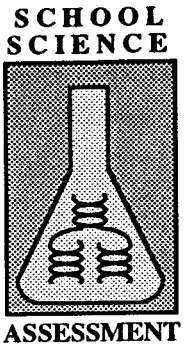


SCIENCE LABORATORY TEST

BIOLOGY

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

Administration Manual
for
Science Laboratory Tests
in Biology

This packet of information is intended to accompany the science laboratory tests in biology. The administration manual consists of the following sections:

1. Introduction
2. Instructions to students
   -Task station schematic
3. Teacher notes for each task including equipment and material lists
4. Scoring guidelines for Tasks 1 and 2
5. Student test booklets

These tests were designed by Nicholas Hejaily, Williamsville Central Schools, Willamsville, NY and Rodney L. Doran, State University of New York at Buffalo, Buffalo NY.

1. Introduction

The success of this alternative form of assessment depends strongly on the science teacher who administers the tasks. Therefore, a series of guidelines has been prepared, with attention to setting up the equipment, administering the tasks, and scoring the students' responses. One teacher can effectively monitor the work of 12 students, with two working on each of the six tasks. The titles of the six tasks in biology are:

1. Using a Microscope
2. Testing with Indicators
3. Model of a Population
4. Diffusion
5. Respiration
6. Water-Holding Capacity

Tasks 3 through 6 are composed of two booklets labelled Part A and Part B. In Part A, students are given a problem and asked to plan and design an experiment using the material and equipment provided at their laboratory station. In Part B, students are asked to perform an experiment that solves this problem. Students are provided with a test booklet that describes a detailed plan for performing this experiment.

Biology Tasks 1 and 2 differ in form from Tasks 3 through 6. Task 1 and Task 2 are both single part, 40 minute, performance-only tasks.

The elements of each booklet are outlined in the following figures:

Task Format: PART A - DESIGN

— Introduction
— Problem
— Materials
— Experiment Design

TIME: 30 minutes

Task Format: PART B - EXPERIMENTS

— Instructions
— Procedure
— Safety
— Results/Observations
— Calculations
— Conclusions

TIME: 50 minutes

A total of 80 minutes for student "time on task" is required. With a few minutes of introduction, assignment to task, and collection of booklets, one should schedule a time block of 90 minutes for the testing. The students stay at the same station for the entire 90

minute period. The equipment is available for manipulation during Part A, but they are reminded that performance using the equipment comes later, in Part B.

The teacher responsibilities begin several weeks before the testing. We have assembled a list of the major tasks and timeline for this completion.

1. Reserve room	4 weeks prior to testing
2. Assign student to testing period (include alternates if part of plan)	4 weeks prior to testing
3. Plan for alternative activities for those <u>not</u> being tested.	4 weeks prior to testing
4. Locate equipment and material for tasks	2 weeks prior to testing
5. Assemble, prepare and trial-test equipment	2 weeks prior to testing
6. Copy student test booklets	1 week prior to testing
7. Assemble (and try) equipment and materials as needed for first period testing.	Day before testing
8. Assemble equipment and material for other testing in preparation area.	Day before testing
9. Check with principal and other teachers for duties on testing day	Day before testing

On the testing day, your responsibilities include the following:

1. Assign each student to appropriate station for the task they will do.
2. Assign alternates to task if some students are absent.
3. Send extra alternates to study hall or other planned space or activity.
4. Make students feel welcome. Begin reading directions.
5. Mark beginning time.
6. Check each station to be sure equipment and material are working correctly.
7. Answer questions, usually with the comment, "Reread the directions and do the best you can."
8. When 30 or 40 minutes has elapsed, read directions for changing to next stations or to Part B.
9. Collect Part A booklets and give students Part B booklets (or Biology 1 and Biology 2 booklets).
10. At the end of 80 minutes, read directions for end of testing.
11. Collect student booklets and thank them again as they leave.
12. Check stations. Clean up and replenish material for next students.

2. Instructions to Students

The directions which follow are to be used as oral instructions to students for performance of the biology lab tests. Preliminary instructions include assigning students to stations where test booklets and equipment have been made ready. Step-by-step instructions allow the teacher to lead the student through Part A (Experiment Design) and Part B (Experiment Report) of biology tasks 3 through 6 and similar instructions for Tasks 1 and 2 (both 40 minute tasks).

The format of the directions is in three type styles: normal, italicized, and capitalized. Directions to the teacher appear in normal type. Instructions to be read aloud to the students are italicized. Performance of an action by the teacher (or by the students following an instruction) appears in capitalized print.

normal	Directions to the teacher.
italics	Instructions to be read aloud.
CAPITALS	Actions to be performed by the teacher or the students.

Instructions to Students

As students enter the room, they should be instructed to sit at one of the stations for their assigned task (numbered one through six). When the students are seated, let them look around the room, then instruct them to look at the equipment in front of them and find their test booklet. Tell the students NOT to touch the equipment until they are told to do so.

When the students have settled, the supervising teacher should read the following text. For ease in administration, all sections to be read are printed in italics.

Good morning (afternoon). My name is _____. Today, you are going to perform some science experiments. A booklet explaining the tasks you are to do should be in front of you. If you cannot find your booklet or you do not have a pencil, please raise your hand.

DISTRIBUTE NEEDED TEST BOOKLETS AND/OR PENCILS.

You will keep this booklet for the first testing session. At the end of the first session, it will be collected. You will then be given the test booklet for the second testing session.

Now that each of you have a test booklet and pencil we are ready to begin. Listen very carefully to the instructions and do you best. Please write your name, you school, your sex and today's date in the spaces provided on the front page of the booklet.

GIVE THE STUDENTS TIME TO DO THIS.

This is a science laboratory test. The equipment and material that you will need have been set out for you in front of you. Your test booklet will give you specific directions for this experiment. Write the results of your experiments in your booklet.

This science laboratory test is very different than the other science tests that you completed. We are trying to see how testing of science laboratory skills can be done in US high schools. Your responses are very important to us in this project.

Your individual performance will <u>not</u> be used as part of any science grade or evaluation for you. We ask you to do your best so we can learn as much as possible about this alternative method of testing.

Turn to the first page in your booklet. Check to see that you have all the materials listed for your experiment. Raise your hand if anything is missing.

MAKE SURE EVERYONE IS AT THE CORRECT PAGE IN THE BOOKLET AND THAT THEY HAVE ALL THE MATERIALS THEY NEED.

Once you have started the test, I cannot help you. I can only assist you right now if you have any materials missing. ***Please read the directions carefully before you start to work.***

We are now ready to begin. Are there any questions?

PAUSE

Do your best. You may begin.

AFTER 30 MINUTES, COLLECT THE PART A BOOKLETS FROM THE STUDENTS (who have tasks 3, 4, 5 and 6) AND GIVE THEM THE PART B BOOKLET.

AFTER 40 MINUTES, COLLECT THE BOOKLETS FROM STUDENTS DOING TASKS 1 AND 2. STUDENTS WHO HAD TASK #1 WILL DO TASK #2 IN THE SECOND TESTING SESSION. SIMILARLY, THOSE WHO DID #2 INITIALLY, WILL NOW DO TASK #1.

PLEASE DISTRIBUTE THE APPROPRIATE BOOKLETS.

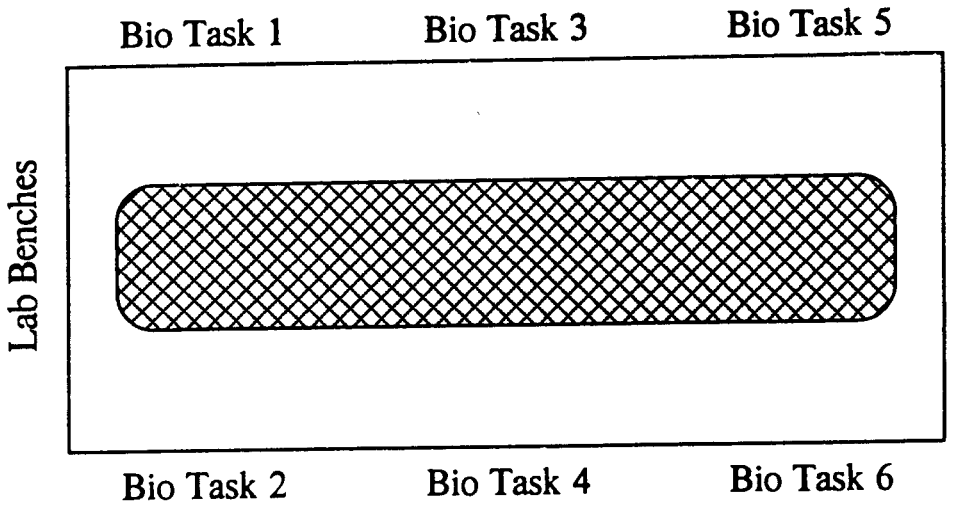
You may begin working on the second booklet. Do your best.

