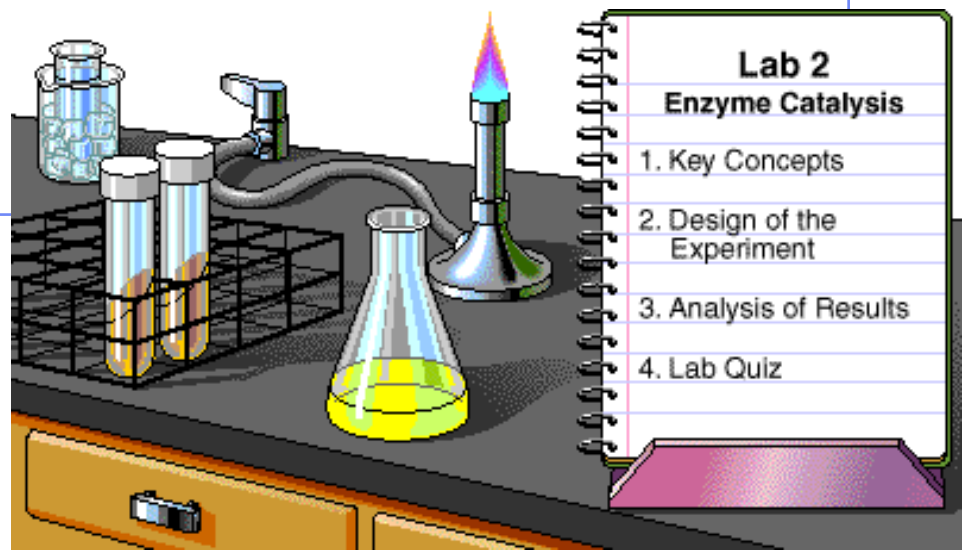
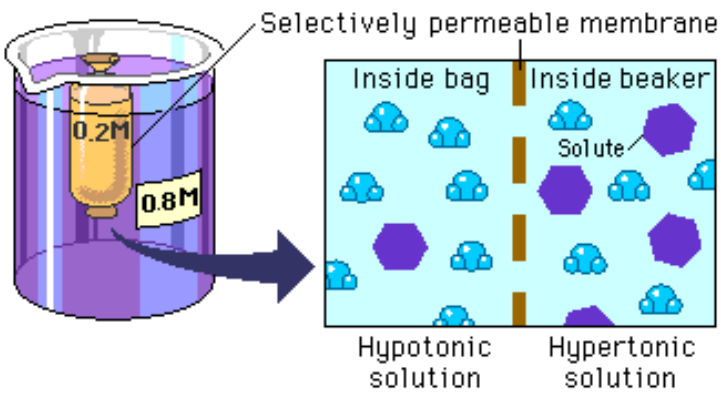
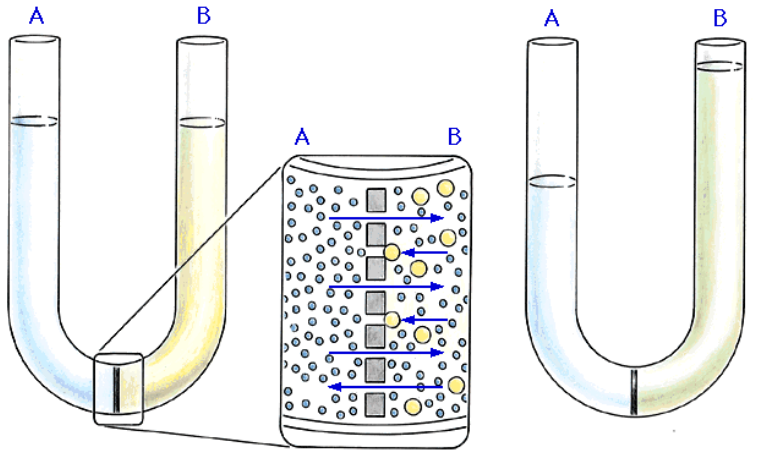
AP Biology

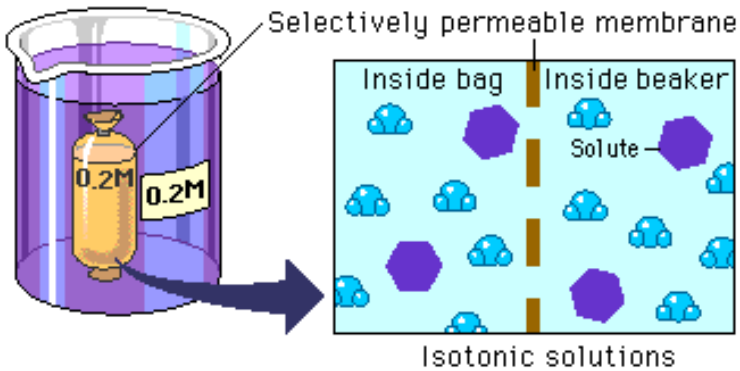
Lab Review

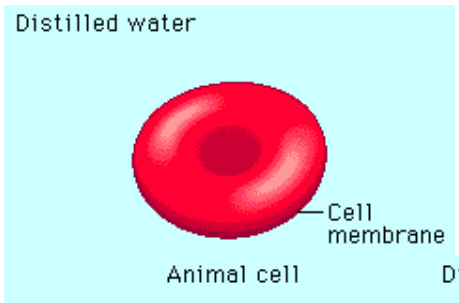


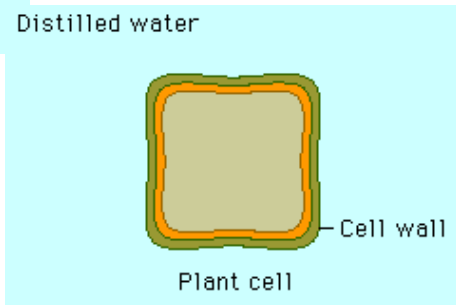
Lab 1: Diffusion & Osmosis









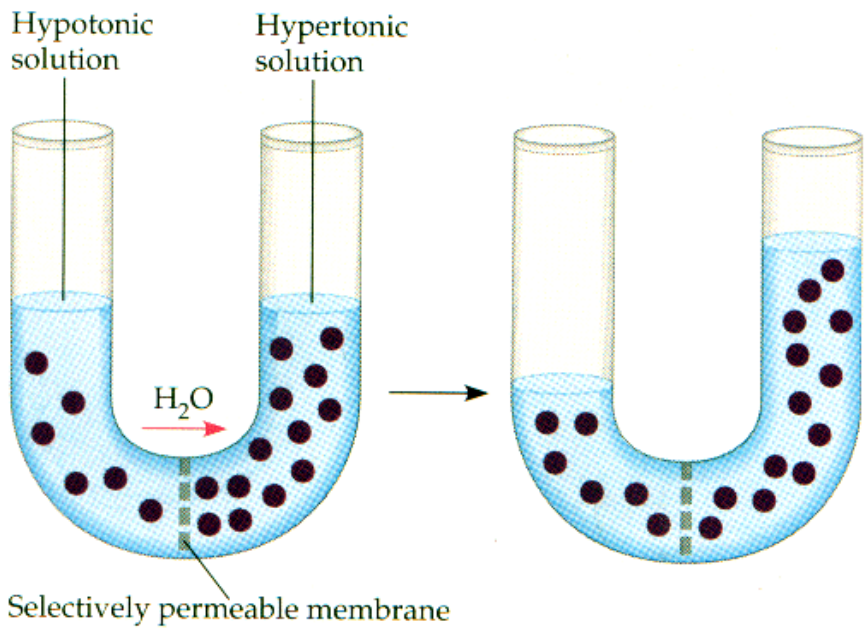


Lab 1: Diffusion & Osmosis

- **Description**
  - dialysis tubing filled with starch-glucose solution in beaker filled with KI solution
  - potato cores in sucrose solutions

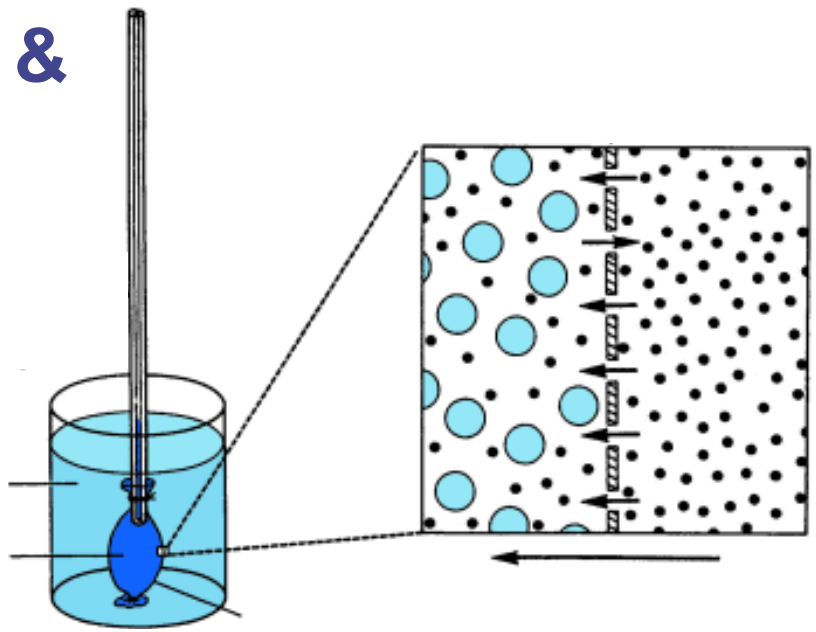
Lab 1: Diffusion & Osmosis

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



Lab 1: 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 1: 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.

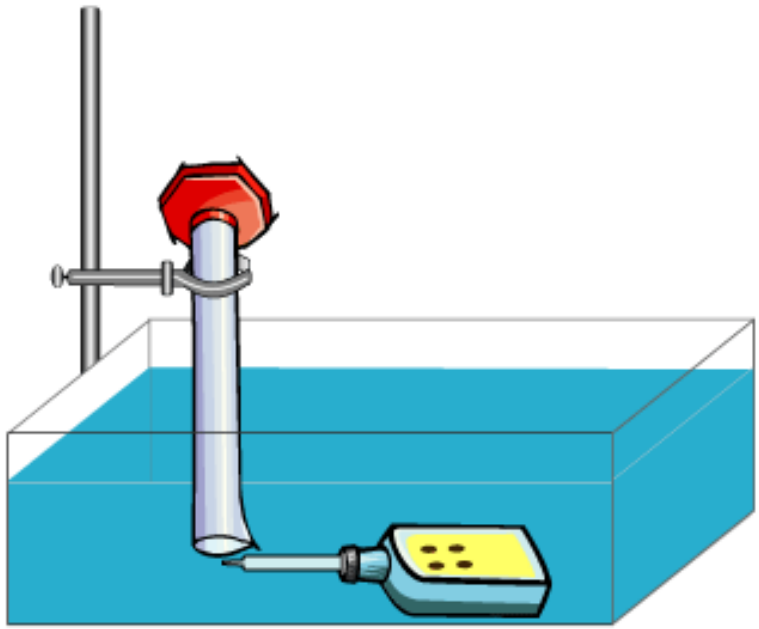
Design an experiment, based on the principles of diffusion and osmosis, that the assistant could use to determine which of the flasks contains each of the four unknown solutions.

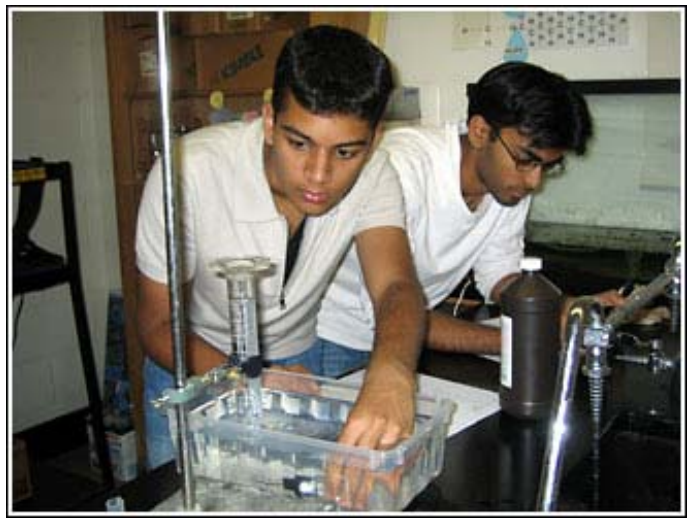
Include in your answer:

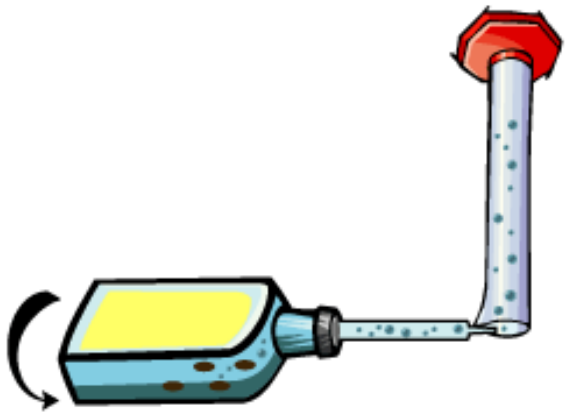
a. **a description of how you would set up and perform the experiment;**
b. **the results you would expect from your experiment; and**
c. **an explanation of those results based on the principles involved.**

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

Lab 2: Enzyme Catalysis

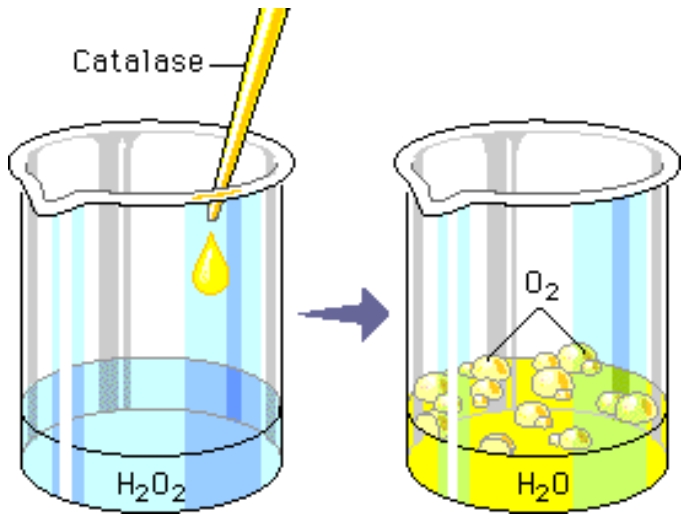






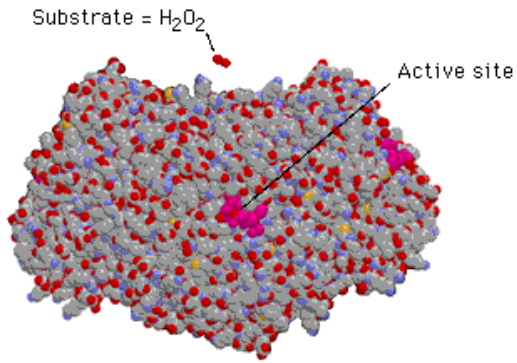
Lab 2: Enzyme Catalysis

- **Description**
  - measured factors affecting enzyme activity
  - $H_2O_2 \xrightarrow{\text{catalase}} H_2O + O_2$
  - measured rate of O_2 production

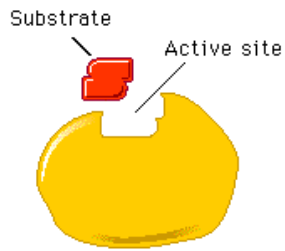


Lab 2: Enzyme Catalysis

- 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

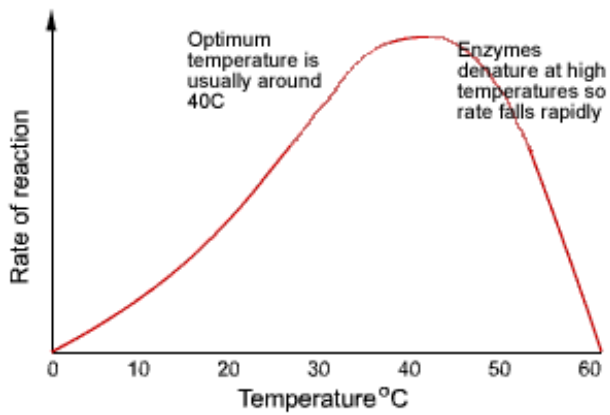


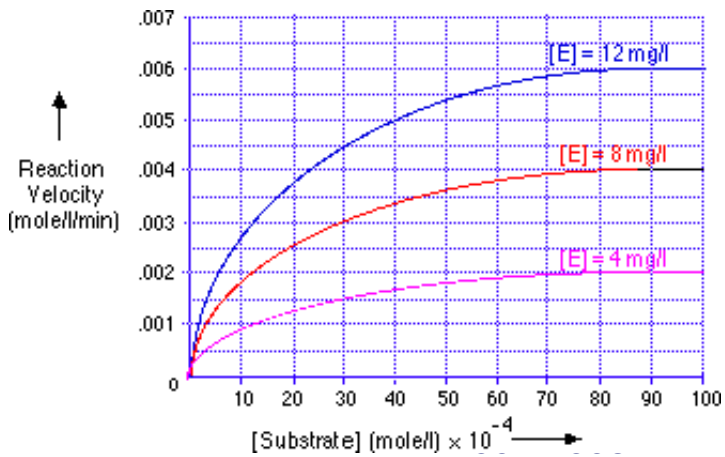
Schematic model of an enzyme

Lab 2: Enzyme Catalysis

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

calculate rate?

