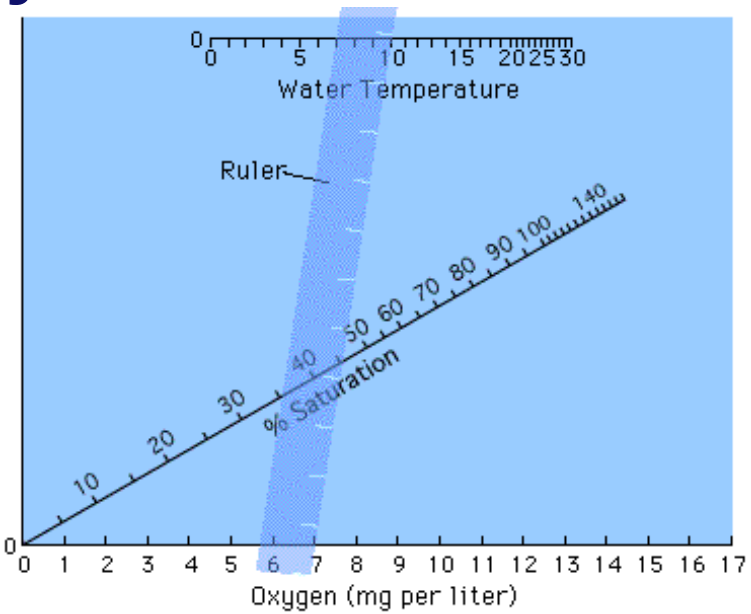
$$X^2 = \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}}$$

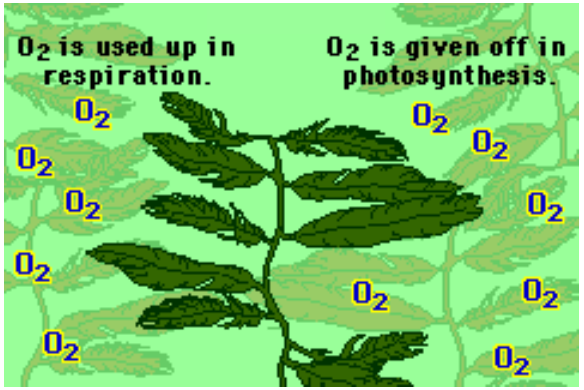
Any Questions??