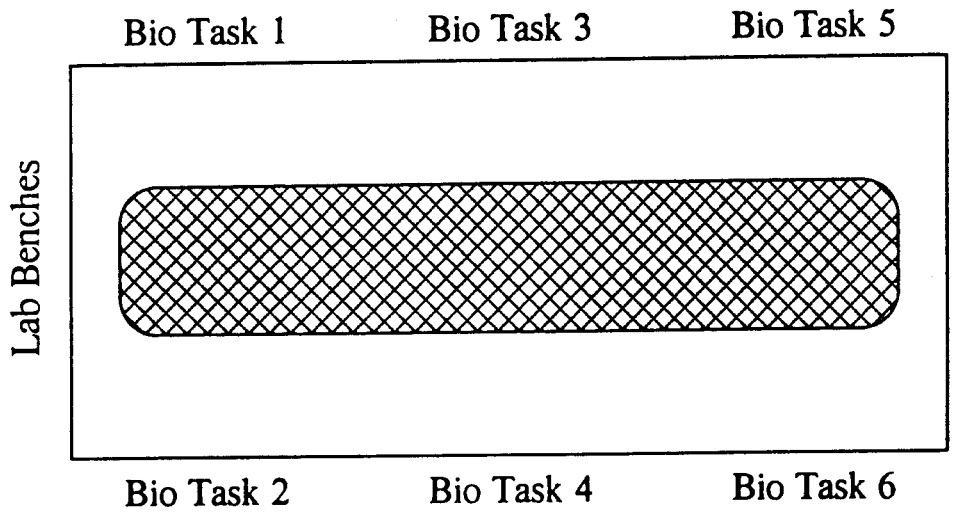
AFTER THE STUDENTS HAVE COMPLETED THE TEST (A TOTAL OF 80 MINUTES) GIVE THE FOLLOWING INSTRUCTIONS

This is the end of the science laboratory test. Please pass in your test booklets and pencils.

Thank you for being so attentive and cooperative during the test. Please wait to be dismissed.

Station Set-up for Biology





3. Teacher Notes

Teacher Notes provide the information which enables the teacher to gather and prepare materials for set-up of the tasks or stations. Suggestions for performance and calculation of results for each biology task are also given. The sections included are:

Materials: Lists the amounts and sizes of all equipment and materials needed for each task.

Safety: Gives suggestions regarding safety considerations specific to each task. In some tasks disposal methods are suggested.

Preparation: Specifies masses, volumes, concentrations, and directions for preparation of the needed materials and samples.

Hints and Clues: Provides suggestions aimed at helping the teacher through a "trial run" of the experiment.

BIOLOGY TASK 1

USING THE MICROSCOPE

Materials

Compound light microscope.
Transparent metric ruler.
Prepared slide of onion specimen.
Glass microscope slide
Plastic cover slips
Dropper bottle with water
Pieces of onion bulb
Forceps
Paper towel or tissue
Prepared slide of colored threads

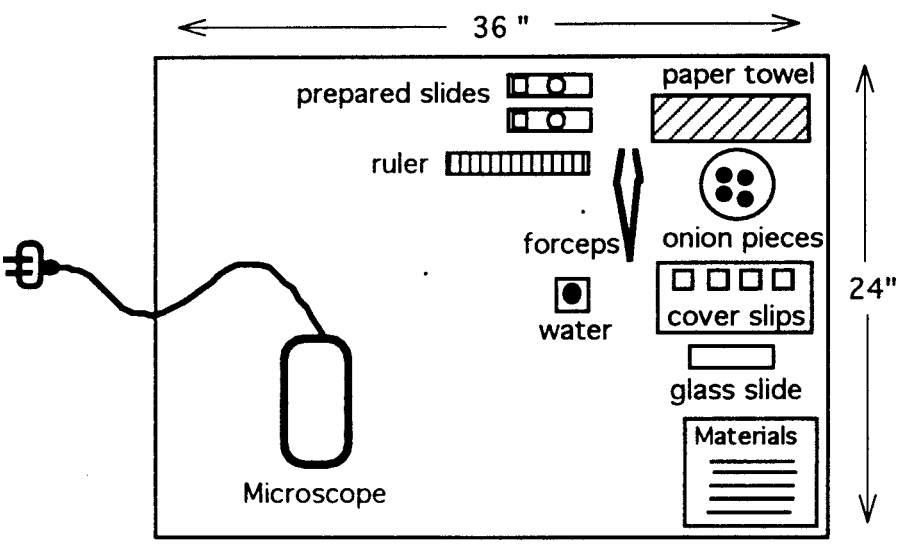
Preparation

1. Select a testing area that provides approximately 24" by 36" of working space and a nearby electrical outlet.

2. Select a compound microscope in good working order and whose lenses are clean. Set the low power objective (100x) in position. The light source should be a lamp. Plug in the scope and make certain the cord is not in the student work area. A spare microscope should be available in case of a malfunction.

3. Arrange the materials at the student work station as indicated by the drawing below. Materials should be arranged the same for each student to be tested.

Materials and Equipment Layout

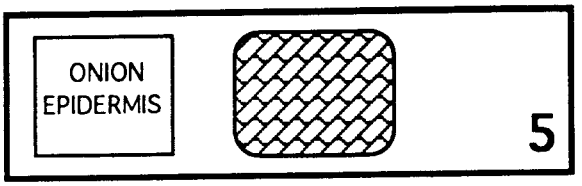


4. Pieces of onion should be cut just prior to testing. Cut pieces approximately 1.25 cm x 1.25 cm. Be certain each piece has its epidermis. At least 4 pieces should be placed in a small dish for each student tested. New onion pieces are required for each student.

5. Clean glass slides and plastic cover slips are to be used. Place the cover slips on an index card to make them more visible. Label the card at the bottom - PLASTIC COVER SLIPS.

6. Label the dropper bottle - WATER.

7. The prepared slide of colored threads, and the prepared slide of the onion epidermis should be numbered in the lower right corner of the slide with a permanent marker to code them for scoring of the papers. See the illustration below.



8. The prepared slides must be coded to identify the following for scoring :

   a. Which colored thread is on top of the others.

   b. The number of onion cells arranged lengthwise and widthwise that span the diameter of the field of view.

   c. Use the chart below to keep a record of the prepared slides used.

Colored Threads Slide Number	Color of Top Thread
_____	_____
_____	_____
_____	_____

Onion Epidermis Slide Number	Cells Across the Field of View Diameter Lengthwise	Widthwise
_____	_____	_____
_____	_____	_____
_____	_____	_____

Instrument Part and Use Review

The following microscope parts and their uses should be reviewed with the students to re-acquaint them with their function.

- ocular/eyepiece
- turret/nosepiece
- low power objective lens - 100x and/or color band
- high power objective lens - 400x/430x and/or color band
- coarse adjustment
- fine adjustment
- stage and stage clips
- diaphragm and its control
- light source and its switch

Focusing Procedure Review

The basic technique for focusing a specimen under both low and high power should be briefly reviewed to prevent possible damage to the microscope. Remind students that only the fine adjustment should be used on high power to sharpen the image.

BIOLOGY TASK 2

TESTING WITH INDICATORS

Materials

60 ml plastic dropper bottles each containing 50 ml of the following:
- 1% - 5% Glucose(dextrose) solution, labelled SUGAR
- 1% - 5% Starch suspension, labelled STARCH
- 1% - 5% Albumen solution, labelled PROTEIN
- 1% - 5% Starch suspension, labelled UNKNOWN

Color the UNKNOWN with red food coloring to produce a pink/light-red color.
60 ml plastic dropper bottles each containing 50 ml of the following:
- Iodine solution, labelled Iodine Solution
- Biuret reagent, labelled Biuret Reagent
- Benedict's solution, labelled Benedict's Solution

Red food coloring
Hot plate (solid/ceramic surface type)
250 ml beaker - 1/4 filled with water
6 clean test tubes - size: 24 ml (16 mm x 150 mm)
- Test tubes must be labelled with permanent ink as indicated under PREPARATION below.

Permanent ink marking pen - black or blue
Test tube rack
Test tube holder
Safety goggles
Paper towels

Preparation

For each station, prepare sufficient quantities as indicated:

1. Prepare 100 ml, 1% - 5% solutions of sugar, starch, and albumen. For the albumen solution, stir 5 grams of albumen powder into 100 ml of warm water.

2. Place 50 ml of the glucose solution in a plastic dropper bottle. Label the bottle with permanent ink SUGAR using capital letters.

3. Place 50 ml of the albumen solution in a bottle. Label this bottle PROTEIN.

4. Place 50 ml of the starch solution in a plastic dropper bottle. Label the bottle STARCH.

5. Place the remaining 50 ml of the starch solution in a second dropper bottle. Add a small amount of red food coloring to produce a pink/light-red color. Label this bottle UNKNOWN.

6. Remove the caps on the bottles at the student station.

7. Fill the 250 ml beaker approximately 1/4 full with hot tap water for the hot water bath. Adjust the hot plate to provide a hot water bath that is near boiling. Caution: Be certain the water level in the bath is maintained. Allow sufficient time for the water to be brought up to temperature prior to the start of testing.

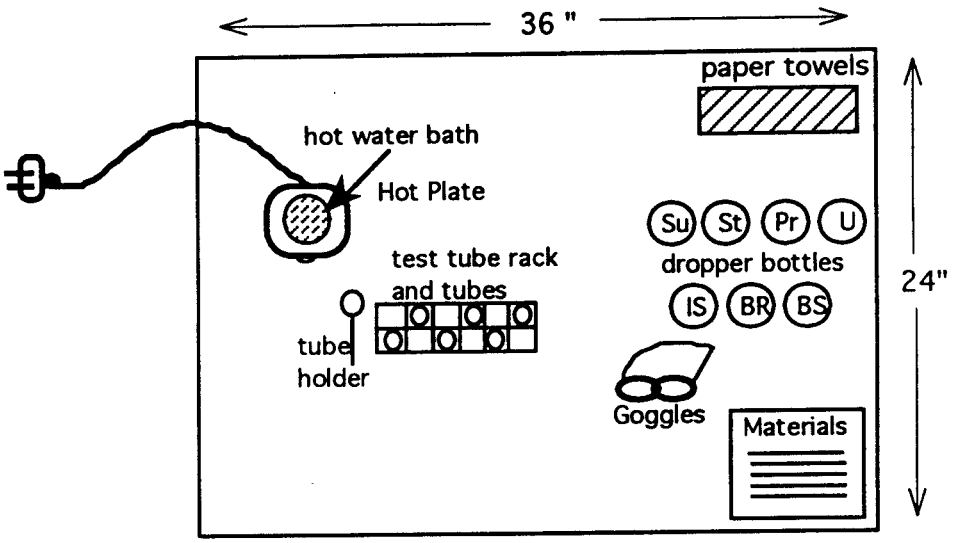
8. Label the test tubes, using permanent ink and in capital letters, as follows:

   Label: A, B, C — for testing the nutrients
   Label: 1, 2, 3 — for finding the unknown

   NOTE: Clean test tubes must be provided for each student to be tested.