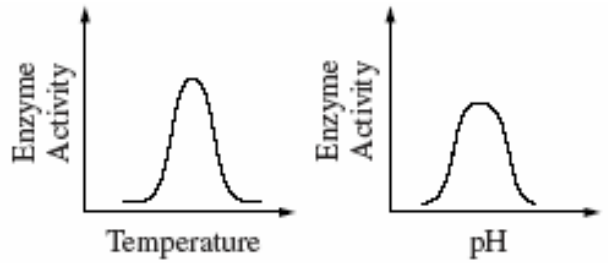




Lab 2: Enzyme Catalysis

ESSAY 2000

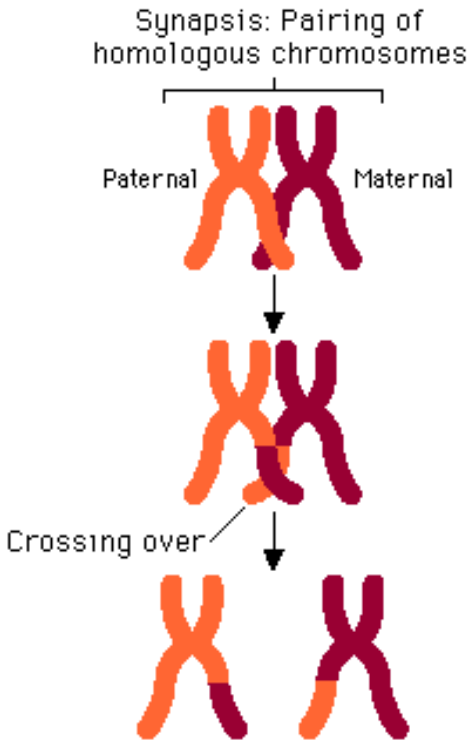
The effects of pH and temperature were studied for an enzyme-catalyzed reaction. The following results were obtained.

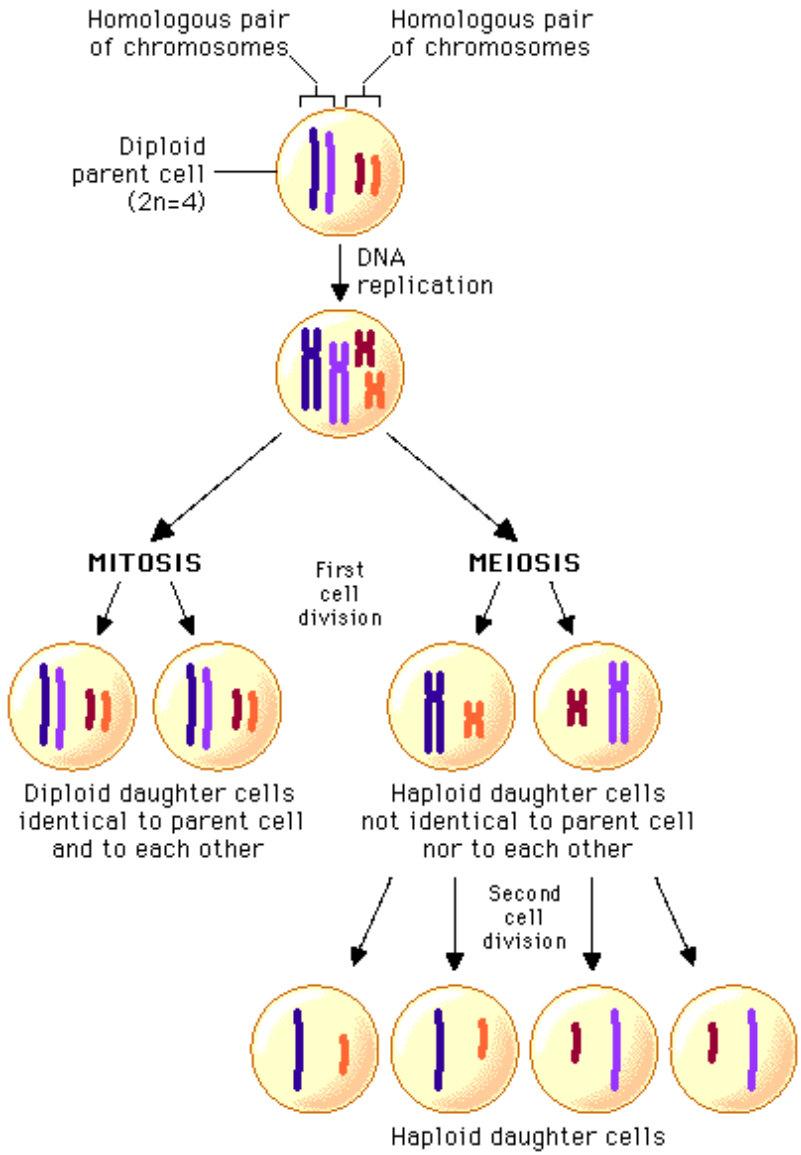


a. How do (1) temperature and (2) pH affect the activity of this enzyme? In your answer, include a discussion of the relationship between the structure and the function of this enzyme, as well as a discussion of ho structure and function of enzymes are affected by temperature and pH.

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

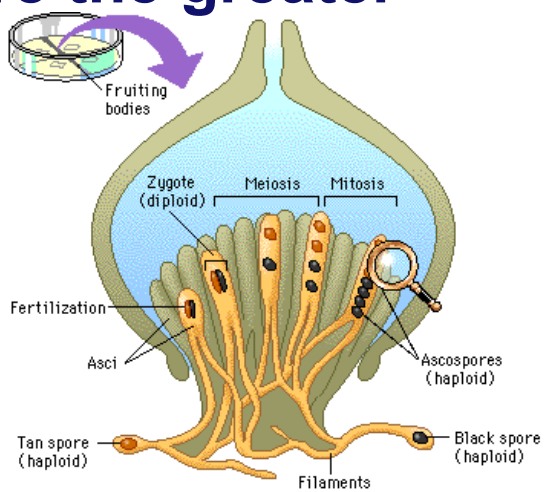
Lab 3: Mitosis & Meiosis





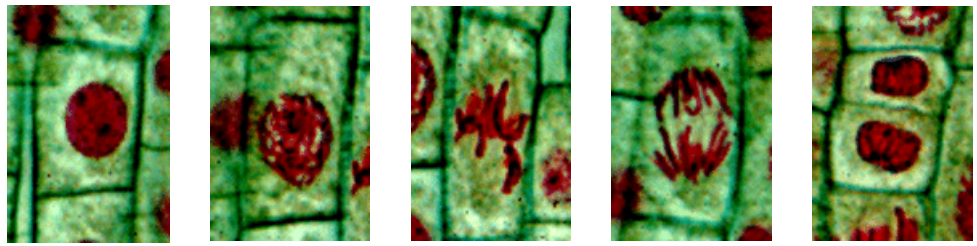
Lab 3: Mitosis & Meiosis

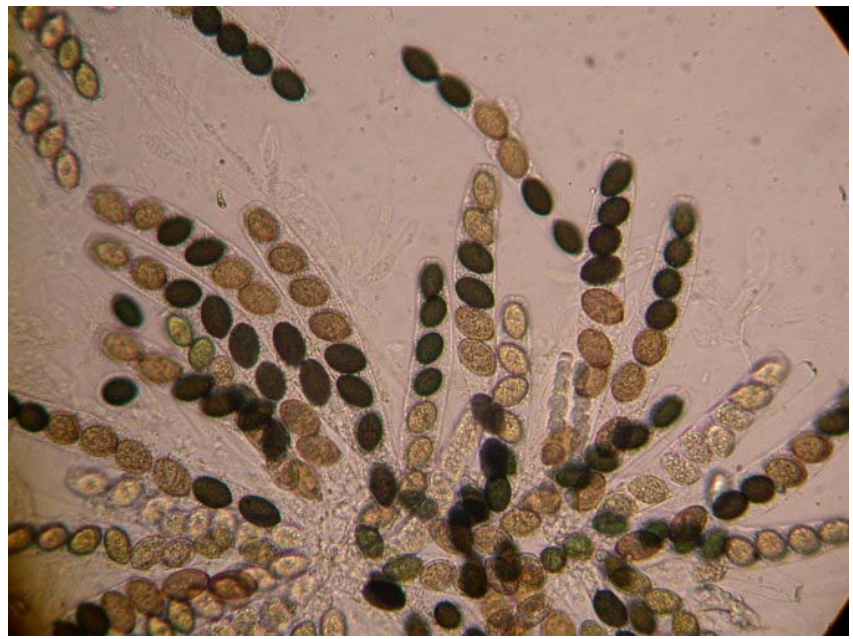
- **Description**
  - cell stages of mitosis
    - exam slide of onion root tip
    - count number of cells in each stage to determine relative time spent in each stage
  - crossing over in meiosis
    - farther gene is from centromere the greater number of crossovers
    - observed crossing over in fungus, *Sordaria*
      - arrangement of ascospores



Lab 3: Mitosis & Meiosis

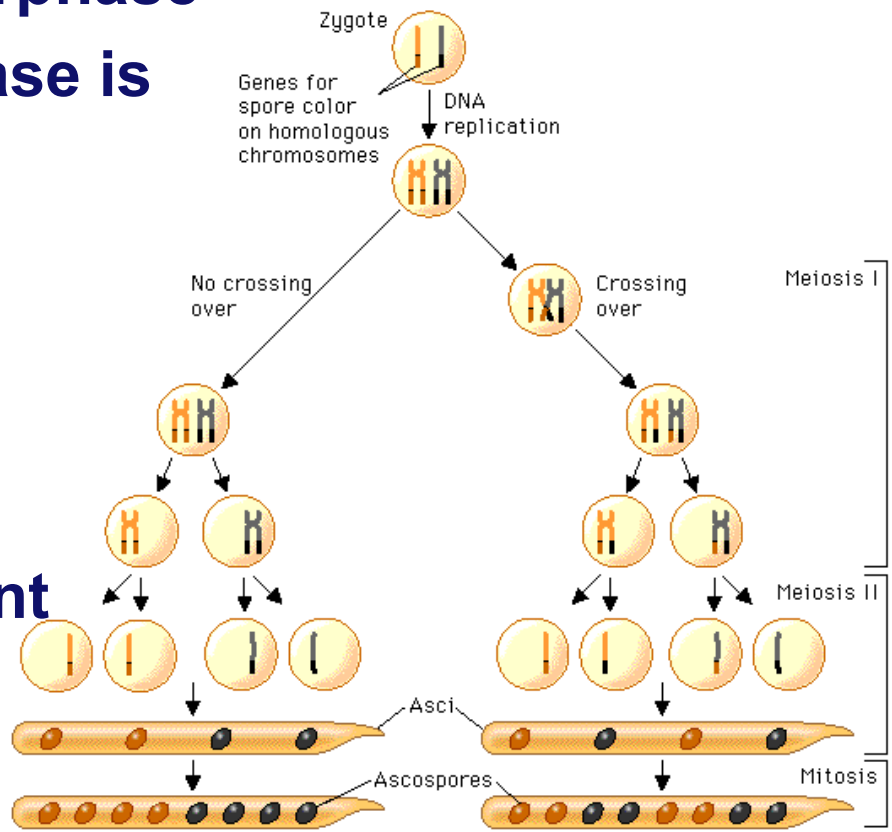
- Concepts
  - mitosis
    - interphase
    - prophase
    - metaphase
    - anaphase
    - telophase
  - meiosis
    - meiosis 1
    - meiosis 2
  - crossing over
    - tetrad in prophase 1





Lab 3: Mitosis & Meiosis

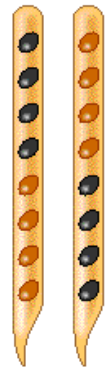
- Conclusions
  - Mitosis
    - longest phase = interphase
    - each subsequent phase is shorter in duration
  - Meiosis
    - 4:4 arrangement in ascospores
      - no crossover
    - any other arrangement
      - crossover
      - 2:2:2:2 or 2:4:2



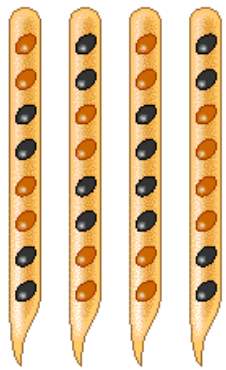
Sordaria analysis

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

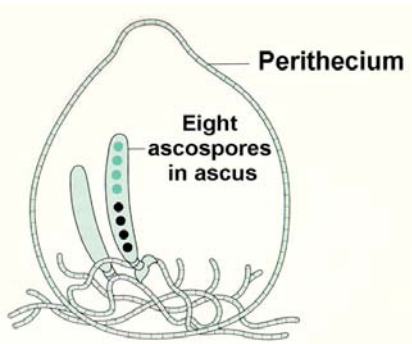
$$\text{distance from centromere} = \frac{\%\ \text{crossover}}{2}$$

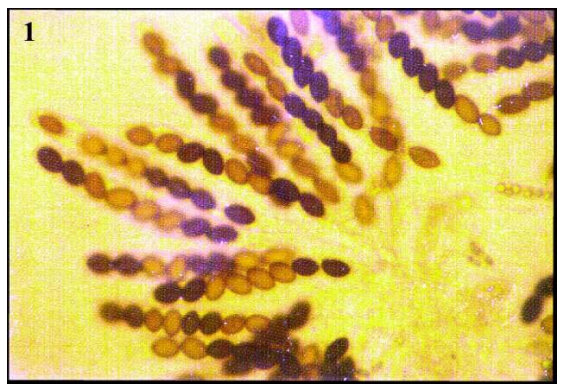


A. No crossing over



B. Crossing over during meiosis





Lab 3: 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.

