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SCI eTIPS for Teachers

Tips for Teaching *IPS* and *FM&E*

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Join Us this Summer for an IPS *or* FM&E *workshop!*

"The workshop provided me with better understanding of the concepts and skills that students learn from IPS*. I have a passion for the program that was lacking in my teaching previous to attending the workshop,"* 2007 SCI workshop attendee.

In this issue...

Whether you've taught science for years or are just starting out, we've prepared summer workshops that will benefit both you and your students! Dates and locations are listed later on page 3 of this newsletter. For more information, visit *http://sci-ips.com/events.html#workshops.*

Writing Lab Notebook Quizzes

By Gery Morey

Grading lab reports can be a challenging, time-consuming task. Yet teachers must hold students accountable for their lab notebook entries. I use quizzes to assess student lab reports, and this frees me from the trouble of collecting and grading every lab notebook.

I assess both lab reports and reading sections from the text on a quiz. Some questions evaluate an understanding of the purpose and conclusion of the lab, as well as the correctness, completeness and legibility of the report. Other questions assess the comprehension of reading sections from the text. I give two quizzes every chapter and, as often as possible, I use multiple-choice questions.

To write a good multiple-choice question, there are three steps to consider. The first step is to identify the single concept to be assessed by the question. Once the target concept is identified, the multiple-choice question should be written so that it can stand alone. That is, it should be answerable by students even if they read only the stem and do not read the answer choices. Finally, each of the incorrect choices should address specific misconceptions related to the original question. Below is an example of a multiple-choice question that assesses the conclusion of Experiment 2.1, The Mass of Dissolved Salt.

1. *Considering the sensitivity of the balance, and the results of the entire class as shown in the histogram for Experiment 2.1, The Mass of Dissolved Salt, what did our class conclude about the change in mass of salt and water as the salt dissolves?*
   - *A. There is no change in mass when salt dissolves in water.*
   - *B. There is an increase in mass when salt dissolves in water.*
   - *C. There is a decrease in mass when salt dissolves in water.*
   - *D. The volume of the mixture increases as the salt dissolves.*
   - *E. The volume of the mixture decreases as the salt dissolves.*

This question has been written so that it can be answered without reading any of the answer choices. Answer choices B and C address the misconception that mass changes when salt dissolves in water.Answers D and E imply that we observed the change in total volume during the lab instead of measuring no change in total mass.

Questions used to assess comprehension of reading sections from the text can also be written as multiple-choice questions. Below are two multiple-choice questions written to evaluate reading sections. Question 2 applies

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From *Writing Quizzes* on Page 1

to Section 3.1, Properties of Substances and Properties of Objects, while Question 3 is relevant to Section 3.13, Identifying Substances.

2. *Suppose you are given two samples of clear, colorless liquids. You do not know the identity of either liquid. How could you determine whether they were the same or different substances?*
   A. You could compare their masses.
   B. You could compare their volumes.
   C. You could compare their freezing points.
   D. You could compare their colors.

This question has to do with the fact that properties such as mass, volume and color are properties of an object, while freezing point is a property that can be used to distinguish between substances. The incorrect choices A, B, and D address the misconceptions that mass, volume and color are characteristic properties of substances.

3. *A student observes two samples of metal. Each sample has a mass of 10 grams, has the shape of a cube, and has a volume of 20 cm3. One object is silver-colored while the color of the other object is yellowish. What does the student know about the two metal samples?*
   A. They must be made of the same substance since they have the same density.
   B. They must be made of the same substance since they have the same shape and volume.
   C. They could be made of the same substance. The student would have to compare additional characteristic properties to be sure.
   D. They must be made of different substances since they have different colors

Here the concept being evaluated is that characteristic properties can be used to distinguish between substances, while properties of an object cannot. Answer choice A addresses the misconception that only one characteristic property is needed to establish that substances are identical. Answer B addresses the misconception that shape and volume are characteristic properties. Answer D addresses the misconception that color is a characteristic property.

I use short answer questions to evaluate how completely, correctly and legibly students write their lab reports. These questions simply ask students to retrieve specific pieces of data or information from their lab reports. Below are three examples of such questions from Experiment 2.1.