9. Set up the station using the following layout. An area should be selected that has convenient access to an electrical outlet. Be certain materials are rearranged prior to each student tested.

Materials and Equipment Layout



Key:

Su = SUGAR solution
St = STARCH solution
Pr = PROTEIN solution
U = UNKNOWN solution
IS = Iodine solution
BR = Biuret reagent
BS = Benedict's solution

Student Materials List

- Plastic dropper bottles labelled:
  - SUGAR solution
  - STARCH solution
  - PROTEIN solution
  - UNKNOWN solution
- Plastic dropper bottles labelled:
  - Iodine solution
  - Biuret reagent
  - Benedict's solution
- Hot Plate and hot water bath
- Test tube rack with 6 clean test tubes labelled: A, B, C; 1, 2, 3
- Test tube holder
- Paper towels
- Safety goggles

CAUTION: SAFETY GOGGLES MUST BE WORN AT ALL TIMES AT THIS STATION.

CAUTION: BIURET REAGENT MAY CAUSE SKIN BURNS. FLUSH WITH WATER IF CONTACT IS MADE WITH THE SKIN.

General Information

1. Have extra supplies available in case they are needed.

   Examples:
   - labelled dropper bottles and solutions
   - labelled test tubes
   - materials lists
   - pencils and/or pens
   - paper towels
   - water to refill the baths

2. Test each solution and reagent to determine that positive results will occur.

3. Safety goggles are required at all times at this station.

CAUTION: BIURET REAGENT MAY CAUSE SKIN BURNS. FLUSH WITH WATER IF CONTACT IS MADE WITH THE SKIN.

BIOLOGY TASK 3

MODEL OF A POPULATION

Materials (per student station)

25 white navy beans.
25 red kidney beans.
2 small opaque paper bags.
1 beaker or cup (200ml).

1. Use dry, whole beans. Have additional beans available for replacement of broken or dropped ones.
2. Make certain that each student begins the activity with 25 of each type of bean.
3. Brown paper lunch bags are sufficient.

BIOLOGY TASK 4

DIFFUSION

Materials

2 firm potatoes.
Metric ruler (30 cm).
3 small beakers (approx. 150 ml).
1%, 5%, and 10% solutions of potassium permanganate (in beakers).
Forceps.
Scalpel.
Stopwatch/clock.
Paper towels.
Experiment Display Sheet.
Waste container.
Graph paper.

BIOLOGY TASK 5
RESPIRATION

Prepare the following : 0.5% solution (aqueous) of methylene blue.

General Materials

1 beaker, 800 ml.
Graduated cylinder, 10 ml.
10 test tubes - 16 mm by 150 mm.
1 rubber stopper (solid),
to fit test tubes.
Test tube holders.
Test tube rack.
Adjustable hot plate, solid surface.
Paper towels.
Thermometer (°C).
Wax marking pencil.
Stopwatch/clock.
Graph paper.
Pencil.

Special Materials

1 package dry yeast, mixed with 100 ml distilled water (approx. 30°C)
100 ml Distilled water.
0.5% Methylene Blue (aqueous) solution, 40 ml in dropper bottle.
pH solutions of 2, 4, 6, 8, 10 in plastic dropper bottles (60 ml).

1. Plastic dropper bottles are 60 ml size. Label and place at the student station with the caps removed.

2. Prepare the yeast suspension approximately one hour before testing. Stir the package of dry yeast into 100 ml of distilled water at about 30° C.

   NOTE: Use a fresh package of dry yeast.

3. Prepare the 37° C water bath by filling the 800 ml beaker with approximately 200 ml of tap water.

4. Locate station near water source and sink.

BIOLOGY TASK 6

WATER-HOLDING CAPACITY

Materials

Water - 800 ml (approx.) in a large beaker.
Graduated cylinder - 100ml.
3 funnels - 100 mm top diameter.
3 funnel supports (ring stands or tripods).
3 beakers - 250 ml.
3 sheets of filter paper - 18.5 cm diameter.
Clock/timer.
Glass marking pencil.
Dry potting soil (enough for 100 gms for each student).
Dry sand (enough for 100 gms for each student).
Dry sphagnum moss (enough for 100 gms for each student).
Paper towels.
3 paper cups.
Balance (accurate to $\pm$ 0.1 gram).

NOTE: Dry the potting soil by spreading out on newspaper overnight.

4. Scoring Guidelines for Tasks 1 and 2:

Once all the tests have been administered, training sessions for the scoring process should be scheduled. A scoring team should consist of teachers experienced in teaching the content area being assessed. The scoring should not be done just by the teacher of the students being tested. If there are several teachers of a science area, they could each be trained to score a few tasks rather than all six tasks, becoming specialists on those tasks. Additional information regarding the training of scorers is available in the Scoring Manual.

Biology Tasks 1 and 2 differ in form from Tasks 3 through 6. Task 1, "Using the Microscope", and Task 2, "Testing with Indicators", are both single part, 40-minute performance-only tasks. Point values which differ from those in Tasks 3 through 6 have been assigned to the procedures within the tasks. For these reasons, individualized scoring guidelines were developed for these two tasks.

A scoring form and scoring summary sheet are included with the guidelines which follow. These forms assist the scorer in summarizing the total points accrued by the student. The scoring guidelines describe the criteria and the point values established for each procedure within the two tasks.

For information regarding scoring Biology Tasks 3 through 6 see the Scoring Manual.

SCORING FORM

BIOLOGY LABORATORY TEST

School/Student ID No. _____ Reader ID No. _____

Date _____ Time: _____

Task 1: Using Microscope

Procedure A:							
1.	S:	NR	0	1	2	3	NA
	L:	NR	0	1	2		NA
	A:	NR	0	1	2	3	NA
Procedure B:							
2, 3.(total)		NR	0	1	2	3	NA
Procedure C:							
1.		NR	0	1	2		NA
Procedure D:							
2, 3. (total)		NR	0	1	2		NA
4.		NR	0	1	2		NA
6.		NR	0	1	2		NA
7.		NR	0	1	2		NA

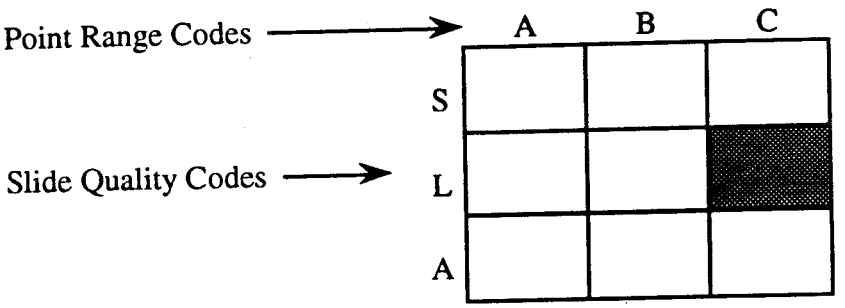
Task 2: Testing With Indicators

Table A:							
Test Tube	A:	NR	0	1	2	3	NA
	B:	NR	0	1	2	3	NA
	C:	NR	0	1	2	3	NA
Table B:							
Unknown Tube	A:	NR	0	1	2	3	NA
	B:	NR	0	1	2	3	NA
	C:	NR	0	1	2	3	NA
Conclusion		NR	0	1	2	3	NA

BIOLOGY TASK 1
USING THE MICROSCOPE

SCORING GUIDELINES

PROCEDURE A



Slide Quality Codes:

S - specimen quality
L - liquid amount
A - air bubbles

Point Range Code Values:

A — 1
B — 2
C — 3

To award points, place a check (√) in the appropriate space for each slide quality factor. If no points are awarded, place a dash (—) in each box. No points can be awarded in the shaded area.

Slide Quality Guidelines:

Specimen Quality (S):

Award 0 to 3 points by placing a check (√) in the appropriate box based upon the information below.

If the student has:

- used the lower onion epidermis tissue - **1 point**
- used a piece of tissue that is smaller in size than the cover slip - **1 point**
- not folded or damaged the specimen in preparing the wet mount - **1 point**

Award zero points if none of the above are met. Place a dash (-) in each box to indicate that no points were given.

Liquid Amount (L):

Award 0 to 2 points for the amount of liquid used in preparing the wet mount slide by checking the appropriate box based upon the following:

- if sufficient water was used - **1 to 2 points**

If too little or too much water was used, award zero points by placing a dash (-) in each box to indicate that no points were given.