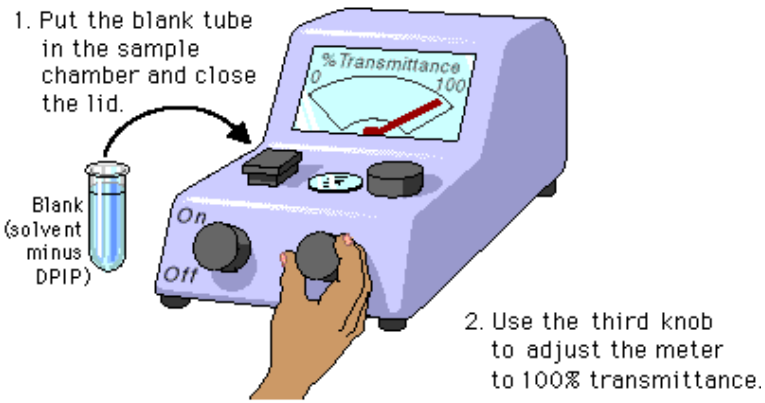
a. Explain how the reduction and rearrangement are accomplished in meiosis.

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.

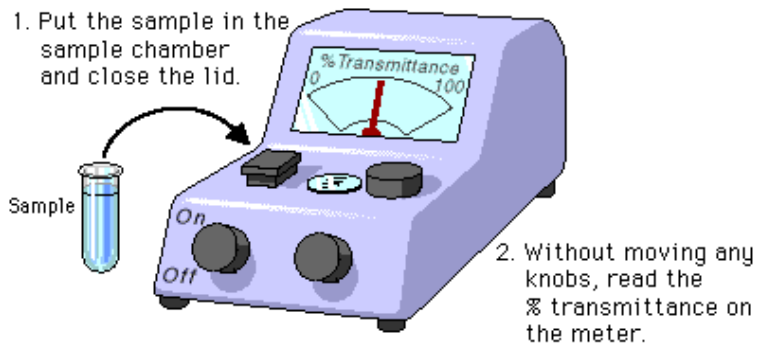
c. Production of offspring by parthenogenesis or cloning bypasses the typical meiotic process. Describe either parthenogenesis or cloning and compare the genomes of the offspring with those of the parents.

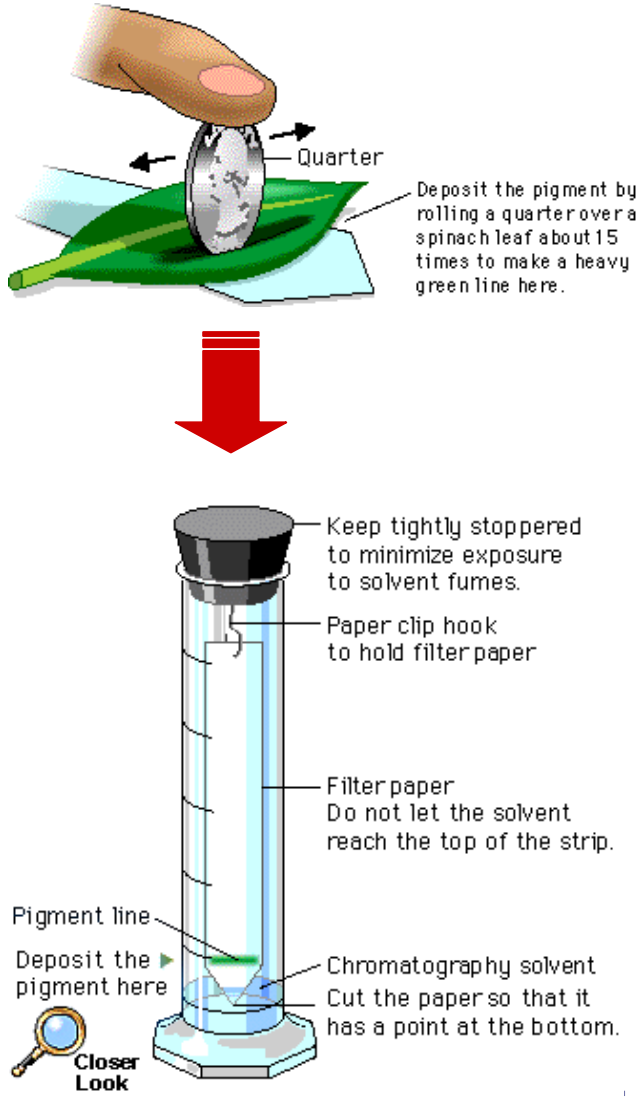
Lab 4: Photosynthesis

B. Calibrate the Spectrophotometer ("blanking")



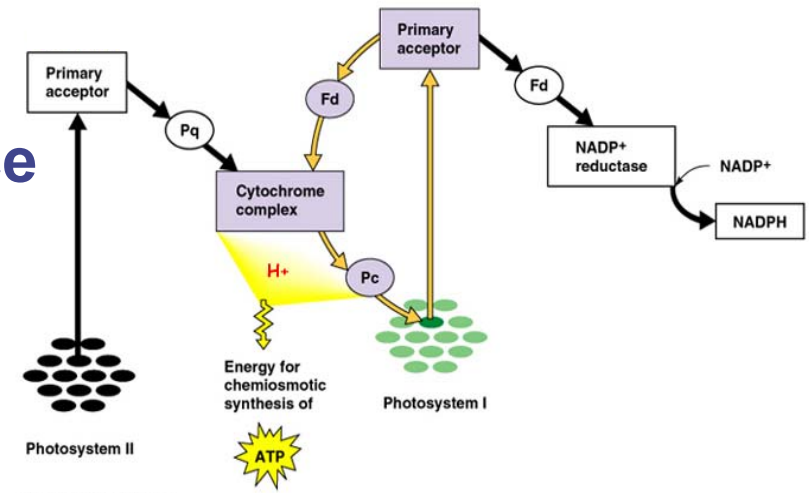
C. Read the Sample





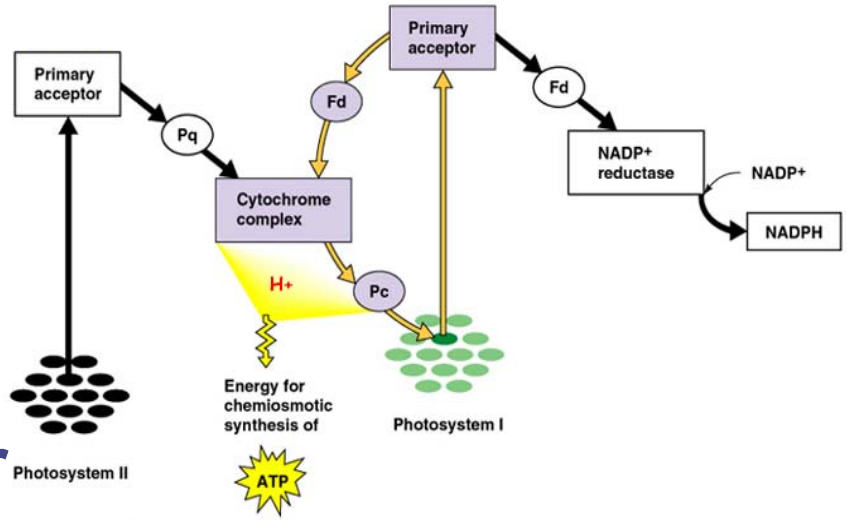
Lab 4: Photosynthesis

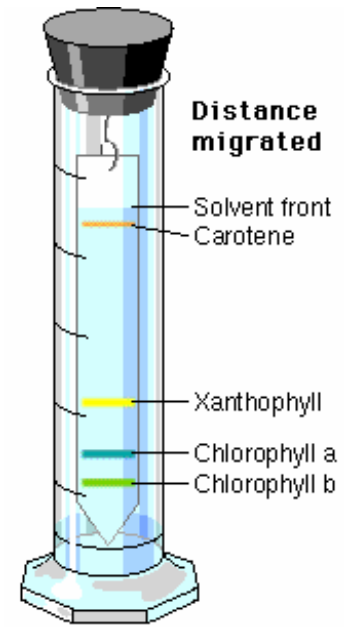
- **Description**
  - determine rate of photosynthesis under different conditions
    - light vs. dark
    - boiled vs. unboiled chloroplasts
    - chloroplasts vs. no chloroplasts
  - use DPIP in place of $NADP^+$
    - $DPIP_{ox}$ = blue
    - $DPIP_{red}$ = clear
  - measure light transmittance
  - paper chromatography to separate plant pigments



Lab 4: Photosynthesis

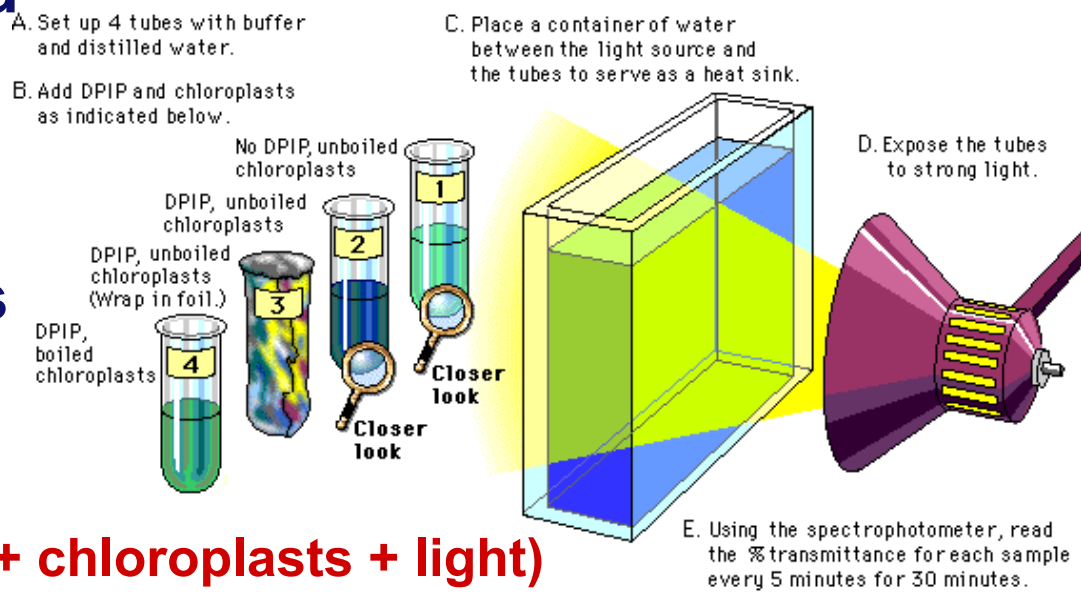
- Concepts
  - photosynthesis
  - Photosystem 1
    - NADPH
  - chlorophylls & other plant pigments
    - chlorophyll a
    - chlorophyll b
    - xanthophylls
    - carotenoids
  - experimental design
    - control vs. experimental





Lab 4: Photosynthesis

- **Conclusions**
  - **Pigments**
    - pigments move at different rates based on solubility in solvent
  - **Photosynthesis**
    - light & unboiled chloroplasts produced highest rate of photosynthesis



Which is the control? **#2 (DPIP + chloroplasts + light)**

Lab 4: Photosynthesis

ESSAY 2004 (part 1)

A controlled experiment was conducted to analyze the effects of darkness and boiling on the photosynthetic rate of incubated chloroplast suspensions. The dye reduction technique was used. Each chloroplast suspension was mixed with DPIP, an electron acceptor that changes from blue to clear when it is reduced. Each sample was placed individually in a spectrophotometer and the percent transmittance was recorded. The three samples used were prepared as follows.

Sample 1 — chloroplast suspension + DPIP

Sample 2 — chloroplast suspension surrounded by foil wrap to provide a dark environment + DPIP

Sample 3 — chloroplast suspension that has been boiled + DPIP

Data are given in the table on the next page.

a. Construct and label a graph showing the results for the three samples.

b. Identify and explain the control or controls for this experiment.

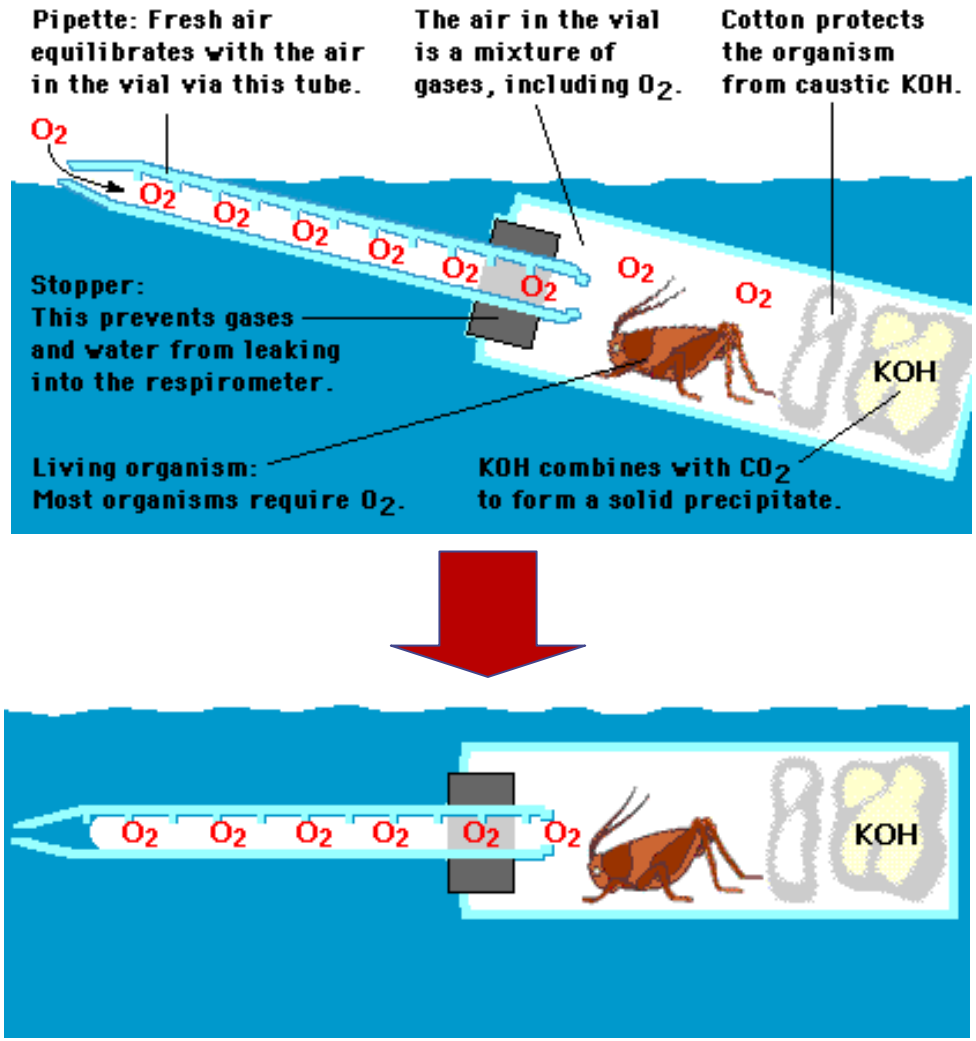
c. The differences in the curves of the graphed data indicate that there were differences in the number of electrons produced in the three samples during the experiment. Discuss how electrons are generated in photosynthesis and why the three samples gave different transmittance results.

