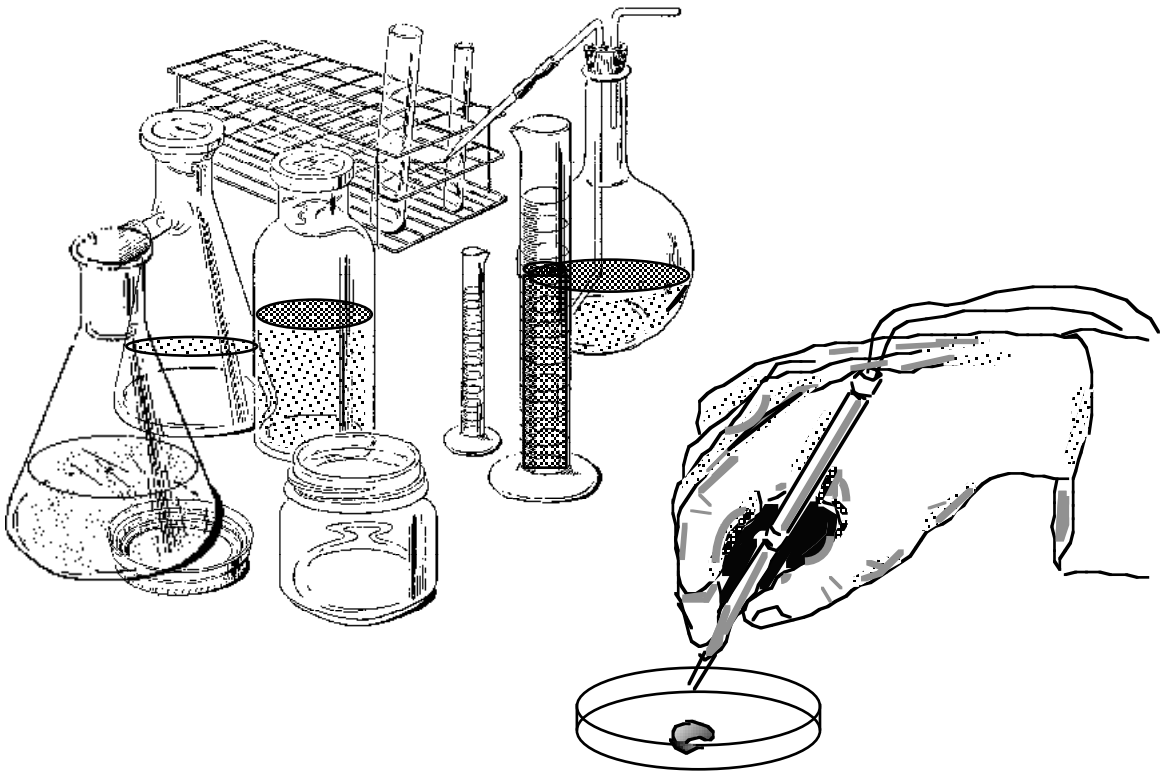
Laboratory Performance Assessment for *Biology: As Scientific Inquiry*



The following lab performance assessment was demonstrated at some NSTA and other conferences and workshops. ***This Fish-Curling Assessment*** is the first module of a four-module assessment package of sixteen lab assessments that are available with other assessment instruments for ***Biology: As Scientific Inquiry.***

See www.BioInquiry.com for more information about this curriculum and the assessment packages that accompany it.

The best way to evaluate how well students are doing in mastering inquiry is to eventually have them *independently* demonstrate that they can solve a laboratory problem. The four performance assessment modules are designed to allow lab assessment at least once a quarter. Any or all of these options can also be used as supplemental lab activities.

Module One
for the First Quarter
-Lab Performance Based Assessment-

What Makes the Fish Curl?

This task is a novel assessment that will help ease students into the new performance based assessment experience. They will enjoy using the "Fortune Teller Fish" to determine their pseudo-romance quotient.

Assessment Type: Cooperative Group Assessment

This activity is designed to introduce students to the B:ASI Performance Based Assessment Modules and should be a cooperative group assessment. Completing this investigation prepares students for the other modules in the assessment package. This lab requires very little teacher preparation and can be easily completed in a 50 min. period with time to spare.

Prior preparation:

- Read the student assessment pages and then read the "Teacher Information and Scoring Rubric" section that follows.
- Order the "Fortune Teller Fish" well ahead. See ordering information in the "Teacher Information" for this module.
- Set up the needed materials at least one day prior to the lab.
- Introduce the concept and purpose of Lab Performance Based Assessment to your students at least three days prior or earlier. It is a good idea to explain early in the quarter that students will need to periodically demonstrate their problem-solving skills in this type of testing environment.
- Photocopy the student pages and distribute them on the days of the assessment.