Air Bubbles (A):

Award 0 - 3 points for the occurrence of air bubbles visible to the unaided eye by checking the appropriate box based upon the following:

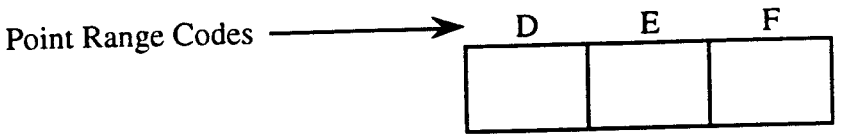
- no air bubbles visible - **3 points**
- few small air bubbles visible - **2 points**
- many small or one large air bubble visible - **1 point**

If more than one large air bubble is visible to the unaided eye, award zero

points by placing a dash (-) in each box to indicate that no points were given.

PROCEDURE B

1. Student identifies slide number - non-scored.
2. Focusing under low power:



Point Range Code Values:
D — 0
E — 1
F — 2

Award 0 - 2 points for low power focusing by checking the appropriate box based upon the following:
- image in sharp focus - **2 points**
- image out-of-focus - **1 point**
- image not visible - **0 points**

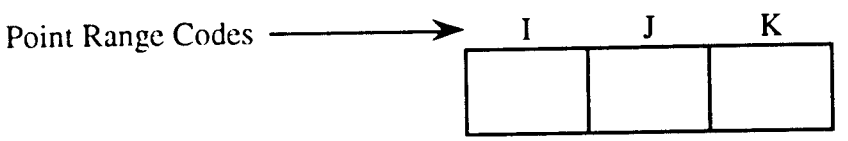
3. Identify the colored thread that is on top of the others and write it on the line below:

_____

Point Range Code Values:
G — 0
H — 1

Award 0 - 1 points for identifying the correct color thread by checking the appropriate box based upon the following:
- correct colored thread identified - **1 point**
- incorrect colored thread identified - **0 points**

PROCEDURE C



Point Range Code Values:
I — 0
J — 1
K — 2

Award 0 - 2 points for high power focusing by checking the appropriate box based upon the following:

- image in sharp focus - **2 points**
- image out-of-focus - **1 point**
- image not visible - **0 points**

PROCEDURE D

Before scoring this section, it is necessary to compile information about the microscopes and prepared slides of the onion epidermis that will be used in the testing. Follow the steps below to determine the microscope low and high power field of view diameters, average onion cell length, and approximate nucleus diameter.

A. Determine the diameter of the 100x field of view for the microscope(s) used in the skills test. **NOTE:** Repeat the data below if microscopes are of different manufacturers, models, or have different oculars or objective lenses.

100x field of view diameter in millimeters: _____

Convert to micrometers: 1 millimeter = 1000 micrometers

100x field of view diameter in micrometers: _____

B. Prior to the testing, examine each prepared slide of onion cells to be used to determine the average number of cells end to end that span the diameter of the field of view. Code each slide to identify differences in the onion epidermis tissue used to manufacture the prepared slide. Record the information below:

Slide No: _____ Number of onion cells end to end: _____

Slide No: _____ Number of onion cells end to end: _____

Determine the average onion cell length in micrometers using the following:

$$\frac{\text{100x field of view diameter}}{\text{No. of onion cells across the field of view}} = \text{Average length of a single onion cell}$$

Slide No: _____ Average length of a single onion cell: _____

Slide No: _____ Average length of a single onion cell: _____

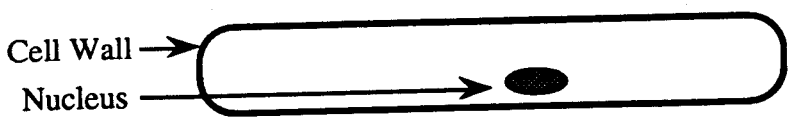
C. Determine the diameter of the high power field of view for each microscope by using the following:

$$\left(\frac{\text{low power magnification}}{\text{high power magnification}}\right) \times (\text{low power field diameter}) = \text{high power field diameter}$$

High power field of view diameter in micrometers: _____

High power field of view diameter in micrometers: _____

D. Examine an onion cell on the prepared slide and determine the approximate diameter of its nucleus in micrometers by comparing it to the average cell length. Use the following information:



$$\frac{\text{average onion cell length}}{\text{approximate number of nucleii needed to span the cell length}} = \text{approximate diameter of a single cell nucleus}$$

Scoring:

Item:

2. If the student correctly measures the field of view diameter +/-.25 millimeters, award **1 point.**

3. If the student correctly calculates the field of view diameter based on the above measurement to micrometers, award **1 point.**

4. If the student correctly explains and/or shows how the average length of an onion cell is calculated based upon the information in D above, award **1 point.**

   If the student correctly calculates the length of a single onion cell, award **1 point.**

5. Non-scored item.

6. If the student correctly explains and/or shows how the diameter of the high power field is calculated based upon the information in C above, award **1 point.**

   If the student correctly calculates the diameter of the high power field, award **1 point.**

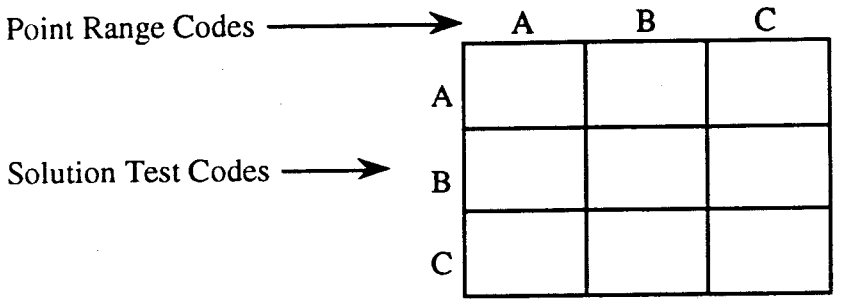
7. If the student correctly explains and/or shows how the approximate diameter of a single onion cell nucleus is calculated based upon the information in D above, award **1 point.**

   If the student correctly calculates the approximate diameter of a single onion cell nucleus, award **1 point.**

BIOLOGY TASK 2
TESTING WITH INDICATORS

SCORING GUIDELINES

TABLE A



Solution Test Codes:

A - sugar test (test tube A)
B - protein test (test test tube B)
C - starch test (test tube C)

Point Range Code Values:

A — 1
B — 2
C — 3

To award points, place a check (√) in the appropriate space for each solution testing factor. If no points are awarded, place a dash (—) in each box.

Solution Testing Guidelines:

Test Tube A (Sugar test):

Award 0 to 3 points by placing a check (√) in the appropriate box based upon the information below.

If the student has:

- xxx - **1 point**
- yyy - **1 point**
- zzz - **1 point**

Award zero points if none of the above are met. Place a dash (-) in each box to indicate that no points were given.

Test Tube B (Protein test):

Award 0 to 3 points by placing a check (√) in the appropriate box based upon the information below.

If the student has:

- xxx - **1 point**
- yyy - **1 point**
- zzz - **1 point**

Award zero points if none of the above are met. Place a dash (-) in each box to indicate that no points were given.

Test Tube C (Starch test):

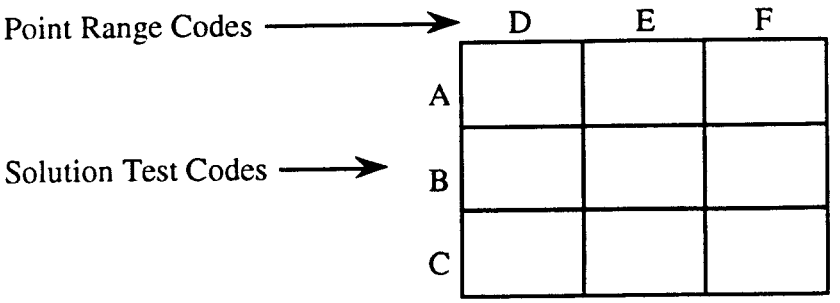
Award 0 to 3 points by placing a check (√) in the appropriate box based upon the information below.

If the student has:

- xxx - **1 point**
- yyy - **1 point**
- zzz - **1 point**

Award zero points if none of the above are met. Place a dash (-) in each box to indicate that no points were given.

TABLE B



Solution Test Codes:

A - sugar test (test tube A)
B - protein test (test test tube B)
C - starch test (test tube C)

Point Range Code Values:

D — 1
E — 2
F — 3

Solution Testing Guidelines:

Unknown Test Tube A (Sugar test):

Award 0 to 3 points by placing a check (√) in the appropriate box based upon the information below.

If the student has:

- xxx - **1 point**
- yyy - **1 point**
- zzz - **1 point**

Award zero points if none of the above are met. Place a dash (-) in each box to indicate that no points were given.

Unknown Test Tube B (Protein test):

Award 0 to 3 points by placing a check (√) in the appropriate box based upon the information below.

If the student has:

- xxx - **1 point**
- yyy - **1 point**
- zzz - **1 point**

Award zero points if none of the above are met. Place a dash (-) in each box to indicate that no points were given.

Unknown Test Tube C (Starch test):

Award 0 to 3 points by placing a check (√) in the appropriate box based upon the information below.

If the student has:

- xxx - **1 point**
- yyy - **1 point**

- zzz - **1 point**

Award zero points if none of the above are met. Place a dash (-) in each box to indicate that no points were given.

CONCLUSION:

Point Range Codes → G H I J

Point Range Code Values:

G — 0
H — 1
I — 2
J — 3

Award 0 - 3 points for the conclusion by checking the appropriate box based upon the following:

- aaa - **3 points**
- bbb - **2 point**
- ccc - **1 points**
- ddd - **0 points**

BIOLOGY TASK 2
TESTING WITH INDICATORS

SUMMARY SCORING SHEET

Maximum points for each item are identified in parentheses.