Lab 4: Photosynthesis

ESSAY 2004 (part 2)

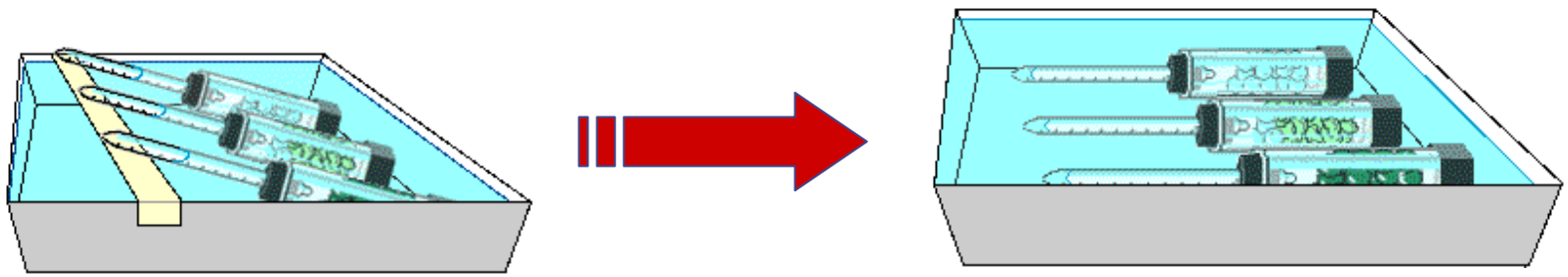
Time (min)	Light, Unboiled % transmittance Sample 1	Dark, Unboiled % transmittance Sample 2	Light, Boiled % transmittance Sample 3
0	28.8	29.2	28.8
5	48.7	30.1	29.2
10	57.8	31.2	29.4
15	62.5	32.4	28.7
20	66.7	31.8	28.5

Lab 5: Cellular Respiration



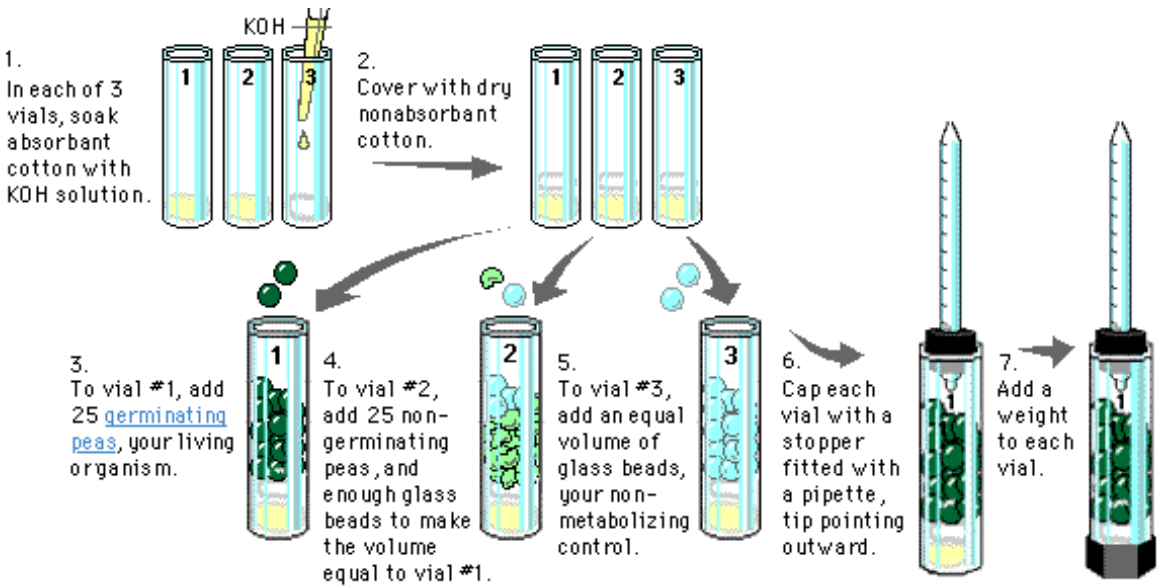
Lab 5: Cellular Respiration

- **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



Lab 5: Cellular Respiration

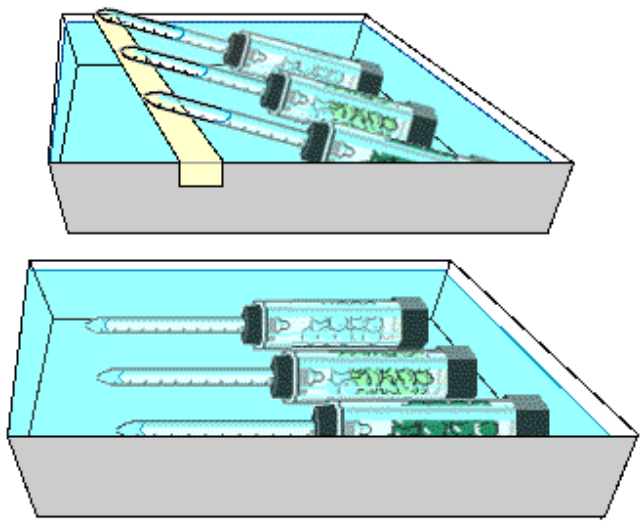
- Concepts
  - respiration
  - experimental design
    - control vs. experimental
    - function of KOH
    - function of vial with only glass beads



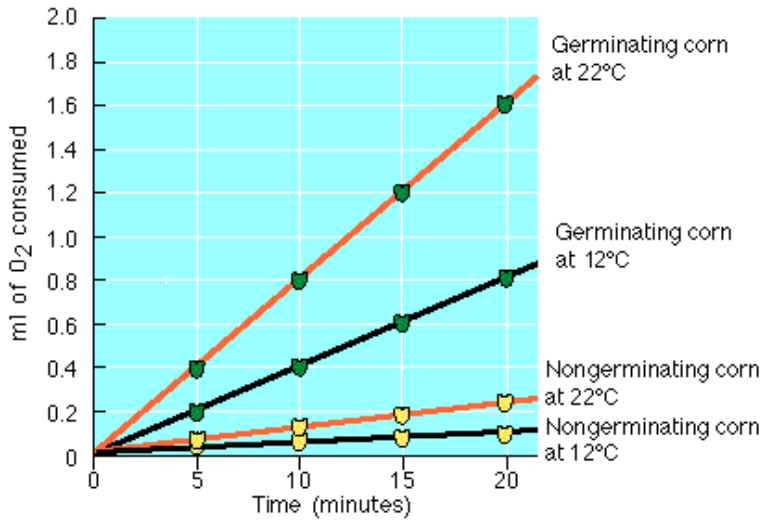
Lab 5: Cellular Respiration

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

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.



calculate rate?



2004-2005

Lab 5: 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.

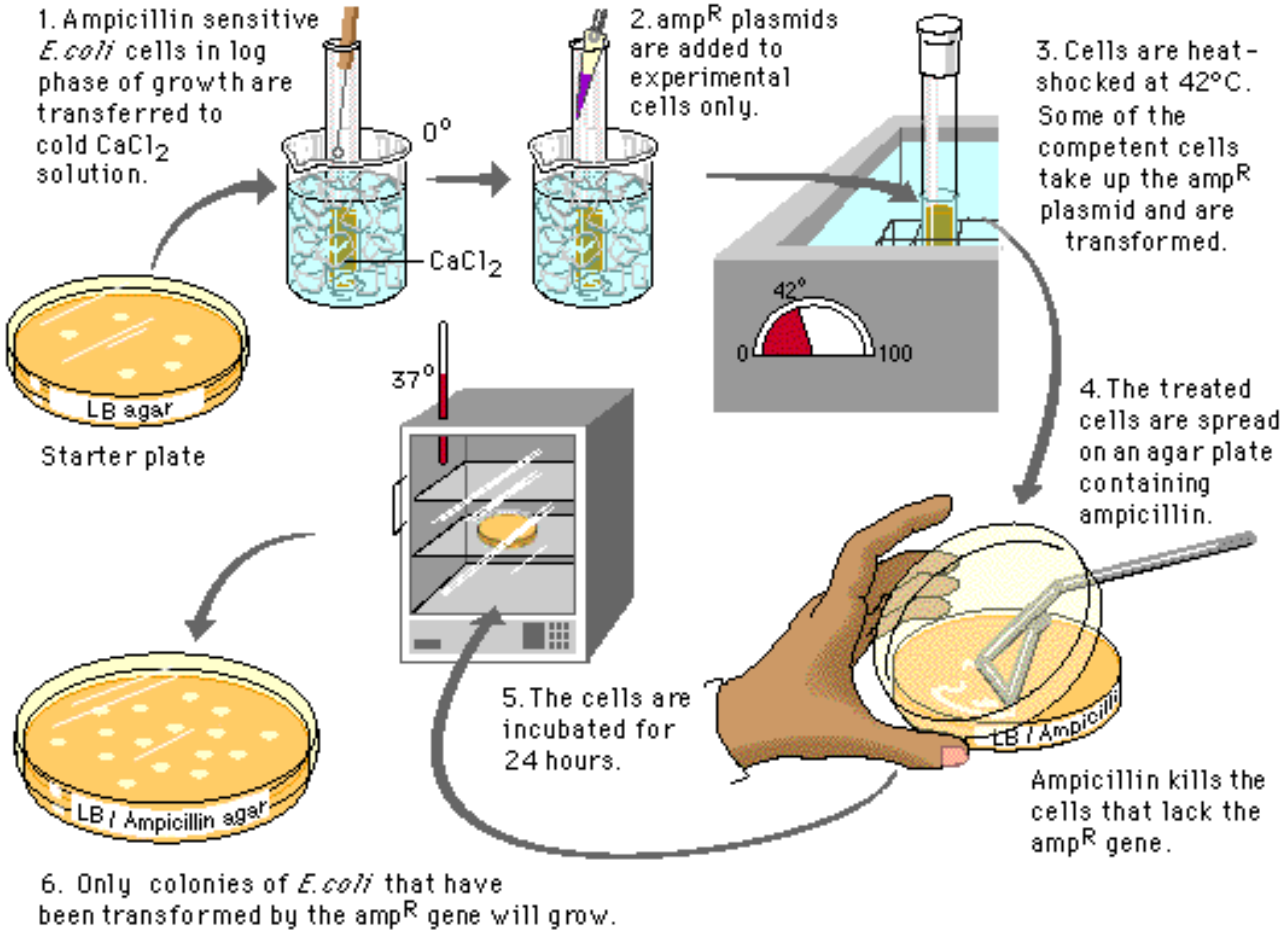
b. Calculate the rate of oxygen consumption for the germinating seeds at 22°C, using the time interval between 10 and 20 minutes.

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

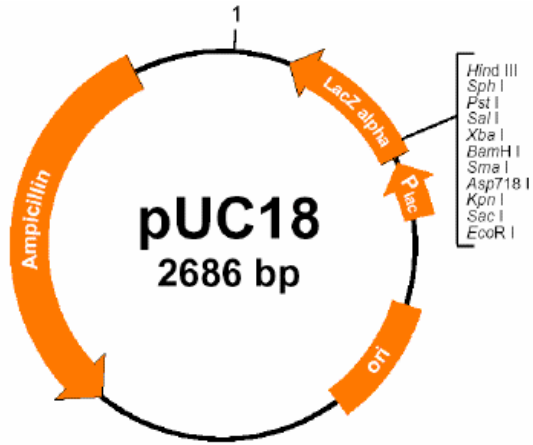
   1. germinating seeds at 22°C and at 10°C
   2. germinating seeds and dry seeds.

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.

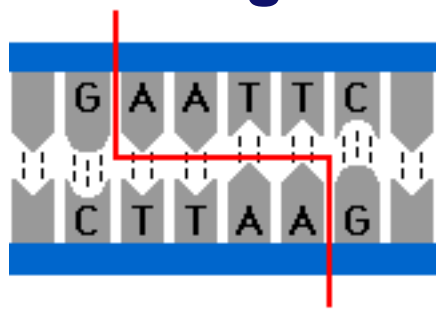
Lab 6: Molecular Biology

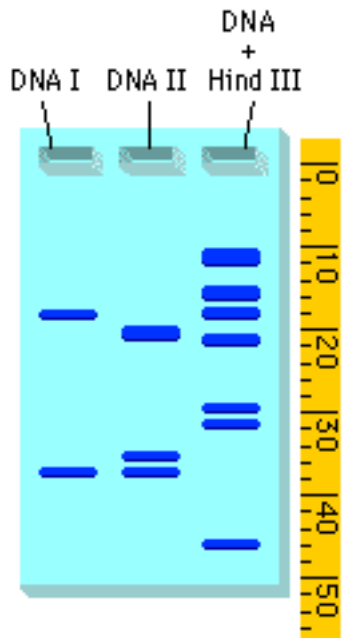


Lab 6: Molecular Biology



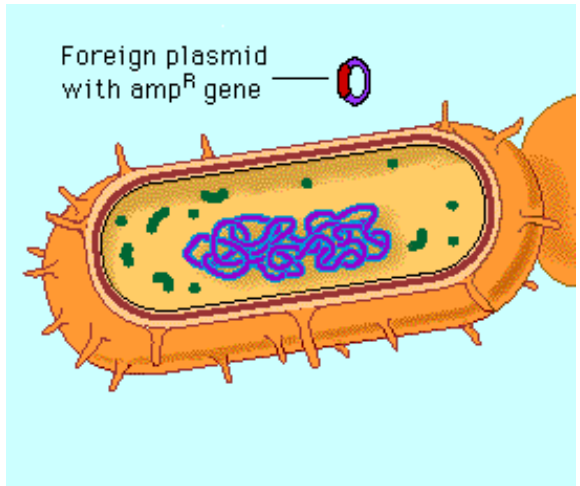
- **Description**
  - **Transformation**
    - insert foreign gene in bacteria by using engineered plasmid
    - also insert ampicillin resistant gene on same plasmid as selectable marker
  - **Gel electrophoresis**
    - cut DNA with restriction enzyme
    - fragments separate on gel based on size