If teachers would rather use the *Fortune-Telling* cellophane fish as a regular inquiry lab activity, the following pages can also be used for that purpose. Simply ignore the rubric.

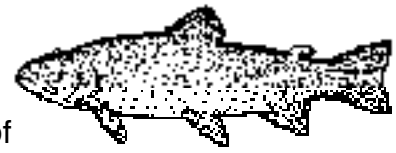
Name _____ Per. ____ Table or Team # ____
last first

Laboratory Performance Based Assessment
What Makes the Fish Curl?

General Instructions

In this assessment activity, you and your lab partners will be asked to demonstrate that you can solve a problem in the laboratory using the appropriate steps in the scientific process. You will be able to use the materials found on the supply table as well as any other materials available in the room. You may not need all of the materials available. You will see other students using different materials than you use. This is because they may have a different problem. Also remember that there may be many different correct ways to answer the same question. In this first assessment, you will work as a team at your table. In later assessments you will be expected to individually demonstrate that you can solve similar problems. **Remember that this is a test so be sure to talk only to those in your team or with your teacher**. Do not talk with other teams.

Pre-assessment Activity



1. Find the red cellophane "Fortune-Teller Fish" in a small plastic envelope. There should be one fish for each member of your team.
2. Follow the directions on the back of the package. Watch the fish in your hand for at least 1/2 minute. Note what the back of the envelope says about your personality.

Assessment A (Work as a team but each student is to write his or her own report by filling in the blanks that follow.)

Problem: What causes the fish to behave as observed?

As a team, suggest **two different hypotheses** to account for the fish's observed behavior.

1._____

_____

2._____

_____

EXPERIMENTAL DESIGN:

3. In the boxes on the next page, explain in detail how your team will set up experiments to determine which of your two hypotheses best explains the fish's observed behavior. Be sure to describe experiments that will test both of your hypotheses. You can conduct 1, 2 or 3 experiments for each hypothesis.

Experiment for Hypothesis 1:

Experiment for Hypothesis 2:

Experiments:

4. Plan and **conduct your experiments** to determine which hypothesis best describes the fish's behavior.

Recording Data:

In the spaces below, clearly describe what you observed in each experiment.
Results for experiment(s) to test *hypothesis 1*:

Results for experiment(s) to test *hypothesis 2*:

_____

_____

_____

_____

_____

_____

_____

Interpretation of Results:

Write appropriate interpretations for the results obtained for experiments conducted to test *each* hypothesis.

Interpretation of results for experiment testing *hypothesis 1*

_____

_____

_____

Interpretation of results for experiment testing *hypothesis 2*

_____

_____

_____

Conclusion about your hypotheses:

Reread your two hypotheses. Which hypothesis, if any, does your data support?

_____

Explain your choice.

_____

_____

Please return the fish (in its plastic envelope) and all materials to the supplies table. They are needed for the next class. If needed, dry any water spilled at your table. **Turn in this paper**, stapled with the other papers for your team, to your teacher. Be sure each of you has placed your name on the top of the first page of your individual report.

Teacher Information and **Scoring Rubric** for the Curling Fish Lab Performance Based Assessment

If you decide to have students do one lab performance based assessment per quarter, it is desirable to have them work in groups of 3-4 students on the first performance assessment. Students must understand that they will eventually need to *individually* demonstrate that they can solve a similar problems later in the year. This assessment is one that is designed to be used for this first cooperative effort.

Materials needed for each team

Four cellophane fish

(You can also conduct this assessment with 2 fish. If possible use 4 fish so each student can have the fun of evaluating their romantic potential. Most students realize that this is for fun and not a scientific determination. You might want to mention this in your review of the activity.)

You can order the "Fortune-Teller Fish" from:
GTA, Inc.
14650-28th Ave. No.
Plymouth, MN 55447

Send check or purchase order for $13.70 plus shipping charges. This will provide you with 144 fish (1 gross) in envelopes. These should last a long time or you can give them to students to keep. You may have to periodically replace some fish that student immerse completely in water. Order #510-747. Call 1 800 328-1226 M-F, 8 AM-4:30 PM central time. Mention that the fish was recommended to you by Ron Thompson for use in your biology classes.

1 small container of tap water
2 paper towels
1 student desk lamp
1 wad of cotton
2 toothpicks
1 piece of plastic wrap, saran wrap or plastic sandwich bag

and a variety of objects that may be of little use for their experiments. These items require students to make judgments about what materials are useful for their experiments. For example: dry beans, small ruler, glass microscope slide, etc.

Suggest that they can use any useful materials located in the room.

General Background Information for the Teacher

Usual student hypotheses:

1. Moisture from the hand causes the curling.
2. Heat from the hand causes the curling.
3. Static electricity from the hand causes the curling.