TABLE A:

				Points Awarded:
Test Tube:	A	Sugar test	(3)	_____
Test Tube:	B	Protein test	(3)	_____
Test Tube:	C	Starch test	(3)	_____

TABLE B:

				Points Awarded:
Test Tube:	A	Unknown	(3)	_____
Test Tube:	B	Unknown	(3)	_____
Test Tube:	C	Unknown	(3)	_____

CONCLUSION:

		Points Awarded:
Identify the Unknown	(3)	_____

BIOLOGY TASK 1
USING THE MICROSCOPE

SUMMARY SCORING SHEET

Maximum points for each item are identified in parentheses.

PROCEDURE A:

				Points Awarded:
Test Item:	1	Specimen Quality	(3)	_____
		Liquid Amount	(2)	_____
		Air Bubbles	(3)	_____

PROCEDURE B:

				Points Awarded:
Test Item:	2	Low Power Focus	(2)	_____
	3	Colored Thread	(1)	_____

PROCEDURE C:

				Points Awarded:
Test Item:	1	High Power Focus	(2)	_____

PROCEDURE D:

			Points Awarded:
Test Items:	2	(1)	_____
	3	(1)	_____
	4	(1,1)	_____, _____
	5		non-scored
	6	(1,1)	_____, _____
	7	(1,1)	_____, _____

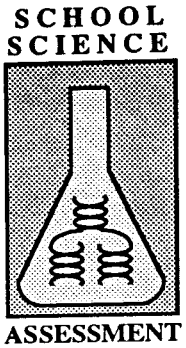
5. Student Test Booklets

The student test booklets which follow for Biology Tasks 3 through 6 consist of two booklets, labelled Parts A and B, for each of the six tasks. In part A, students are given a problem and asked to plan and design an experiment using the material and equipment provided at their laboratory station. In most tasks, students are asked to generate a hypothesis and formulate a plan that would include an appropriate procedure that could be used to solve the problem. Students are encouraged to manipulate the equipment and write a strategy for the solution of the problem, with attention to safety precautions in a laboratory. Students are also asked to suggest methods for organizing the data to be collected, and to suggest calculations necessary for making inferences. At the conclusion of 30 minutes, the student's plan is collected.

In Part B, which is 50 minutes in length, students are given a test booklet that provides a detailed plan for data collection and suggestions for organizing the data leading to appropriate graphs, calculations, and conclusions. A student who does not formulate an adequate plan in Part A can still perform the task and obtain credit for work completed in Part B. Thus, the detailed plan provided in Part B eliminates "double jeopardy" situations by not requiring students to proceed with an inadequately conceived plan from Part A.

Biology Tasks 1 and 2 differ in form from Tasks 3 through 6. Task 1 and Task 2 are both single part, 40 minute, performance-only tasks. Point values which differ from those in Tasks 3 through 6 have been assigned to the procedures within these tasks. For these reasons, individualized scoring guidelines were developed for these two tasks and may be found in Section 4: "Scoring Guidelines for Tasks 1 and 2".

For information regarding scoring Biology Tasks 3 through 6 see the Scoring Manual.



SCIENCE LABORATORY TEST

BIOLOGY

TASK NUMBER 1
USING THE MICROSCOPE

TIME : 40 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

USING THE MICROSCOPE

Introduction

This laboratory test presents tasks and lists materials. You will be asked to follow different procedures provided to solve the several tasks. You will be asked to have your worked checked by your teacher (or test administrator) several times. After being checked, continue with the next procedure. You will have a total of 40 minutes to complete this test. Record your answers in the test booklet.

Materials

Compound light microscope.
Glass microscope slide.
Plastic cover slips.
Dropper bottle with water.
Pieces of onion bulb.
Forceps.
Paper towel or tissue.
Prepared slide of colored threads.
Transparent plastic metric ruler.
Prepared slides of onion epidermis cells.

Please contact your test administrator if you need a review of the procedure for operating a microscope.

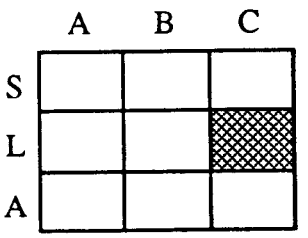
USING THE MICROSCOPE

Do not write in the boxes below

PROCEDURE A

1. Using the materials at the station, prepare a wet mount slide of onion epidermis tissue.

2. When finished, raise your hand to have your wet mount slide examined by the teacher. Do **NOT** place this slide on the microscope.

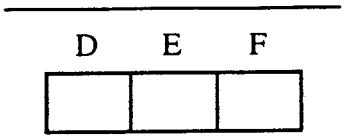


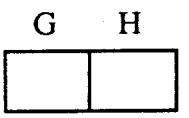
PROCEDURE B

1. At your station is a prepared slide labelled "Colored Threads." On the line at the right, write the number that is on the slide.

2. Focus on the colored threads under **low** power. Raise your hand to have the teacher examine your results.

3. Where the threads cross, identify which color thread is on top of the others. Write your answer on the line at right.

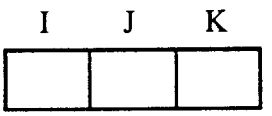




PROCEDURE C

1. Focus the slide of the colored threads under **high** power. Raise your hand to have the teacher examine your results.

   Remove the slide from the stage.



USING THE MICROSCOPE

PROCEDURE D

1. Adjust the microscope so that it is set for 100X magnification.

2. Using the metric ruler, measure the diameter of the 100X field of view in millimeters.

   Diameter of the field of view at 100X magnification = _____ millimeters

3. Calculate the diameter of the 100X field of view in micrometers. One millimeter is equal to 1000 micrometers.

   Diameter of the field of view at 100X magnification = _____ micrometers

4. View the prepared slide of onion cells at 100X magnification and determine the average length of a single onion cell in micrometers.

   Show and/or explain how you calculated the length of a single onion cell (in micro-meters) in the box below.

   Length of a single onion cell in micrometers = _____ micrometers

5. Change to high power and record the high power magnification that you will use below.

   High power magnification that you used = _____ X

USING THE MICROSCOPE

6. As magnification increases, the diameter of the field view decreases. Calculate the diameter of the high power field that you are using. Express your answer in micrometers.

   Show and/or explain how you calculated the diameter of the field of view at high power (in micrometers) in the box below.

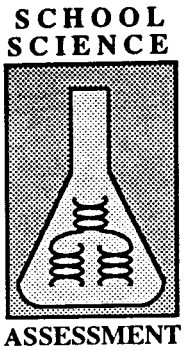
Diameter of the field
of view at high power = _____ micrometers.

7. View the prepared slide of onion cells at high power and determine the approximate diameter of a single onion cell nucleus in micrometers.

   Show and/or explain how you calculated the approximate diameter of a single onion cell nucleus (in micrometers) in the box below.

Approximate diameter of
a single onion cell nucleus = _____ micrometers

Your test booklet will be collected at the end of 40 minutes. If you finish early, please wait at this station.



SCIENCE LABORATORY TEST

BIOLOGY

TASK NUMBER 2
TESTING WITH INDICATORS

TIME : 40 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

TESTING WITH INDICATORS

Introduction

This laboratory test presents a problem, lists materials, and outlines the sequence to be followed in solving the problem and writing your observations and conclusions. You will have a total of 40 minutes to complete this test. Record your answers in this test booklet.

Problem

Biologists often use indicators to identify the properties of an unknown substance. Your problem is to conduct an experiment to determine which organic compound is present in the test tube marked "Unknown."

Materials

4 dropper bottles : each with 50 ml of solution and labelled
- Sugar
- Starch
- Protein
- Unknown

250 ml beaker — water bath.
Hot plate.
Dropper bottles of :
- Iodine solution
- Biuret's reagent
- Benedict's solution

6 clean test tubes.
Marking pencil.
Test tube holder.
Test tube rack.
Goggles.
Paper towels.

CAUTION : Biuret's reagent can cause skin burns.

TESTING WITH INDICATORS

Record your work on the answer sheets under the appropriate headings.

a) Perform the experiment by following the steps outlined in the procedure listed below.

b) Under the heading RESULTS record the findings of the experiment. Use statements, descriptive paragraphs, and measurements where appropriate.

c) Under the heading CONCLUSION give an interpretation of your results. What was the unknown? What was your evidence for this identification?

d) At the end of the 40 minutes your answer sheets will be collected.

SAFETY GOGGLES MUST BE WORN AT ALL TIMES AT THIS STATION.

Procedure

1. Start your water bath. It needs to be boiling for the testing procedure.

2. Transfer 2 ml (≈50 drops) of the starch to a clean test tube (labelled A) and add iodine solution one drop at a time until a change is noted. Record your observations in Table A.

3. Transfer 2 ml (≈50 drops) of the protein to a clean test tube (labelled B) and add Biuret's reagent one drop at a time until a change is noted. Record your observations in Table A.

4. Transfer 2 ml (≈50 drops) of the sugar to a clean test tube (labelled C) and add 2 ml (≈50 drops) of Benedict's solution and heat for 2 minutes in the water bath (water should be boiling).. Record your observations in Table A.

5. Take the unknown solution and transfer 2 ml (≈50 drops) to each of three test tubes numbered 1, 2, and 3.

   (a) Add iodine solution, one drop at a time to test tube #1 (up to 10 drops). Record your observations in Table B.

   (b) Add Biuret's reagent, one drop at a time to test tube #2 (up to 20 drops). Record your observations in Table B.

   (c) Add 2 ml (≈50 drops) of Benedict's solution to test tube #3 and heat for 2 minutes. Record your observations in Table B.

ANSWER SHEET

Use the front and back of these sheets if necessary.