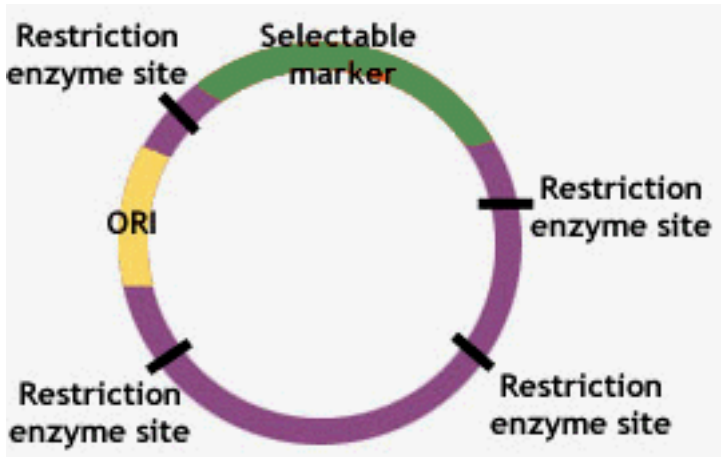




Lab 6: Molecular Biology

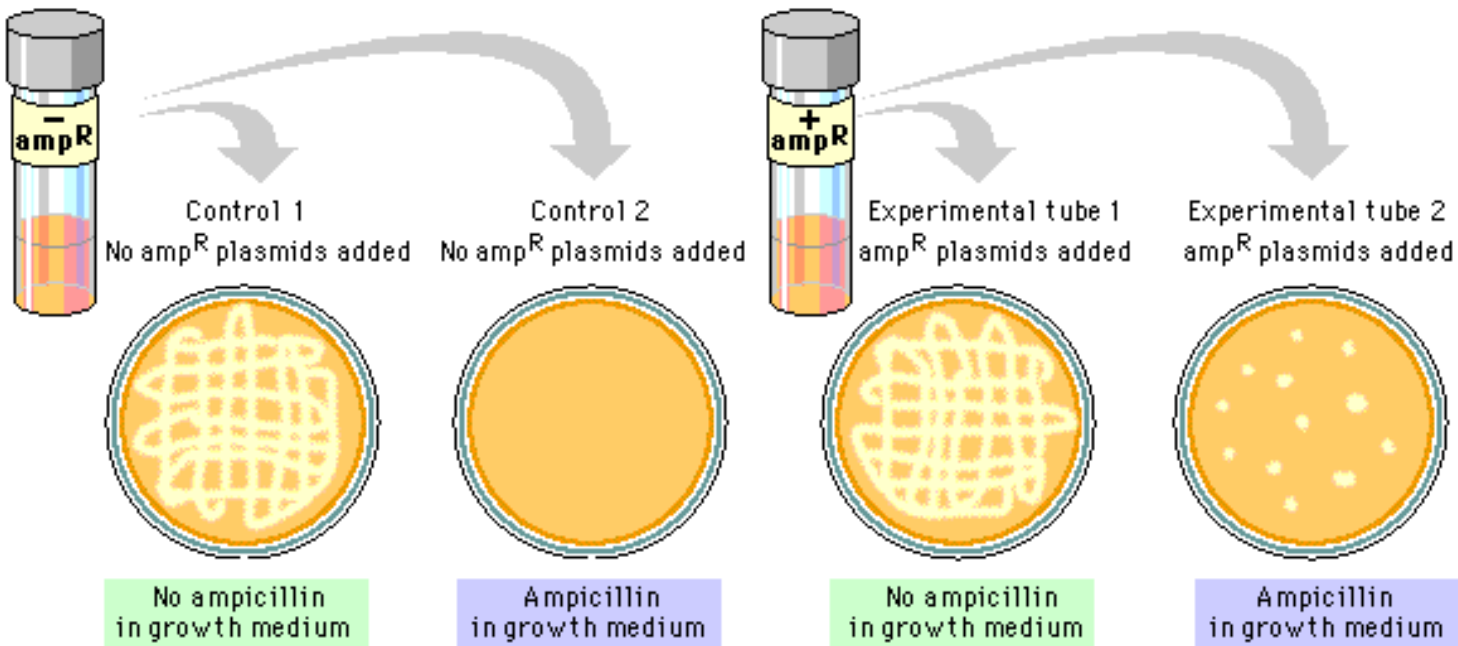
- Concepts
  - transformation
  - plasmid
  - selectable marker
    - ampicillin resistance
  - restriction enzyme
  - gel electrophoresis
    - DNA is negatively charged
    - smaller fragments travel faster





Lab 6: Transformation

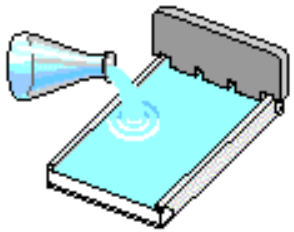
- Conclusions
  - can insert foreign DNA using vector
  - ampicillin becomes selecting agent
    - no transformation = no growth on amp$^+$ plate



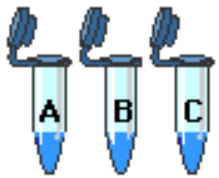
Lab 6: Gel Electrophoresis

- **Conclusions**

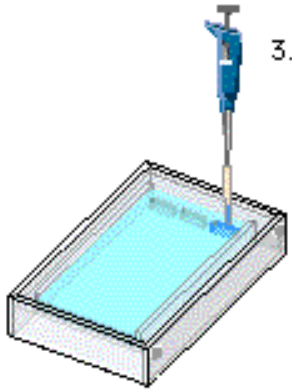
1. Make gel.



2. Obtain prepared DNA samples.

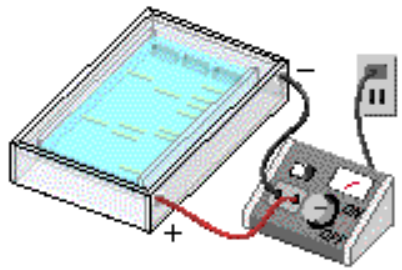


3. Load samples into gel.



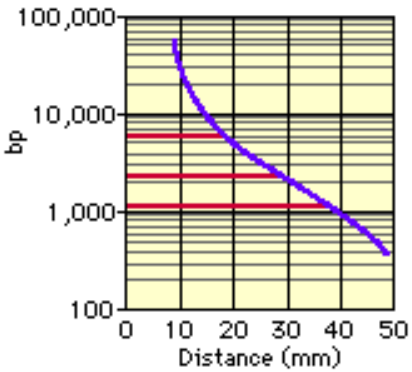
DNA = negatively charged

4. Separate fragments by electrophoresis.

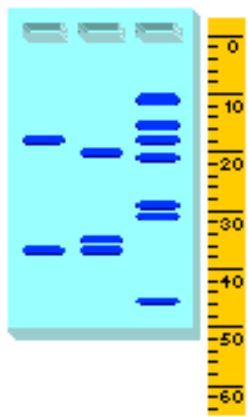


correlate distance to size

6. Prepare a standard curve. Determine fragment sizes.



5. Stain DNA fragments and measure distances.

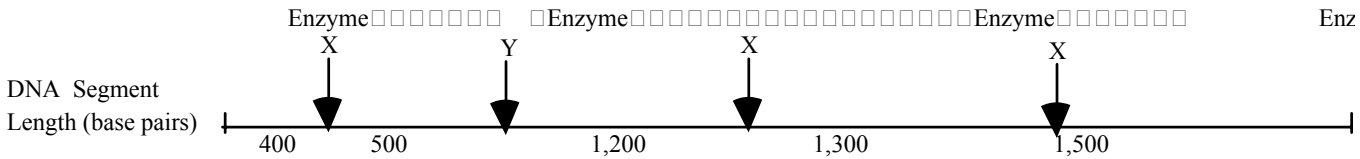


smaller fragments travel faster & therefore farther

Lab 6: 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 6: Molecular Biology

ESSAY 2002

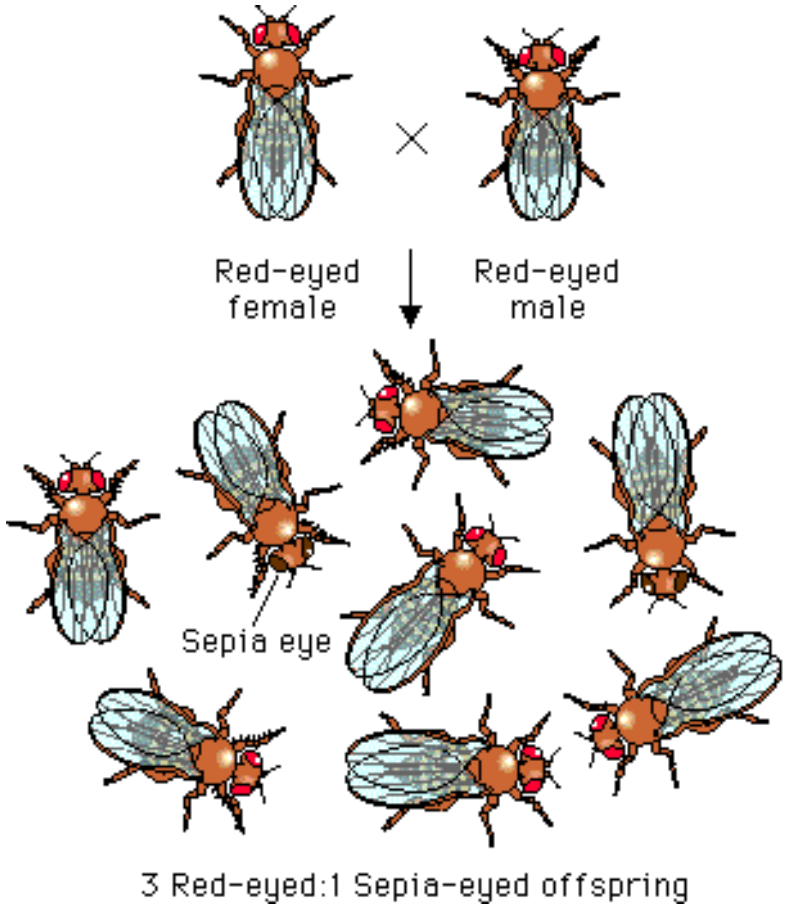
The human genome illustrates both continuity and change.

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)**

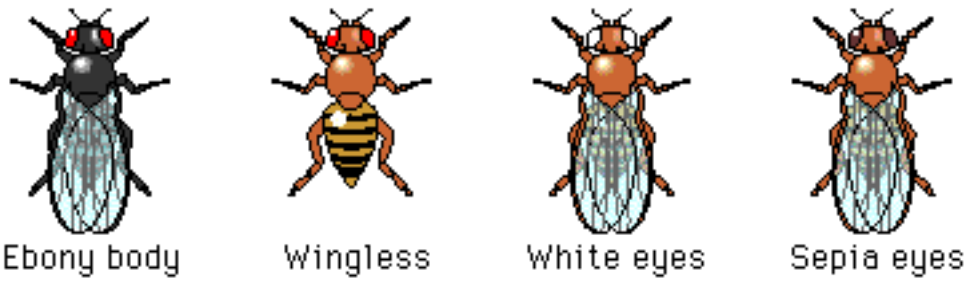
b. All humans are nearly identical genetically in coding sequences and have many proteins that are identical in structure and function. Nevertheless, each human has a unique DNA fingerprint. Explain this apparent contradiction.

Lab 7: Genetics (Fly Lab)



Lab 7: Genetics (Fly Lab)

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



Lab 7: Genetics (Fly Lab)

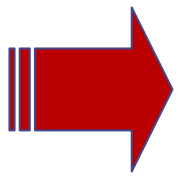
- **Concepts**
  - phenotype vs. genotype
  - dominant vs. recessive
  - P, F1, F2 generations
  - sex-linked
  - monohybrid cross
  - dihybrid cross
  - test cross
  - chi square

Lab 7: Genetics (Fly Lab)

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

Case 1

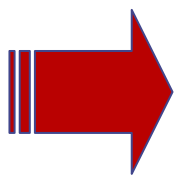
F_1 RESULTS	OBSERVED PHENOTYPES AND NUMBERS
	Red eyes
♂ MALES	12 
♀ FEMALES	8 



	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 7: 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 Female	Wild-Type Female	White-eyed Female	White-Eyed Male	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 Female	Wild-Type Female	White-eyed Female	White-Eyed Male	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 7: Genetics (Fly Lab)

ESSAY 2003 (part 2)

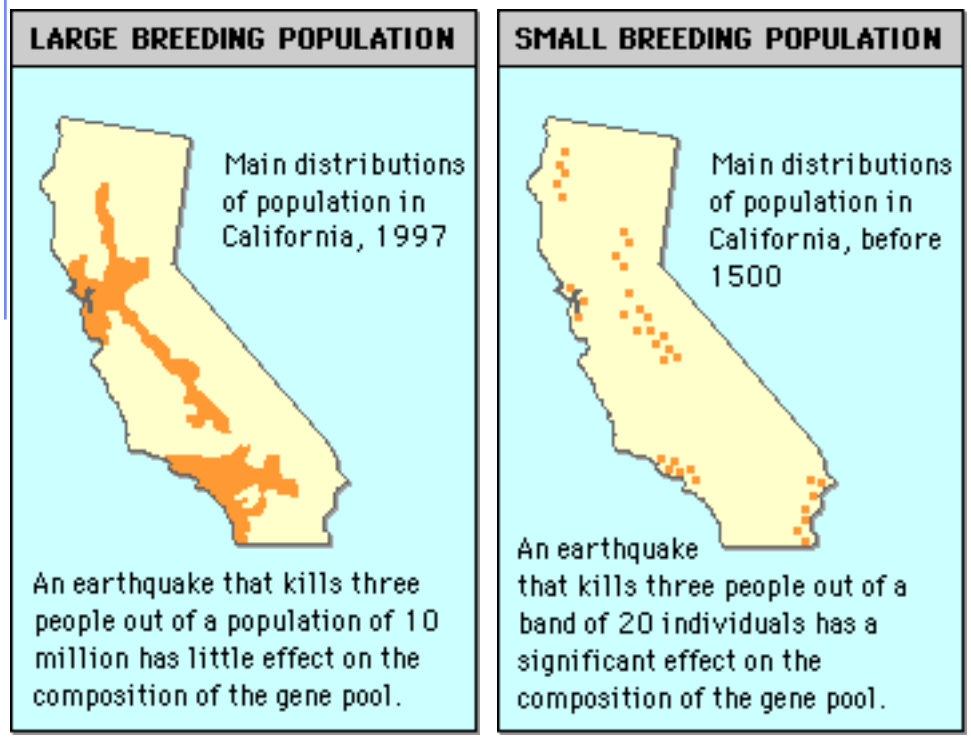
Probability (p)	Degrees of Freedom (df)				
	1	2	3	4	5
.05	3.84	5.99	7.82	9.49	11.1

The formula for Chi-squared is:

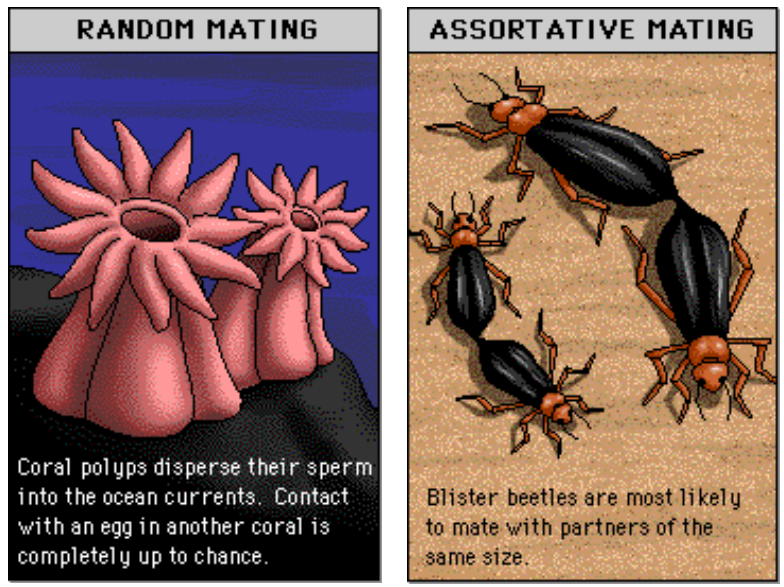
$$X^2 = \sum \frac{\text{(observed – expected)}}{\text{expected}}$$