Students usually test the moisture hypothesis by placing a small amount of water on a paper towel or table and setting the fish on the moistened area. Students test the heat hypothesis by using the desk lamp or create heat in other ways. One ingenious way to distinguish between heat and moisture is to place the plastic envelope on your hand to let it heat up. Then place the fish on top of the envelope. To test static electricity, I have seen students use a charged comb to test the fish. I have also seen them rub their hands or feet on a carpet to test the fish. Next they repeat the experiment while touching grounded metal.

Explanation for curling:
The fish curls in response to moisture and not heat. The cellophane curls as water from the hand or another surface is absorbed into the bottom layer of the cellophane. This causes the cellophane layer that is absorbing the water to expand, forcing the fish to curl up, away from the moisture. If the fish is submerged in water and then removed, both sides absorb water equally and therefore will not curl in the same way. Placing the fish on top of the plastic envelope on your hand is an ideal way to quickly distinguish between the heat and moisture hypotheses. The hand's heat is still present but the moisture is not. The fish does not curl in this test unless the envelope is already moist. The fish will usually not curl if a lamp is used to create heat from the top. If the fish does curl, it is because the room is a little humid and the heat from the lamp evaporates the moisture from the top side of the fish. This results in a difference in moisture levels for each side and can cause the fish to curl up a little. One way to resolve this is to alternately heat each side a couple of times and then try the lamp on one side. This generally results in no curling. The success of this procedure depends upon the humidity in the room.

Later Follow-up Content Connections:
If you teach about **plant tropisms**, this bending (curling) phenomenon mimics the way plant stems elongate on one side in response to gravity or light, causing the stem to bend negatively to gravity and positively to light. This type of bending might also be used in teaching how stoma sections on leaves bend and open as they absorb water.

Teacher's Grading Rubric

Problem: What causes the fish to behave as observed? (The curling behavior of the fish will be apparent to every group.) This problem was provided indirectly in the student pages.

As a team, suggest **two different hypotheses** to account for the fish's observed behavior.

1. *Moisture from the hand causes the curling.*
2. *Heat from the hand causes the curling.*
3. *Static electricity from the hand causes the curling.*

Total Possible Points = 4
(2 maximum per hypothesis)

Any two of the above are acceptable. Most students will offer 1 & 2. A few groups will offer a hypothesis not listed. Evaluate the hypothesis according to the following scoring rubric:

2 points (Excellent) Hypothesis is an appropriate possible answer to the question
Hypothesis is stated in a complete sentence that provides the degree of detail

1 point (Satisfactory) Hypothesis is an appropriate possible answer to the question
Hypothesis is not stated in a complete sentence or does not provide the degree of detail appropriate for the question.

0 points (Unsatisfactory) Hypothesis is not an appropriate possible answer or shows no relationship to the question
Response shows little understanding of what a hypothesis is

EXPERIMENTAL DESIGN:

3. In the boxes on the next page, explain in detail how your team will set up experiments to determine which of your two hypotheses best explains the fish's observed behavior. Be sure to describe experiments that will test both of your hypotheses. You can conduct 1, 2 or 3 experiments for each hypothesis.

Experiment for Hypothesis 1: (*Moisture from the hand causes the curling.*

Place a small drop or streak of water on the table. Then place a fish on the wet, room temperature area. Or use some other way to apply water to only one side of the fish. As a control, place a 2nd fish on the dry table or paper towel at room temperature. Observe and record what happens. Be sure the heat variable is eliminated.
Place one fish submerged in water and the leave the 2nd control fish in a dry, room temperature place. Observe.

2 points for exper. set-up & 2 points for control description.

1 point for exper. set-up & 1point for control description.

4 points total for Experimental design

Experiment for Hypothesis 2: (*Heat from the hand causes the curling.)*

Warm one fish in some way that eliminates the moisture variable. Examples: Use the lamp, Use hot water to warm a glass slide (but dry the slide before the test). Place a fish on the warmed slide of container. Leave another fish at room temperature under the same circomstances. Observe.

Place the plastic envelope that the fish came in or a piece of plastic wrap on my hand. Next place a fish on top of the plastic and observe. Place a fish on the bare hand as a control. ** This distinguishes between moisture & heat. Observe.

2 points for exper. set-up & 2 points for control description.

3 points for exper. set-up & 2 points for control description.

5 points total for Experimental design

Experiment for Hypothesis 3: (*Static electricity from the hand causes the curling.)*

Place the fish on a dry, room temperature surface. Charge a comb or my hand with static electricity by rubbing the comb on cloth or drag my feet on a carpet to charge by body. Place the charged comb or hand over the fish. Do not touch the fish. Place a 2nd fish under the same conditions as a control but do not suject it to the static test. Observe to see if the fish curls.

2 points for exper. set-up & 2 points for control description.

4 points total for Experimental design

Other experimental designs may be submitted.