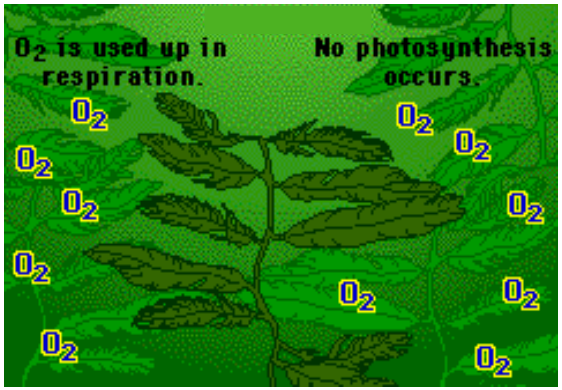
Lab : Dissolved Oxygen

- Dissolved O_2 availability

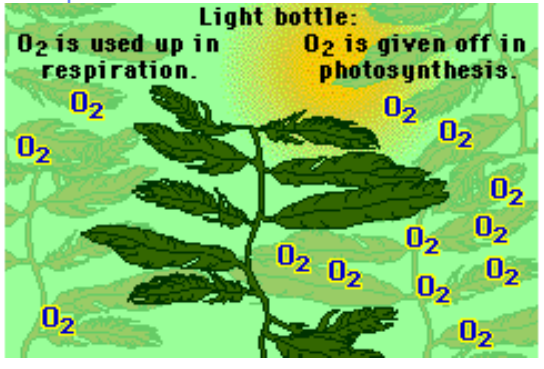


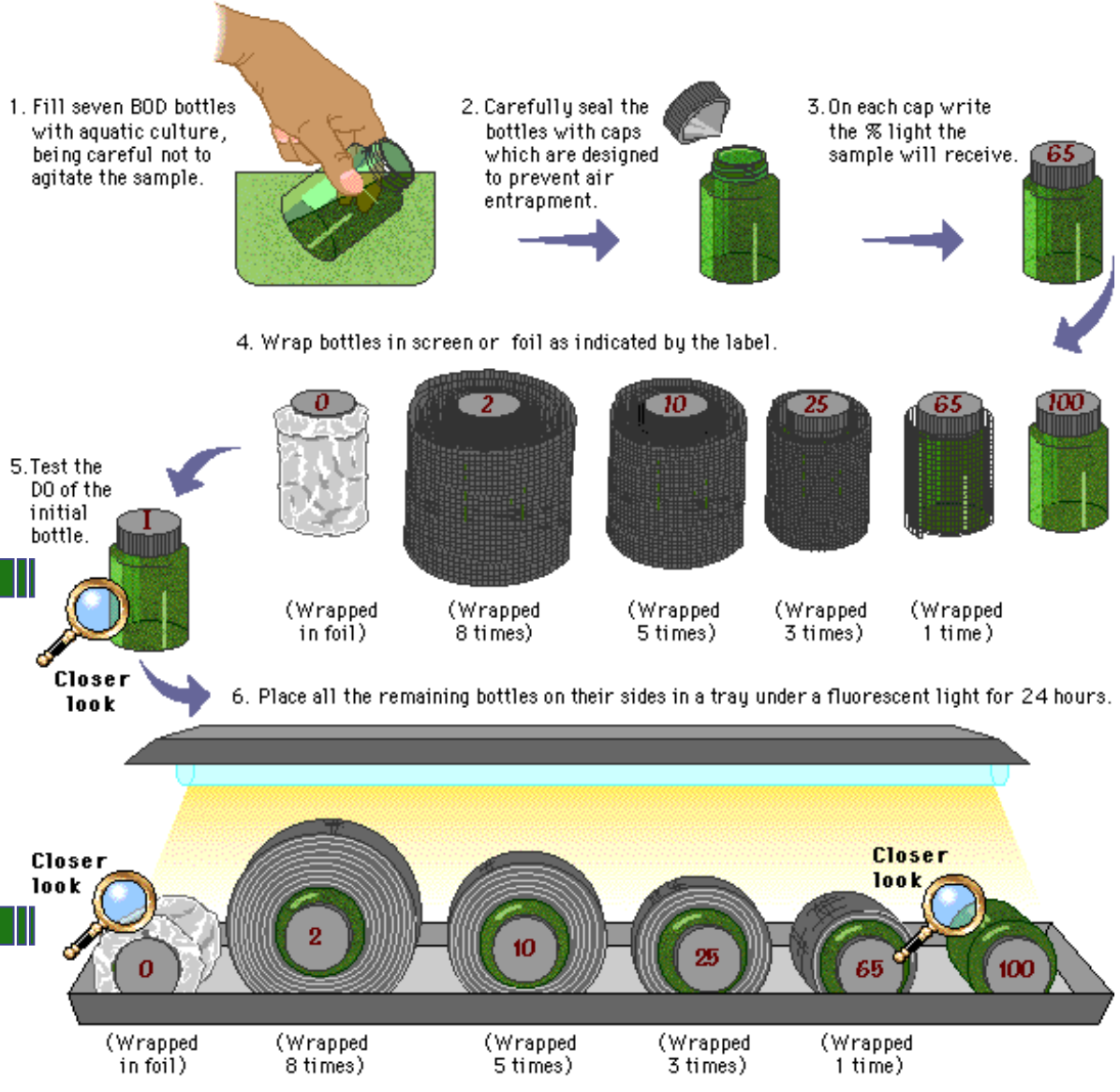






Lab : Dissolved Oxygen



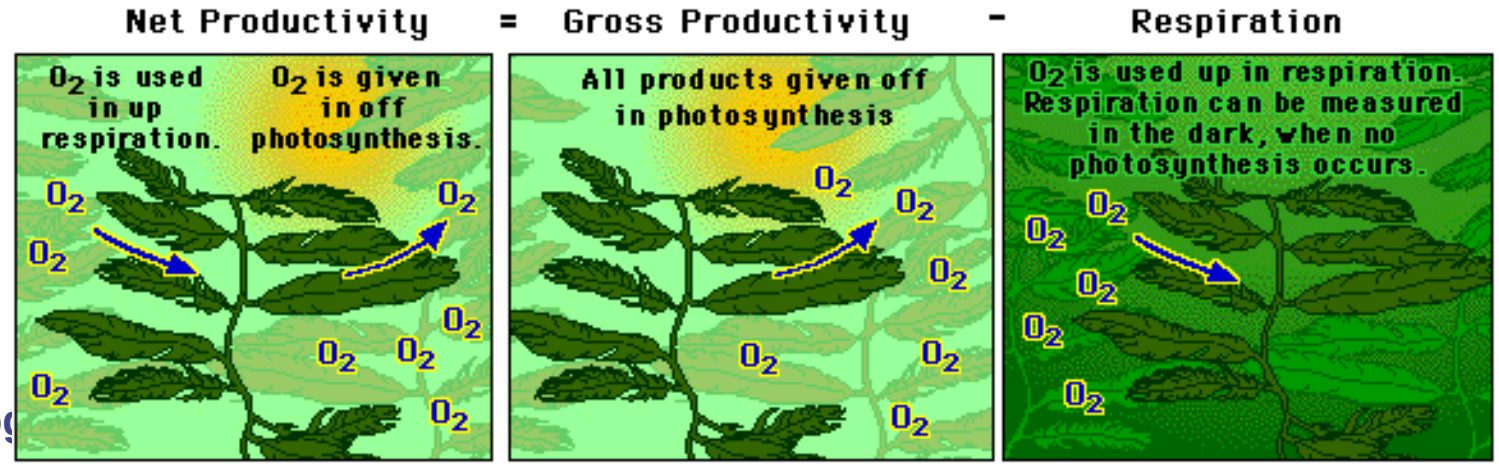


Lab : Dissolved Oxygen

- **Description**
  - measure primary productivity by measuring O_2 production
  - factors that affect amount of dissolved O_2
    - temperature
      - as ↑water temperature, its ability to hold O_2 decreases
    - photosynthetic activity
      - in bright light, aquatic plants produce more O_2
    - decomposition activity
      - as organic matter decays, microbial respiration consumes O_2
    - mixing & turbulence
      - wave action, waterfalls & rapids aerate H_2O & ↑O_2
    - salinity
      - as water becomes more salty, its ability to hold O_2 decreases

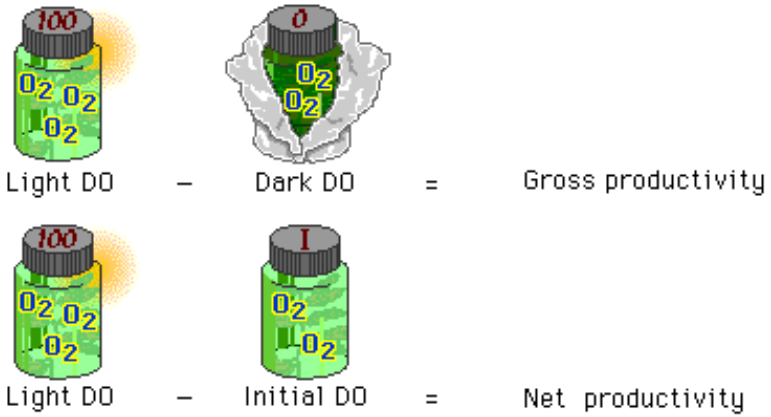
Lab : Dissolved Oxygen

- **Concepts**
  - dissolved O_2
  - primary productivity
    - measured in 3 ways:
      - amount of CO_2 used
      - rate of sugar (biomass) formation
      - rate of O_2 production
  - net productivity vs. gross productivity
  - respiration



Lab : Dissolved Oxygen

- **Conclusions**
  - ↑temperature = ↓dissolved O_2
  - ↑light = ↑photosynthesis = ↑O_2 production
  - O_2 loss from respiration
  - ↑respiration = ↓dissolved O_2 (consumption of O_2)



Lab : Dissolved Oxygen

ESSAY 2001

A biologist measured dissolved oxygen in the top 30 centimeters of a moderately eutrophic (mesotrophic) lake in the temperate zone. The day was bright and sunny and the wind was calm. The results of the observation are presented below.

a. **Using the graph paper provided, plot the results that were obtained. Then, using the same set of axes, draw and label an additional line/curve representing the results that you would predict had the day been heavily overcast.**