Lab 8: Population Genetics

size of population & gene pool

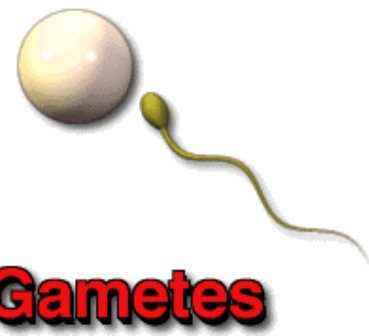


random vs. non-random mating



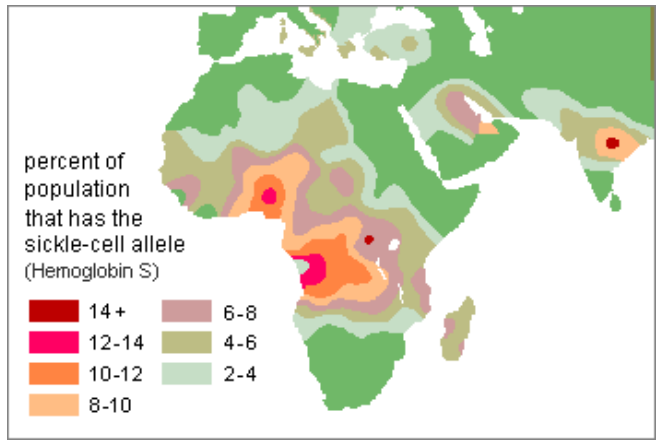
Lab 8: Population Genetics

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



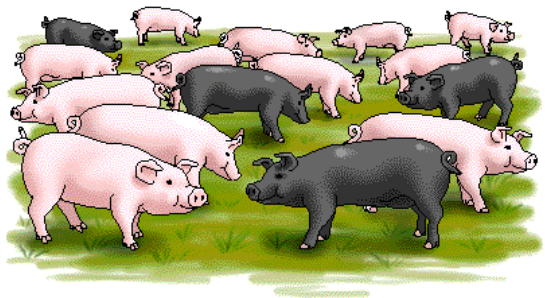
Lab 8: Population Genetics

- 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 8: 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 8: Population Genetics

ESSAY 1989

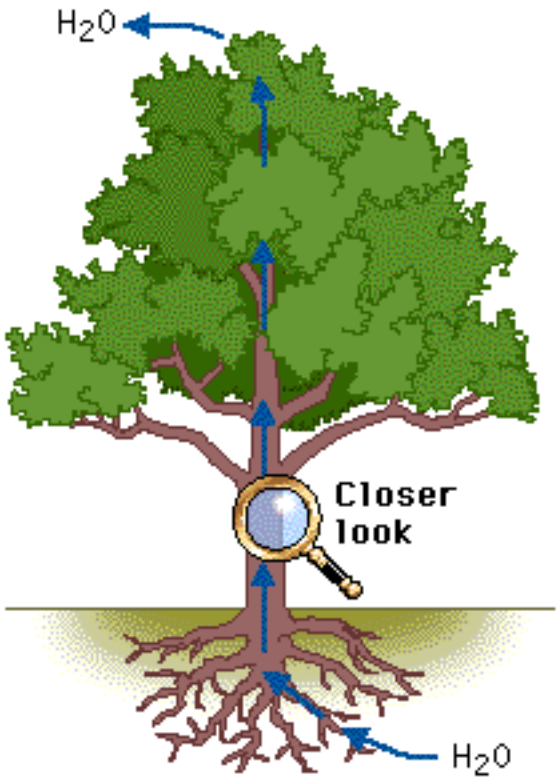
Do the following with reference to the Hardy-Weinberg model.

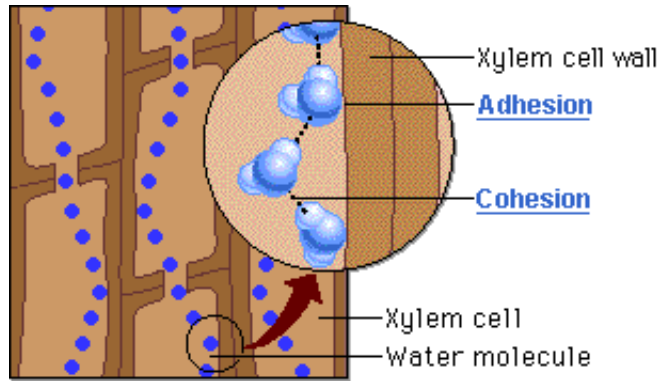
a. Indicate the conditions under which allele frequencies (p and q) remain constant from one generation to the next.

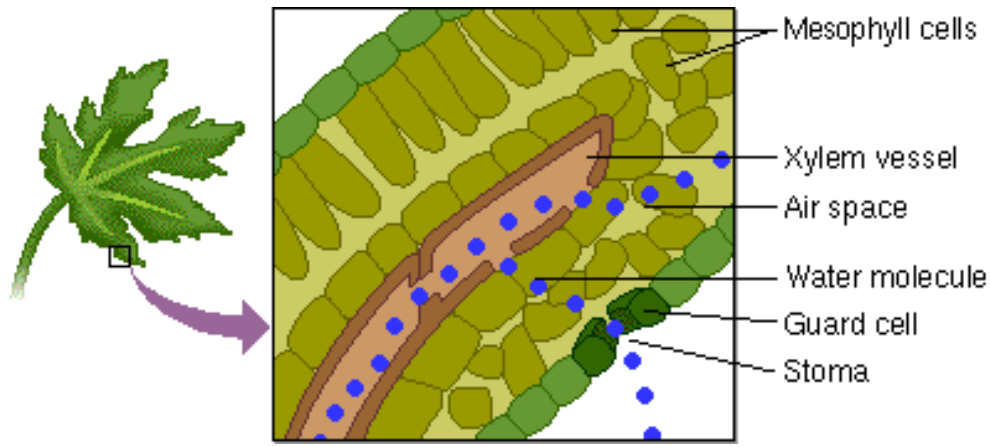
b. Calculate, showing all work, the frequencies of the alleles and frequencies of the genotypes in a population of 100,000 rabbits of which 25,000 are white and 75,000 are agouti.
(In rabbits the white color is due to a recessive allele, w, and agouti is due to a dominant allele, W.)

c. If the homozygous dominant condition were to become lethal, what would happen to the allelic and genotypic frequencies in the rabbit population after two generations?

Lab 9: Transpiration

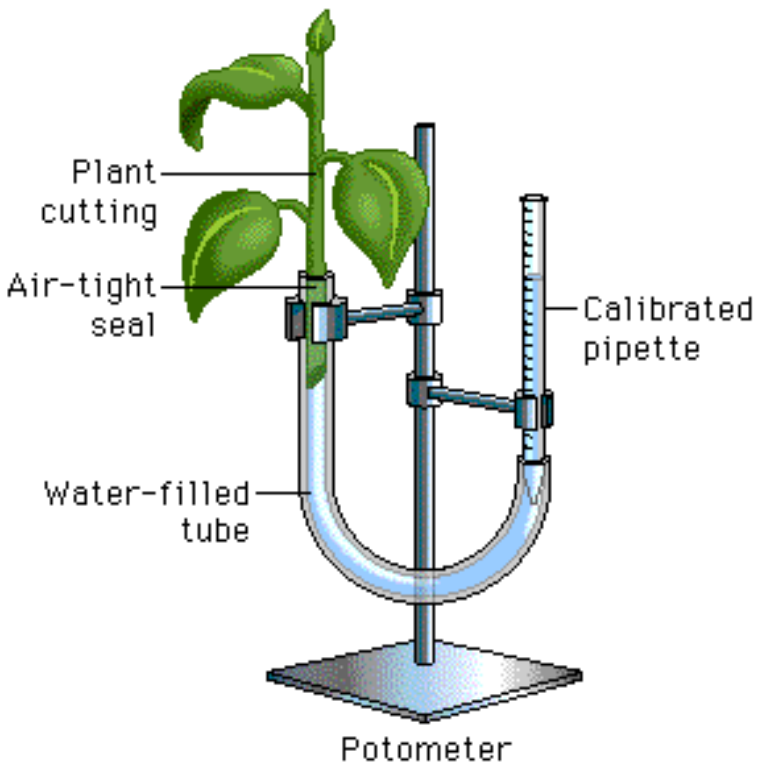






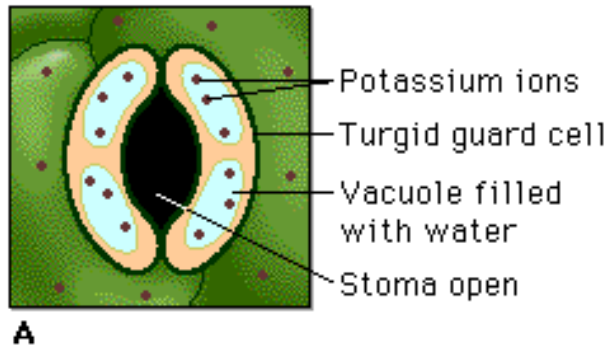
Lab 9: Transpiration

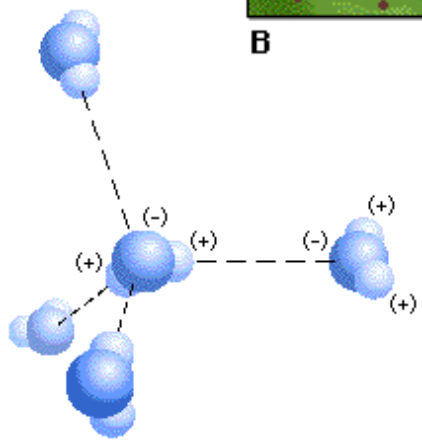
- **Description**
  - test the effects of environmental factors on rate of transpiration
    - temperature
    - humidity
    - air flow (wind)
    - light intensity



Lab 9: Transpiration

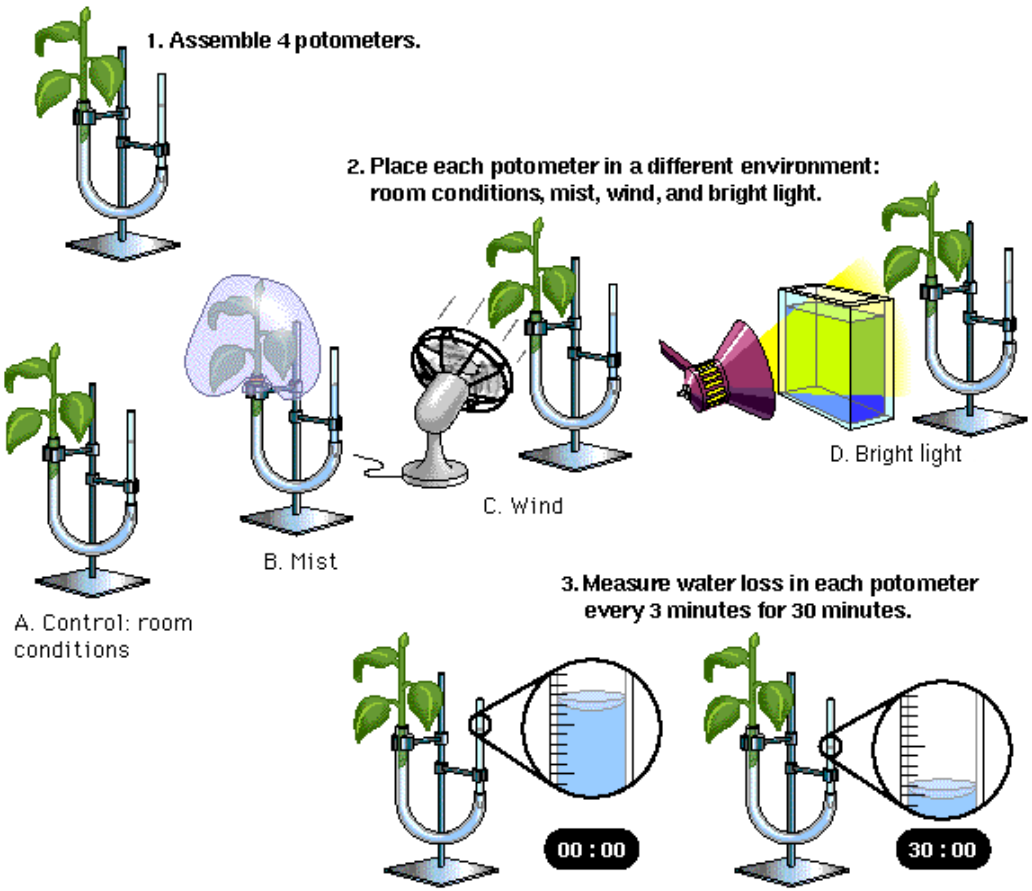
- **Concepts**
  - transpiration
  - stomates
  - guard cells
  - xylem
    - adhesion
    - cohesion
      - H bonding

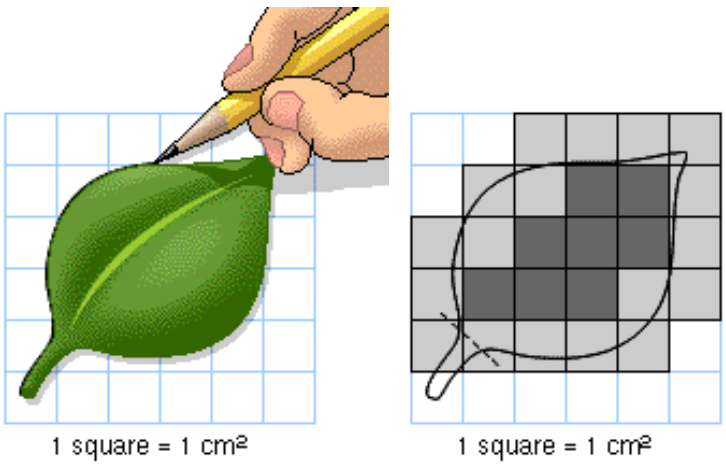




Lab 9: Transpiration

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





Lab 9: 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.