RESULTS

Table A

Test Tube	Solution	Observations
A	STARCH (+ Iodine solution)	
B	PROTEIN (+ Biuret's reagent)	
C	SUGAR (+ Benedict's solution and heat)	

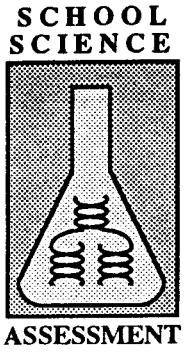
Table B

Unknown Test Tube	Indicator Used	Observations
1	Iodine solution	
2	Biuret's reagent	
3	Benedict's solution plus heat	

ANSWER SHEET

Use the front and back of these sheets if necessary.

CONCLUSION — Identify the unknown. Give reasons for your answer.



SCIENCE LABORATORY TEST

BIOLOGY

TASK NUMBER 3
MODEL OF A POPULATION

PART A

TIME : 30 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
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MODEL OF A POPULATION

Introduction

This laboratory test presents a problem. Your task in Part A is to plan and design an experiment to solve the problem. You will have **30 minutes** to complete Part A. At the end of the 30 minutes, your answer sheet will be collected. You will then receive separate directions for Part B. In Part B you will use materials and equipment provided in the laboratory kit to collect experimental data for this problem. You may wish to do your preliminary planning on the sheet labelled "Working Copy." Write this plan on the appropriate answer sheet in your test booklet.

Problem

Scientists often use models when it is difficult to observe phenomena directly. The changes in a population of real organisms over many generations can be modeled. In this activity, beans represent individuals in a population. A particular trait in this pooulation has two alleles, represented in the model by two beans - white navy and red kidney beans. A bag allows you to sample the population randomly by reaching in withour seeing the color of the beans. Your problem is to design an experiment with this material to see how gene frequencies in a population change over several generations.

a) State a HYPOTHESIS for this investigation that relates to population changes and that uses the beans as a model.

b) Under the heading PROCEDURE list in order the steps you will use to solve the problem. You may include a diagram to help illustrate your plans for the experiment. Include any safety procedures you would follow.

c) Construct a DATA TABLE or indicate any other method that you could use to record the observations and results that will be obtained.

PLEASE NOTE: In Part A you are NOT to proceed with any part of the actual experiment. You are just to plan and organize a way to investigate the problem.

Materials

25 red kidney beans.
25 white navy beans.
2 small opaque paper bags.
1 beaker or cup (200 ml).
Pen or pencil (for marking bags).

ANSWER SHEET

PART A — Experiment Design

Organize your experiment design under the following headings:
HYPOTHESIS, PROCEDURE, and DATA TABLE.
Use the front and back of these sheets if necessary.

HYPOTHESIS

PROCEDURE (Include diagram if appropriate)

ANSWER SHEET

PART A — Experiment Design

Organize your experiment design under the following headings:
HYPOTHESIS, PROCEDURE, and DATA TABLE.
Use the front and back of these sheets if necessary.

DATA TABLE (For results and observations)

WORKING COPY

PART A — Experiment Design

This sheet is provided as a work space (or scrap sheet).
Be sure to enter your final plan on the appropriate answer sheets.
No work on this sheet will be considered for credit.

SCHOOL SCIENCE ASSESSMENT

SCIENCE LABORATORY TEST

BIOLOGY

TASK NUMBER 3
MODEL OF A POPULATION

PART B

TIME : 50 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

MODEL OF A POPULATION

You will have **50 minutes** to complete this part. Record your work for Part B on the answer sheet under the appropriate headings. Perform the experiment by following the steps outlined in the procedure (listed below). Under the heading RESULTS record your observations and measurements for the experiment. Use written statements, descriptive paragraphs, tables of data, and/or graphs where appropriate. Under the heading CONCLUSIONS write an interpretation of your results.

At the end of 50 minutes, your answer sheet for Part B will be collected.

Procedure

1. Label bag number 1 "Original Population." Set up a model of a population of diploid organisms using 25 red beans and 25 white beans from your supply. Place this population into the bag and shake gently to mix the beans. The two colors represent two alleles of a particular trait.
2. Assume that ten individuals from this population migrate to a new location. Randomly withdraw their genes from the bag, and place them into a beaker (two genes for each individual).
3. Record the gene make-up of the new population, called "Migrant Population 1," in Data Table A.
4. Return the beans to the bag. Repeat step 2 three more times and record the results in Table A.
5. Add the results for all four trials and record under "Totals." Use these totals to determine the migrant populations' gene frequencies and record in Table A. Compare the gene frequencies of the migrant populations with those of the original population.
6. Return all the beans to bag number 1. Randomly select the genes for 10 individuals of a new migrant population from bag number 1. Record the gene frequency of this new migrant population in Table B. Label bag number 2 "New Migrant Population." Put the 20 beans that you selected for the new migrant population into this "New Migrant Population" bag.
7. Assume that this new migrant population succeeds in producing 12 offspring. Randomly draw the genes for one of the offspring from the bag and record its gene make-up in Table C. Return the first offspring's genes to the bag and repeat this procedure for the remaining 11 offspring.
8. Determine the gene frequencies of the new migrant offspring, and compare them with those of their parents and the original population.
9. Be sure to answer the questions concerning your results under the section labelled "Conclusion" on the answer sheets.

ANSWER SHEET

PART B — Experiment Report

Organize your experiment report under the following headings:
RESULTS and CONCLUSIONS.
Use the front and back of these sheets if necessary.

RESULTS

	Gene Make-up	
	Red	White
Original Population	25	25
Gene Frequencies	.5	.5

Table A

Migrant Populations	Gene Make-up	
	Red	White
1		
2		
3		
4		
Totals		
Gene Frequencies		

Table B

	Gene Make-up	
	Red	White
New Migrant Population		
Gene Frequencies		

Table C

New Migrant Offspring	Gene Make-up	
	Red	White
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
Totals		
Gene Frequencies		

ANSWER SHEET

PART B — Experiment Report

Organize your experiment design under the following headings:
RESULTS and CONCLUSIONS.
Use the front and back of these sheets if necessary.

CONCLUSIONS

After performing steps 1-5, answer the following:

How did the gene frequencies of the four sample migrant populations compare with the original population?

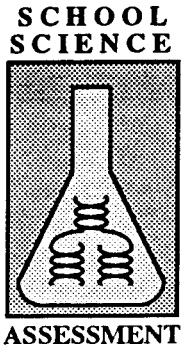
After performing steps 6-8, answer the following:

How did the gene frequency of the offspring compare with the gene frequency of their parents?

How did the gene frequency of the offspring compare with the gene frequency of the original population?

What conclusion can you state?

What are the implications of this principle on actual populations in nature?



SCIENCE LABORATORY TEST

BIOLOGY

TASK NUMBER 4
DIFFUSION

PART A

TIME : 30 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
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DIFFUSION

Introduction

This laboratory test presents a problem. Your task in Part A is to plan and design an experiment to solve the problem. You will have **30 minutes** to complete Part A. At the end of the 30 minutes, your answer sheet will be collected. You will then receive separate directions for Part B. In Part B you will use materials and equipment provided in the laboratory kit to collect experimental data for this problem. You may wish to do your preliminary planning on the sheet labelled "Working Copy." Write this plan on the appropriate answer sheet in your test booklet.

Problem

Diffusion is a process by which substances enter and leave cells. Your problem is to design an experiment to test the effects of two variables (time and concentration) on diffusion of potassium permanganate into potato cubes.

a) State a HYPOTHESIS for this investigation that can be used to test the effects of time and concentration on diffusion.

b) Under the heading PROCEDURE list in order the steps you will use to solve the problem. You may include a diagram to help illustrate your plans for the experiment. Include any safety procedures you would follow.

c) Construct a DATA TABLE or indicate any other method that you could use to record the observations and results that will be obtained.

PLEASE NOTE: In Part A you are NOT to proceed with any part of the actual experiment. You are just to plan and organize a way to investigate the problem.

Materials

2 firm potatoes.
Metric ruler (30 cm).
3 small beakers (approx. 150 ml).
1%, 5%, and 10% solutions of potassium permanganate (in beakers).
Forceps.
Scalpel.
Stopwatch/clock.
Paper towels.
Experiment Display Sheet.
Waste container.
Graph paper.

WORKING COPY

PART A — Experiment Design

This sheet is provided as a work space (or scrap sheet).
Be sure to enter your final plan on the appropriate answer sheets.
No work on this sheet will be considered for credit.

ANSWER SHEET

PART A — Experiment Design

Organize your experiment design under the following headings:
HYPOTHESIS, PROCEDURE, and DATA TABLE.
Use the front and back of these sheets if necessary.

HYPOTHESIS

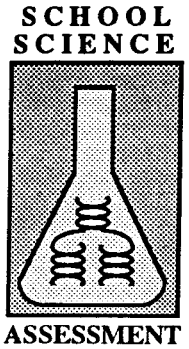
PROCEDURE (Include diagram if appropriate)

ANSWER SHEET

PART A — Experiment Design

Organize your experiment design under the following headings:
HYPOTHESIS, PROCEDURE, and DATA TABLE.
Use the front and back of these sheets if necessary.