b. **Explain the biological processes that are operating in the lake to produce the observed data. Explain also how these processes would account for your prediction of results for a heavily overcast day.**
c. **Describe how the introduction of high levels of nutrients such as nitrates and phosphates into the lake would affect subsequent observations. Explain your predictions.**

hour	6am	8am	10am	noon	2pm	4pm	6pm	8pm	10pm	mid
$[O_2]$ mg/L	0.9	1.7	3.1	4.9	6.8	8.1	7.9	6.2	4.0	2.4

Lab : Dissolved Oxygen

ESSAY 2004B

In most aquatic environments, primary production is affected by light available to the community of organisms.

Using measurements of dissolved oxygen concentration to determine primary productivity, design a controlled experiment to test the hypothesis that primary productivity is affected by either the intensity of light or the wavelength of light. In your answer, be sure to include the following.

- **A statement of the specific hypothesis that you are testing**
- **A description of your experimental design (Be sure to include a description of what data you would collect and how you would present and analyze the data using a graph.)**
- **A description of results that would support your hypothesis**

Lab : Circulatory Physiology

ESSAY 2002

In mammals, heart rate during periods of exercise is linked to the intensity of exercise.

a. **Discuss the interactions of the respiratory, circulatory, and nervous systems during exercise.**
b. **Design a controlled experiment to determine the relationship between intensity of exercise and heart rate.**
c. **On the axes provided below, indicate results you expect for both the control and the experimental groups for the controlled experiment you described in part B. Remember to label the axes.**