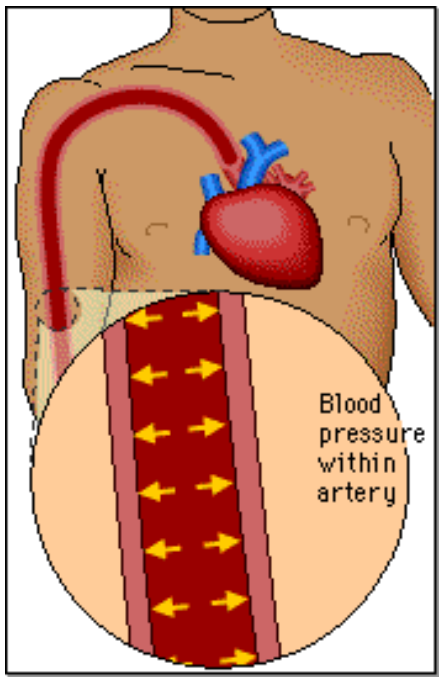
Group I:	**Room conditions (light, low humidity, 20°C, little air movement.)**
Group II:	**Room conditions with increased humidity.**
Group III:	**Room conditions with increased air movement (fan)**
Group IV:	**Room conditions with additional light**

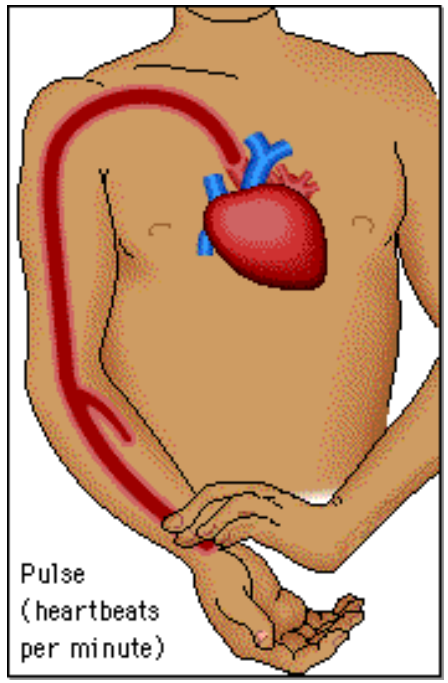
The cumulative water loss due to transpiration of water from each plant was measured at 10-minute intervals for 30 minutes. Water loss was expressed as milliliters of water per square centimeter of leaf surface area. The data for all plants in Group I (room conditions) were averaged. The average cumulative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

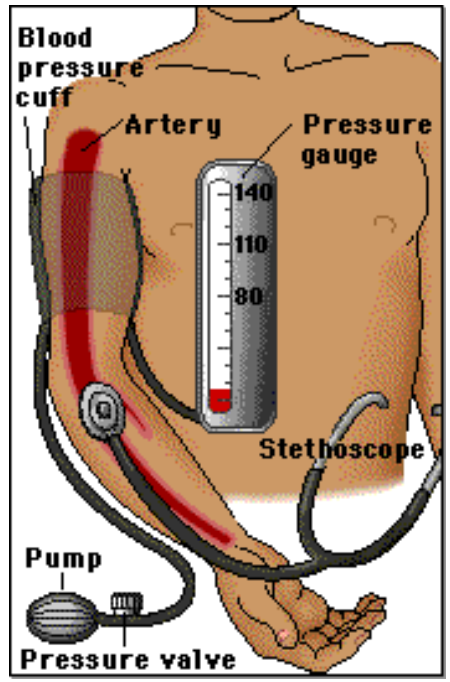
Average Cumulative Water Loss by the Plants in Group I	
Time (minutes)	**Average Cumulative Water Loss ($mL\ H_2O/cm^2$)**
10	**3.5×10^{-4}**
20	**7.7×10^{-4}**
30	**10.6×10^{-4}**

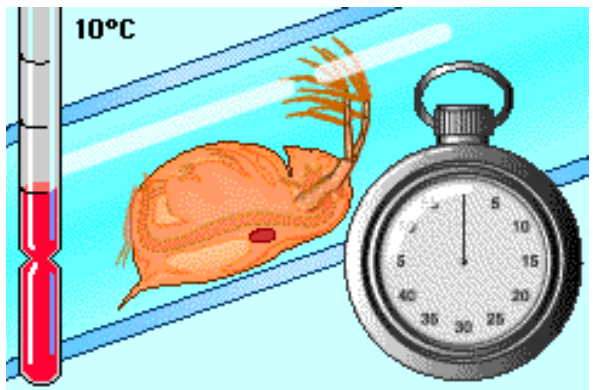
1. **Construct and label a graph using the data for Group I. Using the same set of axes, draw and label three additional lines representing the results that you would predict for Groups II, III, and IV.**
2. **Explain how biological and physical processes are responsible for the difference between each 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.**

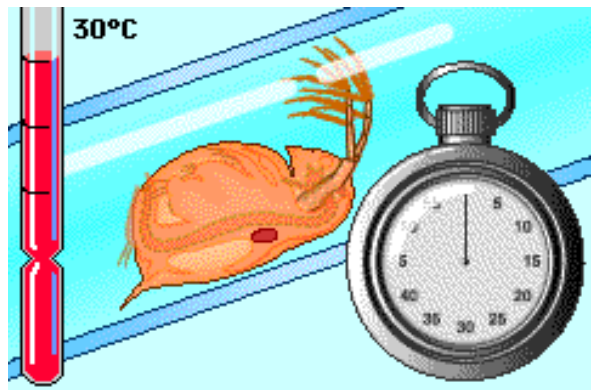
Lab 10: Circulatory Physiology









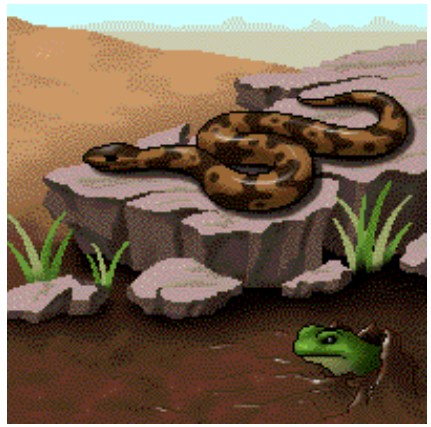


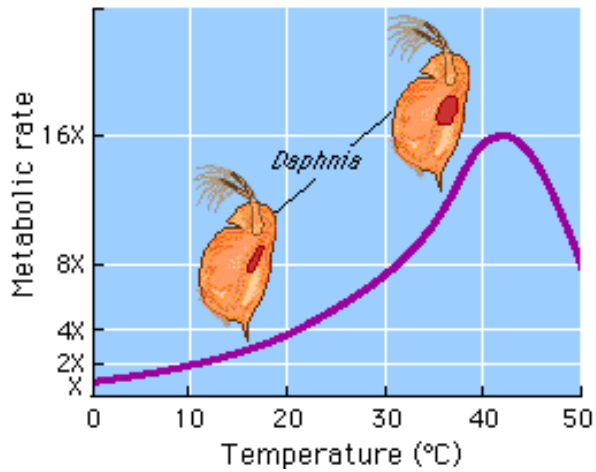
Lab 10: Circulatory Physiology

- **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 10: Circulatory Physiology

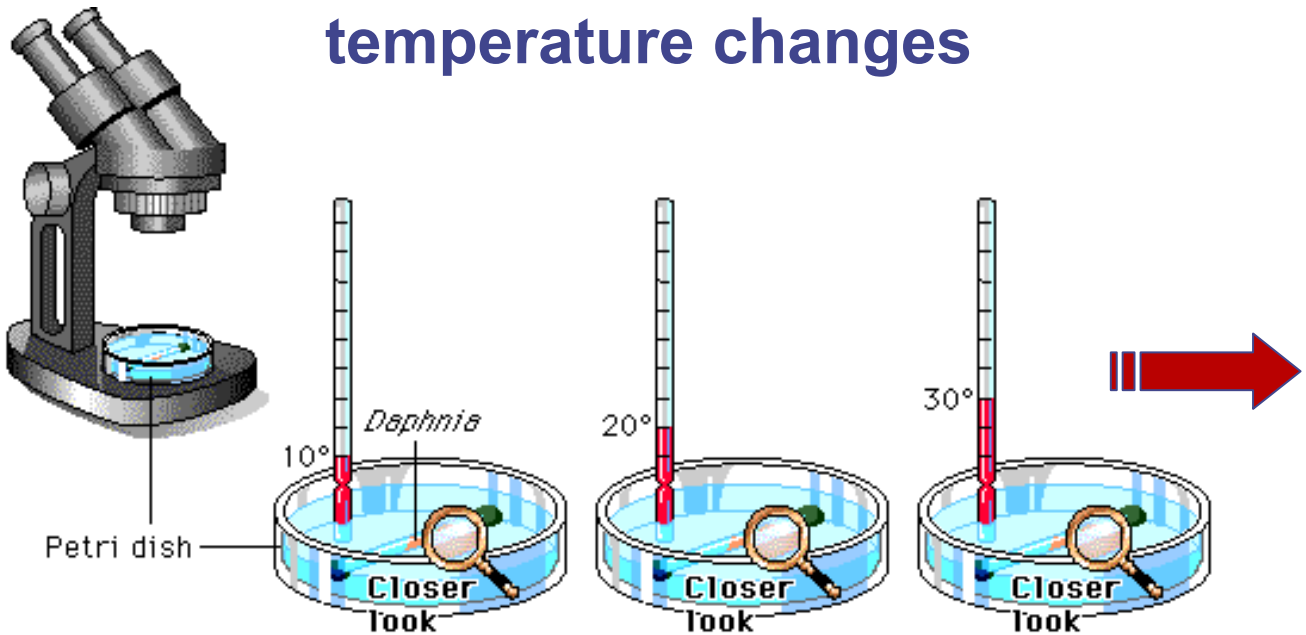
- **Concepts**
  - thermoregulation
  - endotherm
  - ectotherm
  - Q_{10}
    - measures increase in metabolic activity resulting from increase in body temperature
    - Daphnia can adjust their temperature to the environment, as temperature in environment increases, their body temperature also increases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

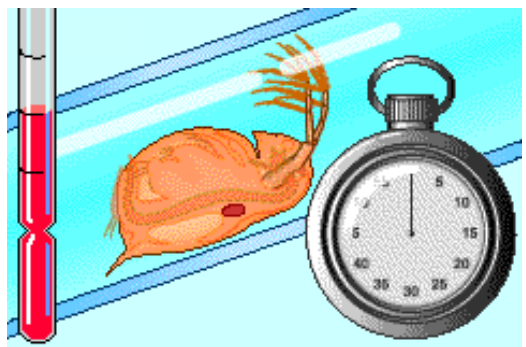




Lab 10: Circulatory Physiology

- **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**





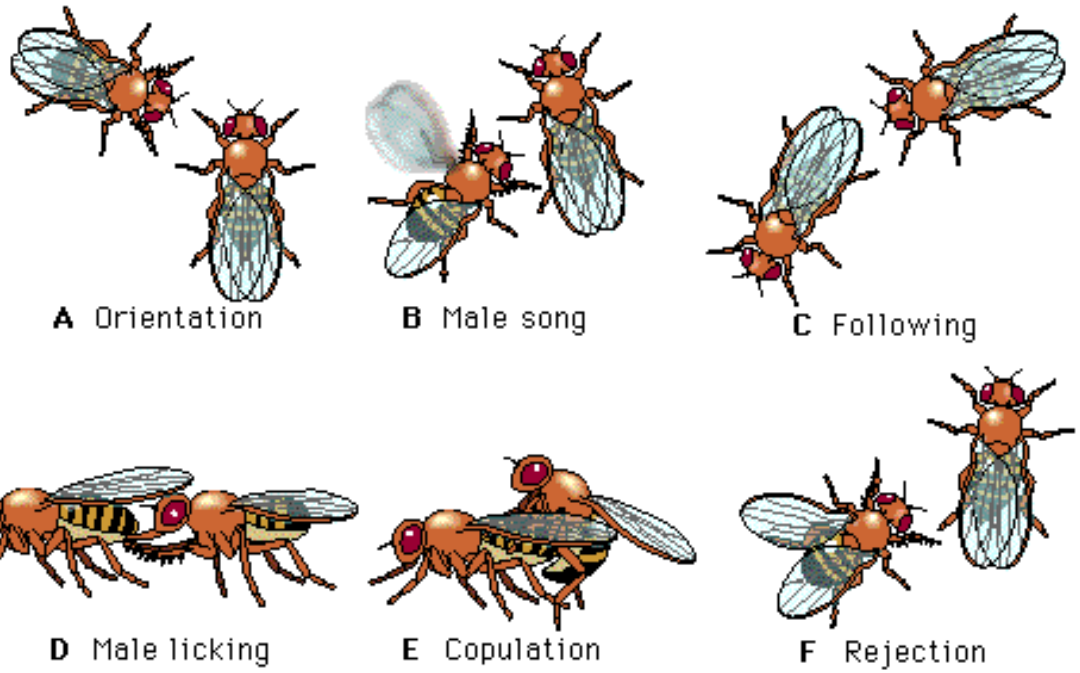
Lab 10: Circulatory Physiology

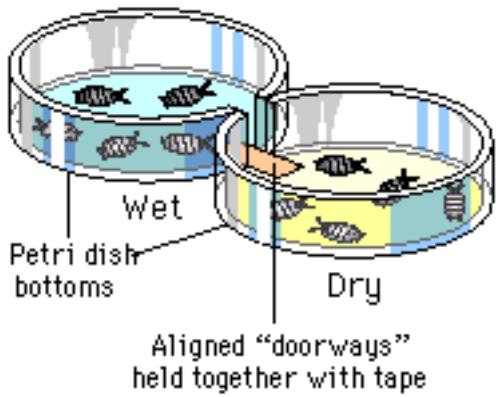
ESSAY 2002

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.**

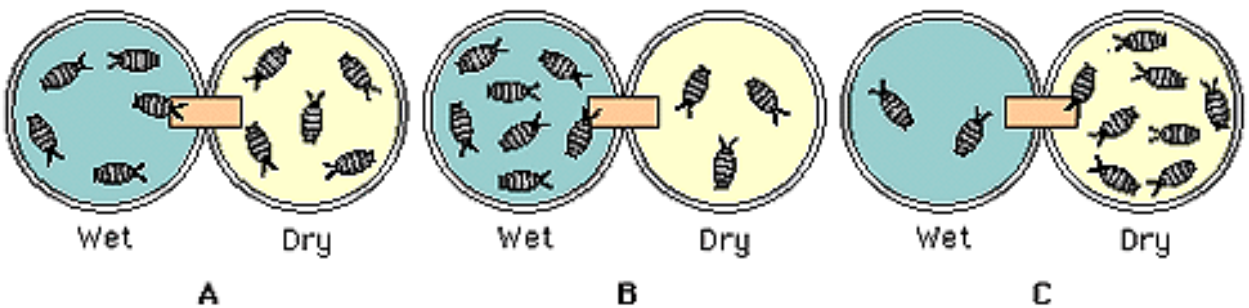
Lab 11: Animal Behavior





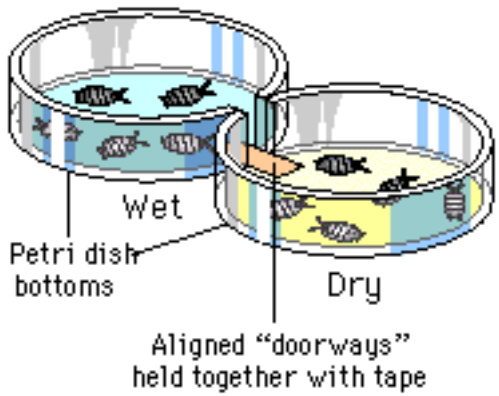
Lab 11: Animal Behavior

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



Lab 11: Animal Behavior

- Concepts
  - innate vs. learned behavior
  - experimental design
    - control vs. experimental
    - hypothesis
  - choice chamber
    - temperature
    - humidity
    - light intensity
    - salinity
    - other factors

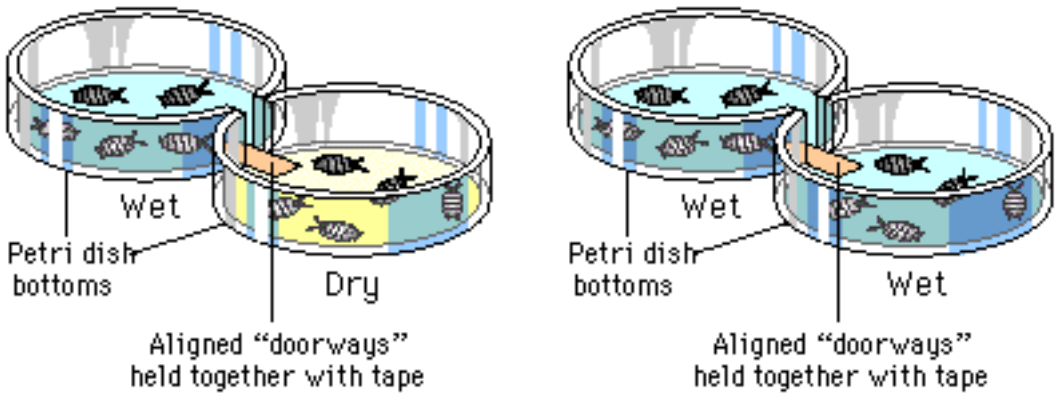


Lab 11: Animal Behavior

- **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.