DATA TABLE (For results and observations)



SCIENCE LABORATORY TEST

BIOLOGY

TASK NUMBER 4
DIFFUSION

PART B

TIME : 50 MINUTES

NAME _____ SEX _____

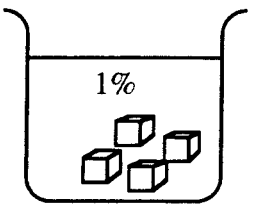
SCHOOL _____ DATE _____

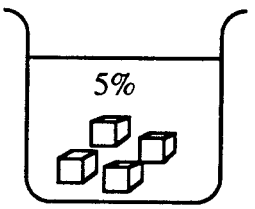
These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

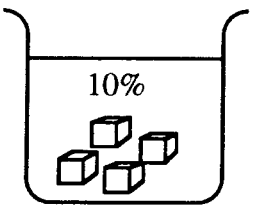
DIFFUSION

You will have **50 minutes** to complete this part. Record your work for Part B on the answer sheet under the appropriate headings. Perform the experiment by following the steps outlined in the procedure (listed below). Under the heading RESULTS record your observations and measurements for the experiment. Use written statements, descriptive paragraphs, tables of data, and/or graphs where appropriate. Construct a GRAPH which presents the relationship between the distance of diffusion into the potatoes and time and concentration. Under the heading CONCLUSIONS write an interpretation of your results. State the effect that time and concentration have on diffusion.

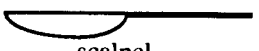
At the end of 50 minutes, your answer sheet for Part B will be collected.







forceps



scalpel

stopwatch/clock

Experiment Display Sheet

	1%	5%	10%
5 min.			
10 min.			
15 min.			
20 min.			

Safety

CAUTION : SLICE AWAY FROM FINGERS TO AVOID CUTS.
HANDLE POTATO CUBES WITH FORCEPS ONLY.

DIFFUSION

Procedure

1. Using a scalpel, cut 12 cubes from a potato. Each side of the cubes should measure approximately 1 cm. Be sure that there is no skin on any of the cubes.

CAUTION : SLICE AWAY FROM FINGERS TO AVOID CUTS.
HANDLE POTATO CUBES WITH FORCEPS ONLY.

2. Place 4 potato cubes in each of the three beakers of different concentrations of potassium permanganate. Note the exact time the cubes were added to the solutions.

3. With forceps, remove one cube from each solution every 5 minutes and place on a paper tower. Slice each cube in half with the scalpel. **CAREFULLY** dry the scalpel before slicing each cube.

4. Remove the Experiment Display Sheet from the back of the test booklet. Measure and record the distance that the solution has diffused into each potato for each time interval. After measuring, place the cubes on the Experiment Display Sheet for later checking of results or verifying conclusions.

5. Record the RESULTS of your experiment in the data table. Enter the distances for each concentration and time.

6. Construct a GRAPH for these results.

7. Based on your data table and graphing of the results, state your CONCLUSIONS as to how the length of time in solution and the concentration of the solution influence the distance of the diffusion.

When you are finished with all work, discard the potato cubes in a container labelled "WASTE."

ANSWER SHEET

PART B — Experiment Report

Organize your experiment report under the following headings:
RESULTS, GRAPH, and CONCLUSIONS.
Use the front and back of these sheets if necessary.

RESULTS

Concentration of potassium permanganate	Distance of Diffusion (in mm)			
	After 5 minutes	After 10 minutes	After 15 minutes	After 20 minutes
1%				
5%				
10%				

ANSWER SHEET

PART B — Experiment Report

Organize your experiment design under the following headings:
RESULTS, GRAPH, and CONCLUSIONS.
Use the front and back of these sheets if necessary.

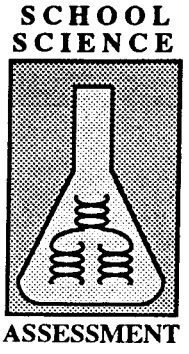
Construct your GRAPH on the graph paper provided.

CONCLUSIONS

Task #4 — DIFFUSION

Experiment Display Sheet :

	1 %	5 %	10 %
5 MINUTES			
10 MINUTES			
15 MINUTES			
20 MINUTES			



SCIENCE LABORATORY TEST

BIOLOGY

TASK NUMBER 5
RESPIRATION

PART A

TIME : 30 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

RESPIRATION

Introduction

This laboratory test presents a problem. Your task in Part A is to plan and design an experiment to solve the problem. You will have **30 minutes** to complete Part A. At the end of the 30 minutes, your answer sheet will be collected. You will then receive separate directions for Part B. In Part B you will use materials and equipment provided in the laboratory kit to collect experimental data for this problem. You may wish to do your preliminary planning on the sheet labelled "Working Copy." Write this plan on the appropriate answer sheet in your test booklet.

Problem

Sometimes biologists use indicators to test the effect of chemical reactions. Your problem is to design an experiment to test the effect of various pH levels on the rate of respiration in microorganisms, using methylene blue as an indicator. During respiration oxygen combines chemically with some compounds.

Methylene blue is an oxygen indicator. When oxygen is present, it's blue. When oxygen is absent, it loses its blue color. (It may keep a blue ring at the upper edge of the test tube.

Design an experiment to test the effect of various pH levels on the rate of respiration in organisms.

a) State a HYPOTHESIS for this investigation as to the effect that various pH levels may have on the rate of respiration in organisms.

b) Under the heading PROCEDURE list in order the steps you will use to solve the problem. You may include a diagram to help illustrate your plans for the experiment. Include any safety procedures you would follow.

c) Construct a DATA TABLE or indicate any other method that you could use to record the observations and results that will be obtained.

PLEASE NOTE: In Part A you are NOT to proceed with any part of the actual experiment. You are just to plan and organize a way to investigate the problem.

Materials

General Materials

1 beaker, 800 ml.
Graduated cylinder, 10 ml.
8 test tubes - 16 mm by 150 mm.
8 clean stoppers for the test tubes (size 6).
Test tube rack.
Test tube holders.
Adjustable hot plate.
Paper towels.
Graph paper.
Thermometer.
Wax marking pencil.

Special Materials

Microorganisms in suspension.
Methylene blue solution,
40 ml in plastic dropper bottles.
pH solutions of 4, 6, 8, and 10
in dropper bottles.

ANSWER SHEET

PART A — Experiment Design

Organize your experiment design under the following headings:
HYPOTHESIS, PROCEDURE, and DATA TABLE.
Use the front and back of these sheets if necessary.

HYPOTHESIS

PROCEDURE (Include diagram if appropriate)

ANSWER SHEET

PART A — Experiment Design

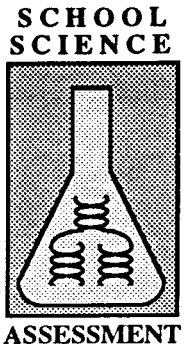
Organize your experiment design under the following headings:
HYPOTHESIS, PROCEDURE, and DATA TABLE.
Use the front and back of these sheets if necessary.

DATA TABLE (For results and observations)

WORKING COPY

PART A — Experiment Design

This sheet is provided as a work space (or scrap sheet).
Be sure to enter your final plan on the appropriate answer sheets.
No work on this sheet will be considered for credit.



SCIENCE LABORATORY TEST

BIOLOGY

TASK NUMBER 5
RESPIRATION

PART B

TIME : 50 MINUTES

NAME _____ SEX _____

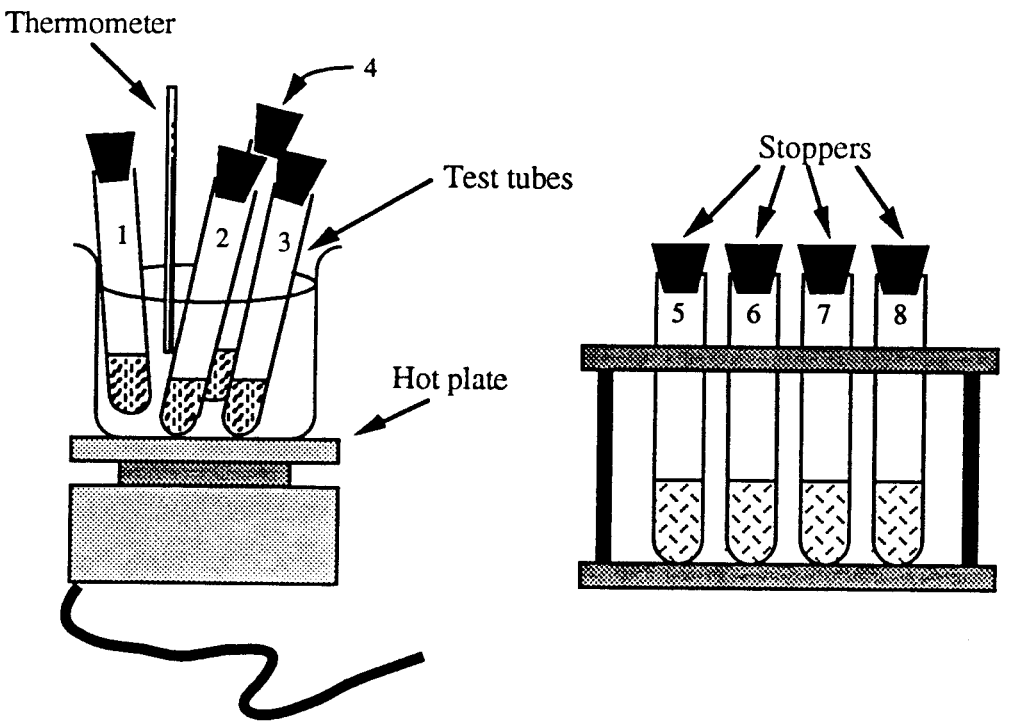
SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

RESPIRATION

You will have **50 minutes** to complete this part. Record your work for Part B on the answer sheet under the appropriate headings. Perform the experiment by following the steps outlined in the procedure (listed below). Under the heading RESULTS record your observations and measurements for the experiment. Use written statements, descriptive paragraphs, tables of data, and/or graphs where appropriate. Construct a GRAPH which presents the relationship between the data you have collected. Under the heading CONCLUSIONS write an interpretation of your results. State the effect that pH level has on respiration of microorganisms.