4 points (Excellent)	Design is appropriate to test hypothesis. Variables are controlled Design contains both control and experimental group Design is described or drawn to clearly communicate each set-up.
2-3 points (Satisfactory)	Design is appropriate to test hypothesis. Not all variables are controlled or control group is missing or faulty. Design is not described or drawn clearly.
0-1 point (Unsatisfactory)	Design is not appropriate to test hypothesis or variables are not controlled No control group Design is not described or drawn clearly.

Experiments:

4. Plan and **conduct your experiments** to determine which hypothesis best describes the fish's behavior.

Recording Data:

In the spaces below, clearly describe what you observed in each experiment.

Results for experiment(s) to test *hypothesis 1*:
The experimental fish curled when we placed it on a damp room temperature surface. The control fish on a dry surface did not curl.

1 point for experimental & 1 point for control description.

2 points total for Data

Alternative:
Neither the fish submerged in water or the fish on the dry area curled.

1 point for experimental & 1 point for control description.

2 points total for Data

Results for experiment(s) to test *hypothesis 2*:
Neither fish curled.

1 point for experimental & 1 point for control description.

2 points total for Data

Results for experiment(s) to test *hypothesis 2* alternative :
(Fish on plastic on hand alternative)
Fish did not curl on plastic over hand while it did curl on the bare hand.

1 point for experimental & 1 point for control description.

2 points total for Data

Results for experiment(s) to test *hypothesis 3*
Neither fish curled.

1 point for experimental & 1 point for control description.

2 points total for Data

Interpretation of Results:
Write appropriate interpretations for the results obtained for experiments conducted to test *each* hypothesis.
Interpretation of results for experiment testing hypothesis *1:*

The moisture produced or caused a curling of the fish. **2 points**

Alternate with fish submerged in water: Hypothesis 1
The moisture did not cause or produce curling in fish. **1 point** (Students need to Realize that moisture needs to be applied to one side of the fish as was the case when the fish was on the moist hand.

2 points total for interpretation

Interpretation of results for experiment testing hypothesis *2:*

Warm fish alternative: *Increased temperature (about body temp) does not cause the fish to curl.* **2 points**

Fish on hand over plastic alternative: *Moisture caused the fish to curl and heat does not cause curling.* **4 points**

Interpretation of results for experiment testing hypothesis *3:*
Static electricity does not cause the fish to curl. **2 points**

2 points total for each interpretation for each of two experiments

Evaluate interpretations of data for any experimental design not covered above according to the following rubric: (Students should receive credit for appropriate interpretations of any data obtained even if the experimental design was not appropriate.)

2 points (Excellent)	Interpretation is consistent with observed results for both the experimental and control groups
1 point (Satisfactory)	Interpretation appears to be consistent with observed results for both the experimental and control groups but is not clearly stated.

0 points (Unsatisfactory) Interpretation is inconsistent with observed results for the experimental and control groups

Conclusion about your hypotheses:
Reread your two hypotheses. Which hypothesis, if any, does your data support?

Use the following rubric in evaluating the conclusions to both hypothesis:

2 points (Excellent) Conclusion appropriately states that the hypothesis is logically *supported* or *contradicted* by the data (or interpretation of data) Or that the data neither supports nor contradicts the hypothesis (Usually referred to as *not supported*)

1 point Conclusion inappropriately states that the hypothesis is supported or *contradicted* by the data (or interpretation of data) Or that the data neither supports nor contradicts the hypothesis (Usually referred to as *not supported*)

0 points (Unsatisfactory) Statement shows that the student does not understand how a statement is to be written to provide a conclusion about the hypothesis.

Examples for the 3 above *hypotheses* and data described below:

1. Moisture from the hand causes the curling. *Supported 2 pts*
2. Heat from the hand causes the curling. *Contradicted 2 pts*
3. Static electricity from the hand causes the curling. *Contradicted 2 pts*

Possible Points = 2 (2 point maximum per conclusion per hypothesis - **4 total**)

A summary of points for each section of the assessment follows:

	1st hypothesis	2nd hypothesis	**total**
Hypothesis	2	2	**4**
Experimental design	4 (An extra point is given if student designs clearly distinguish between heat and moisture variables)	5	**9**
Data	2	2	**4**
Interpretations	2 (An extra 2 points are given if student interpretations clearly distinguish between heat and moisture variables)	4	**6**
Conclusion	2	2	**4**
Total	**Total for all categories**		**27**

24-27 points **Excellent performance** in practical problem-solving

21-23 points **Good performance** in practical problem-solving

16-20 points **Satisfactory performance** in practical problem-solving

13-15 points **Poor performance** in practical problem-solving

0-12 points **Unsatisfactory performance** in practical problem-solving

Points designations for any section of this or any performance assessment can be altered as the teacher decides is appropriate.

Teachers may want to alter or create their own rubric for the activity.

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