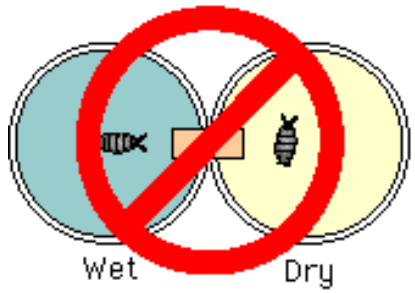
Lab 11: Animal Behavior

- **Experimental design**

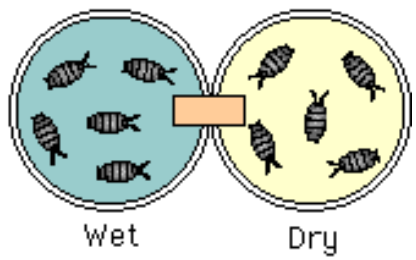


	EXPERIMENT		CONTROL	
	Left compartment	Right compartment	Left compartment	Right compartment
MOISTURE	wet	dry	wet	wet
LIGHT	25 Watts	same	same	same
FILTERPAPER	#1 Whatman	same	same	same
TEMPERATURE	20°C	same	same	same
NUMBER OF BUGS AT START	5	same	same	same

sample size



Sample size too small.



Sample size better.

Lab 11: 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		12 noon	4pm	8pm	12 mid
average distance	8.0	8.9	44.8	174.0	350.5	60.5	8.0

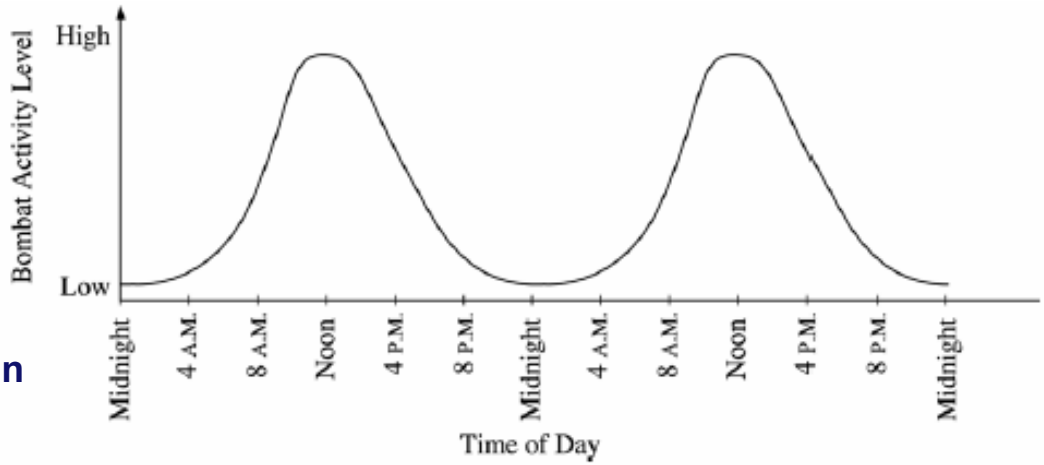
a. For the data above, provide information on each of the following:
   - Summarize the pattern.
   - Identify three physiological or environmental variables that could cause the slugs to vary their distance from each other.
   - Explain how each variable could bring about the observed pattern of distribution.

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 11: 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.

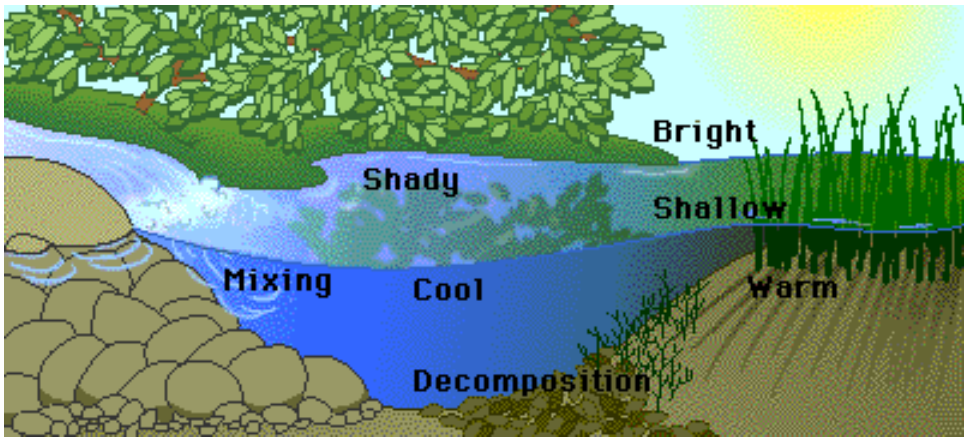


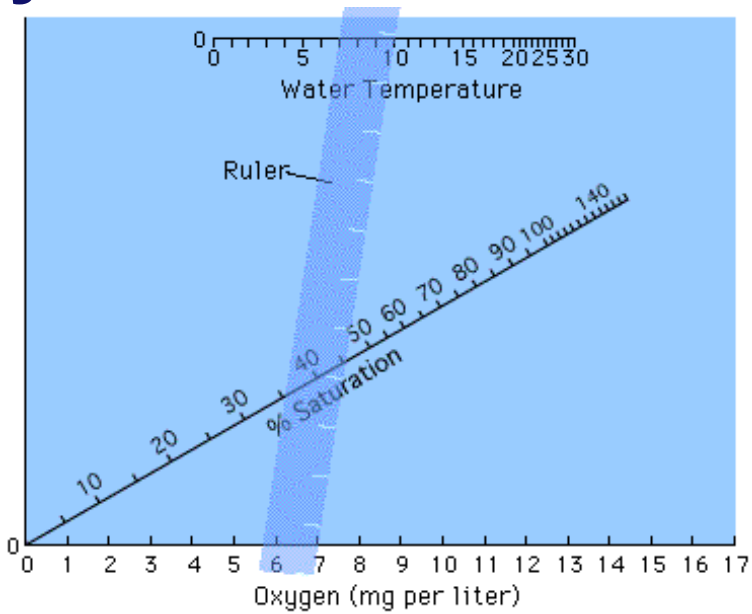
a. Describe the cycle of activity for the bombats. Discuss how three of the following factors might affect the physiology and/or behavior of the bombats to result in this pattern of activity.
   - temperature
   - food availability
   - presence of predators
   - social behavior

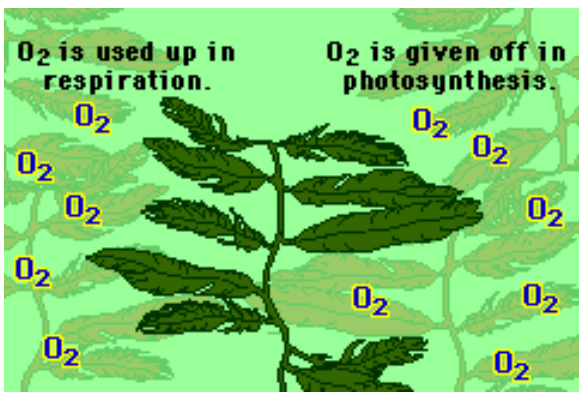
b. Propose a hypothesis regarding the effect of light on the cycle of activity in bombats. Describe a controlled experiment that could be performed to test this hypothesis, and the results you would expect.

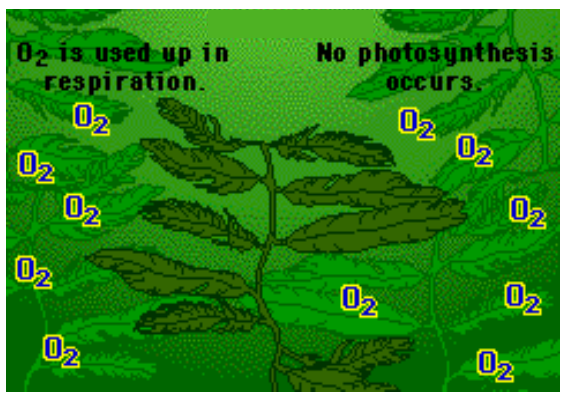
Lab 12: Dissolved Oxygen

- Dissolved O_2 availability

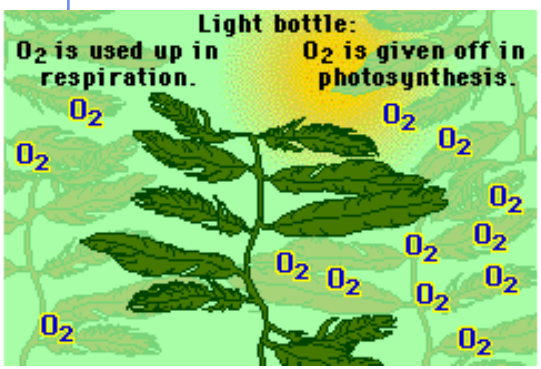




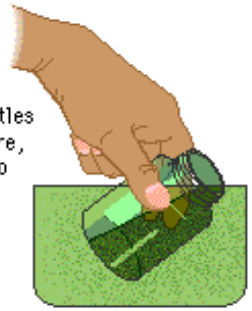




Lab 12: Dissolved Oxygen

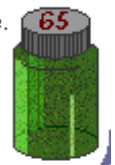


1. Fill seven BOD bottles with aquatic culture, being careful not to agitate the sample.

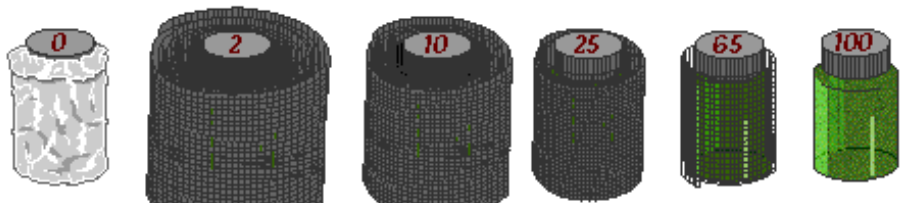


2. Carefully seal the bottles with caps which are designed to prevent air entrapment.

3. On each cap write the % light the sample will receive.



4. Wrap bottles in screen or foil as indicated by the label.

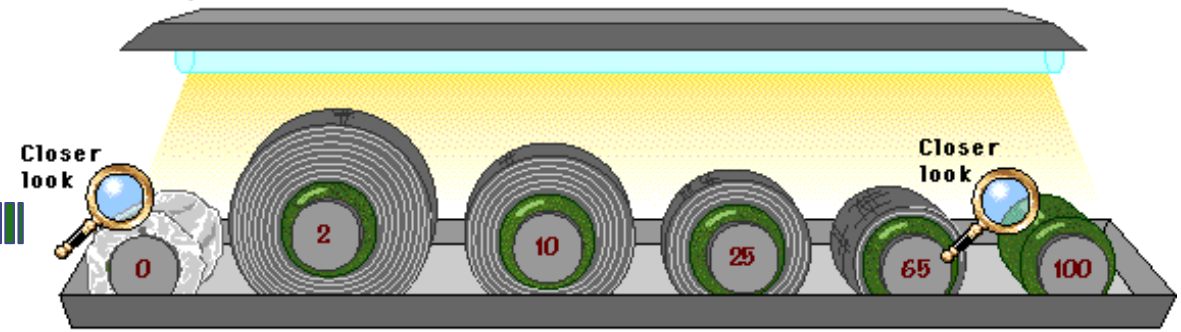


(Wrapped in foil) (Wrapped 8 times) (Wrapped 5 times) (Wrapped 3 times) (Wrapped 1 time)

5. Test the DO of the initial bottle.

Closer look

6. Place all the remaining bottles on their sides in a tray under a fluorescent light for 24 hours.



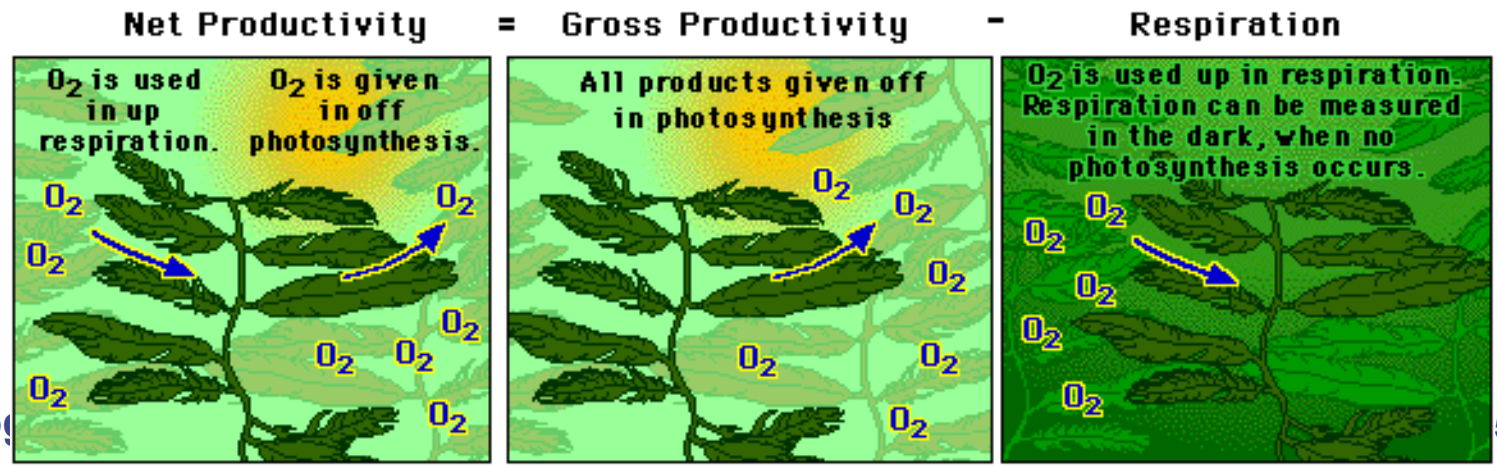
(Wrapped in foil) (Wrapped 8 times) (Wrapped 5 times) (Wrapped 3 times) (Wrapped 1 time)

Lab 12: 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

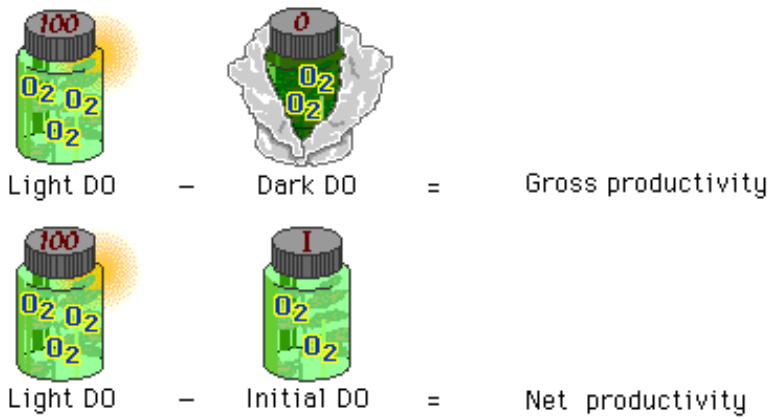
Lab 12: Dissolved Oxygen

- **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 12: 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 12: 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 12: 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**