At the end of 50 minutes, your answer sheet for Part B will be collected.



RESPIRATION

Procedure

1. Check the temperature of the water bath in the 800 ml beaker (on the hot plate). The temperature **must** be between 35°C and 39°C. Record the temperature on the answer sheet.

2. Prepare 4 test tubes each with 5 ml of the microorganism in suspension, and 4 test tubes each with 5 ml of distilled water (for the control). Use the wax pencil to label each test tube with a number from 1 to 8.

3. Place 5 ml of prepared pH solutions in each test tube according to the chart below. The pH in each test tube should be as follows:

Microorganism Suspension		Control: Distilled Water	
Test Tube #	pH	Test Tube #	pH
1	4	5	4
2	6	6	6
3	8	7	8
4	10	8	10

NOTE : Thoroughly RINSE the graduated cylinder after filling EACH test tube.

4. Now add two drops of methylene blue to each test tube (1 through 8). Place stoppers on each test tube. Mix by carefully inverting each test tube several times.

5. Place test tubes 1 through 4 in the water bath. Record the time at which you placed the test tubes in the water bath on the answer sheet. Observe how long it takes for the blue color to disappear in each test tube. Record the times in the data table. Continue timing for 10 minutes.

6. Take test tubes 1 through 4 out of the water bath and place in the test tube rack. Invert each tube several times. What do you observe? Record your observations in the data table.

7. Repeat steps 5 and 6 for test tubes 5 through 8.

8. Enter the RESULTS (your times and observations) in the data tables provided.

9. Construct a GRAPH of your results.

10. Based on your data and your graphing of the results, write your CONCLUSION about how pH effects the time for the indicator to change.

When you are finished with all your work, dispose of the solutions and rinse the test tubes.

ANSWER SHEET

PART B — Experiment Report

Organize your experiment report under the following headings:
RESULTS, GRAPH, and CONCLUSIONS.
Use the front and back of these sheets if necessary.

RESULTS

Water bath temperature _____ °C.

Time you placed test tubes in the water bath _____

Microorganism Suspension

Test tube #	pH	Time for blue color to disappear	Observations after inverting
1	4		
2	6		
3	8		
4	10		

Control : Distilled Water

Test tube #	pH	Time for blue color to disappear	Observations after inverting
5	4		
6	6		
7	8		
8	10		

ANSWER SHEET

PART B — Experiment Report

Organize your experiment design under the following headings:
RESULTS, GRAPH, and CONCLUSIONS.
Use the front and back of these sheets if necessary.

Construct your GRAPH on the graph paper provided.

CONCLUSIONS

SCHOOL SCIENCE ASSESSMENT

SCIENCE LABORATORY TEST

BIOLOGY

TASK NUMBER 6
WATER-HOLDING CAPACITY

PART A

TIME : 30 MINUTES

NAME _____ SEX _____

SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

WATER-HOLDING CAPACITY

Introduction

This laboratory test presents a problem. Your task in Part A is to plan and design an experiment to solve the problem. You will have **30 minutes** to complete Part A. At the end of the 30 minutes, your answer sheet will be collected. You will then receive separate directions for Part B. In Part B you will use materials and equipment provided in the laboratory kit to collect experimental data for this problem. You may wish to do your preliminary planning on the sheet labelled "Working Copy." Write this plan on the appropriate answer sheet in your test booklet.

Problem

The retention of water by different materials affects their use by plants and animals. Your problem is to design a method to determine the water-holding capacity of sand, soil, and moss.

a) State a HYPOTHESIS for this investigation that relates to the water-holding capacity of sand, soil, and moss..

b) Under the heading PROCEDURE list in order the steps you will use to solve the problem. You may include a diagram to help illustrate your plans for the experiment. Include any safety procedures you would follow.

c) Construct a DATA TABLE or indicate any other method that you could use to record the observations and results that will be obtained.

PLEASE NOTE: In Part A you are NOT to proceed with any part of the actual experiment. You are just to plan and organize a way to investigate the problem.

Materials

Water — 800 ml (approx.) in a large beaker.
Graduated cylinder — 100 ml.
3 funnels (100 mm top diameter).
3 funnel supports (ring stands or tripods).
3 beakers — 250 ml.
3 pieces of filter paper (18.5 cm diameter).
Clock/timer.
Wax marking pencil.
Dry potting soil — 100 grams.
Dry sand — 100 grams.
Dry sphagnum moss — 100 grams.
1 spoon.
Paper towels.
3 paper cups.
Balance (accurate to ±0.1 gram).

ANSWER SHEET

PART A — Experiment Design

Organize your experiment design under the following headings:
HYPOTHESIS, PROCEDURE, and DATA TABLE.
Use the front and back of these sheets if necessary.

HYPOTHESIS

PROCEDURE (Include diagram if appropriate)

ANSWER SHEET

PART A — Experiment Design

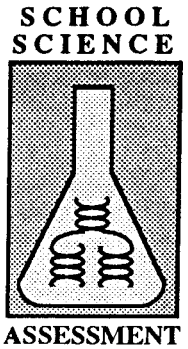
Organize your experiment design under the following headings:
HYPOTHESIS, PROCEDURE, and DATA TABLE.
Use the front and back of these sheets if necessary.

DATA TABLE (For results and observations)

WORKING COPY

PART A — Experiment Design

This sheet is provided as a work space (or scrap sheet).
Be sure to enter your final plan on the appropriate answer sheets.
No work on this sheet will be considered for credit.



SCIENCE LABORATORY TEST

BIOLOGY

TASK NUMBER 6
WATER-HOLDING CAPACITY

PART B

TIME : 50 MINUTES

NAME _____ SEX _____

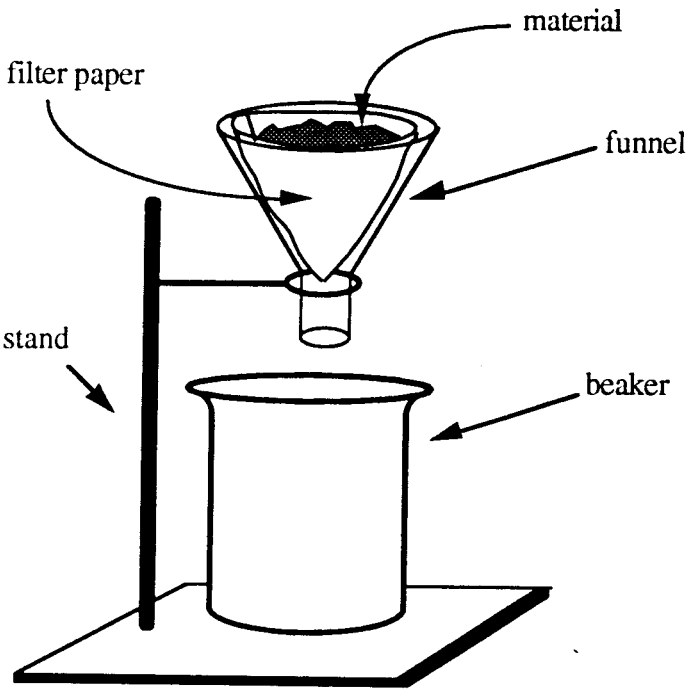
SCHOOL _____ DATE _____

These tests are being developed through
the University at Buffalo and NORC with support of
the National Science Foundation and
the U.S. Office of Education

WATER-HOLDING CAPACITY

You will have **50 minutes** to complete this part. Record your work for Part B on the answer sheet under the appropriate headings. Perform the experiment by following the steps outlined in the procedure (listed below). Under the heading RESULTS record your observations and measurements for the experiment. Use written statements, descriptive paragraphs, tables of data, and/or graphs where appropriate. Under the heading CONCLUSIONS write an interpretation of your results.

At the end of 50 minutes, your answer sheet for Part B will be collected.



WATER-HOLDING CAPACITY

Procedure

1. Place the three funnels into the funnel supports. Place a beaker under the lower end of each funnel. With the marking pencil, label the first beaker SOIL, the second beaker SAND, and the third beaker MOSS.

2. Fold the filter papers to form cones. Insert them into the funnels.

3. To the first funnel add 20 grams of soil. In the second funnel, add 20 grams of sand. In the third funnel, add 20 grams of moss.

4. Using a graduated cylinder, measure 150 ml of water. SLOWLY pour this water into the funnel with the topsoil. Don't allow the water to spill over the top of the filter paper. Record the starting time in the chart. Note what time it will be in 10 minutes. After exactly 10 minutes, remove the beaker in which the water has collected. Place a paper cup under the funnel if water is still flowing.

5. Repeat step 4 for the funnels with sand and moss. In each case record the starting times. Perform these steps while waiting for the water to drain through the first funnel. Wait exactly 10 minutes for each of these funnels, and remove the beakers into which the water has drained. Use paper cups for catching any additional water that is still flowing.

6. Measure the quantity of water collected in each beaker. Record your measurements and observations in the RESULTS section.

7. From these results, state appropriate CONCLUSIONS.

ANSWER SHEET

PART B — Experiment Report

Organize your experiment report under the following headings:
RESULTS and CONCLUSIONS.
Use the front and back of these sheets if necessary.

RESULTS

	Time Water Added	Time Beaker Removed	Amount of Water Collected
Soil			
Sand			
Moss			

CONCLUSIONS