4. *What was the purpose of Experiment 2.1?*

5. *What mass did you record in Experiment 2.1 for the bottle, cap, salt, and water before mixing?*

6. *Refer to the histogram you drew for Experiment 2.1. How many pieces of data are in the bin with –0.06 in the middle? (How many squares did you fill in for the bin with –0.06 in the middle?)*

Of course, each student has recorded his or her own personal data, so there are many possible answers for questions such as #5. I give them credit if their data is within a reasonable range and includes units. Questions #4 and #6 do have specific correct responses. (The reason I added the hint to the end of #6 is because my students often ask if “pieces of data” means each separate box added to the histogram, or just the number of different values added to the histogram. For example, they ask if the values -0.06, -0.06 and -0.06 are considered one piece of data or three.)

Lab notebook quizzes can be used to evaluate student lab reports without collecting and grading each one. This approach also puts the responsibility for writing complete lab reports directly on the student. Writing good questions is the key to creating valid lab notebook quizzes. By writing questions that clearly address one concept, and having incorrect answer choices that relate to specific misconceptions, lab notebook quizzes can be an appropriate, easy method to evaluate student lab reports.

Gery Morey teaches IPS to eighth graders at the Independent Day School in Tampa, Florida. She can be contacted at gmorey@idsyes.com.

Testing Your Energy Wheel

By Bob Stair & Graden Kirksey

The energy wheel is used extensively to define types of energy and study energy conversions in Chapter 7 of Force, Motion, and Energy (FM&E). It is used to acquire data that lead to the generalization known as the law of conservation of energy – that is, if it works properly! Here is how you can check and, if necessary, adjust your energy wheel to provide reliable results.

Set up the energy wheel on the wooden tower that is supplied with it. Be sure to clamp the tower firmly to a rigid countertop to avoid energy-robbing vibrations. (If you have a tower that is simply nailed together, consider reconstructing it with screws and wood glue to make it more stable.)

Give the wheel a good spin and measure the amount of time needed for 10 complete revolutions. (A piece of tape attached to a spoke can be a tremendous help when counting the turns of a fast-spinning wheel.) After allowing the wheel to continue spinning for an additional 5 1/2 minutes, once again measure the time needed to make 10 revolutions. If this second measurement is less than (or equal to) twice the previously measured time, your wheel is in good shape and you should be able to collect the necessary data. On the other hand, if the second time is more than twice the first, your wheel is in need of some attention. Fortunately, the adjustment is probably something that you or someone in your school can perform.

First, the good news is that the bearings themselves or lubrication is likely not the problem. We have a wheel that has been used for close to 40 years, has never had its bearings replaced and has never been lubricated — it works just fine.

The most common problem with wheels that need to be adjusted involves too much pressure being placed on the ball bearings by bearing cap nuts that have been tightened too much. To remedy this, remove the hex nuts on either side of the axle. Then loosen, but do not remove, the nuts holding the bearing caps.

Retighten the bearing cap nuts using only your fingertips—do not over-tighten. Then replace the hex nut on the axle and turn it by hand until it just touches the bearing cap nut. Now use a wrench or pliers to hold the bearing cap nut in place as you use another wrench to tighten the hex nut. (The bearing cap nut should not move in this process.) Repeat this procedure with the bearing cap nut and hex nut on the other end of the axle.

You are now ready to retest your wheel using the procedure outlined earlier. Chances are that, with the simple adjustment to the pressure on the bearings, your wheel will give you many years of useful data!

Workshop Dates and Locations

Introductory Physical Science (IPS) (Chapters 1-5) July 13-18, 2008
Colorado School of Mines

Introductory Physical Science (IPS) (Chapters 6-10) July 20-25, 2008
(To register for this workshop, you must have taken a Chapter 1-5 workshop.)
Colorado School of Mines

Force, Motion, and Energy (FM&E) July 20-25, 2008
Colorado School of Mines

Writing Test Questions and Constructing Tests for Science Courses July 14-18, 2008
Colorado School of Mines

Introductory Physical Science (IPS) July 28-August 8, 2008
Massachusetts

For more information, visit *http://sci-ips.com/events.html#workshops.*