Lab Practicals that Test Practical Skills

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Abstract

I started using a performance-based lab practical about 2 years ago in my freshman-level Principles of Biology class and junior/senior Animal Physiology classes. I wanted to know if the students were mastering the laboratory skills as well as the concepts used in the labs. I tried to match the objectives in our lab manual.

The students are given a sheet with questions like the ones below. They can move to any station where there is no other student, and there are questions usually involving data interpretation that they can do in the back of the room without going to a station. It takes less than an hour for 18 students to answer questions worth 20 points at nine stations. For the questions that require an instructor to verify a skill, the students raise their hands when they are ready and I initial the answer key if they were successful. The instructor must also reset the spectrophotometer and supervise the micropipetting so it helps to group those stations together. I also set up multiple stations for tasks that take more time such as the spectrophotometer.

In addition to the examples below, some of the other topics I include for Principles of Biology are the following: weighing an object on a pan balance, selecting the correct glass pipet for a given volume, determining the amount of magnification with a dissecting scope with a zoom knob, identifying which end of an electrophoresis apparatus (anode or cathode) would you place the end of the gel with the wells and why, identifying substances in cells based on staining, expressing numbers in proper scientific notation with proper

significant figures, naming pieces of equipment, calculating rates, and interpreting data. For Animal Physiology, I ask them to name equipment and give me its function(s). We use a variety of data acquisition equipment (transducers, preamplifier, digital-to-analod converters). I might ask them what a particular switch or knob does or give them a printout of some graphs that they have generated and ask them what they mean. Because I do not take the entire class period, the last question may be to form a group and ask them to set up the equipment needed for that lab and demonstrate that it is set up correctly. Every one in the group would receive the same number of points.

The first time I used this format at the end of the courses, the average grade in both classes was about 65%. The students were not mastering many of the skills. I now point out what might appear on a lab practical during each lab and have given a practical with fewer points within the first 5 weeks of the semester. The average grades are now in the high 70's. The lab practicals are only about one third of the student's lab grade; they also do independent projects, mini-lab reports, formal lab reports and pass in their lab notebooks.

I hope that by pointing out the importance of knowing techniques and data interpretation, and testing specifically for these skills as well as for the content, the students will become more responsible for the practical lab skills that they will need in other classes and in their careers.

Principles of Biology Examples

Station A. Compound Microscope

1. Put anaphase in the center of the field and raise your hand.   _____

2. What is the approximate size of this cell?   _____

3. To what kingdom does the organism belong?   _____

Station E. Micropipette

10. What is the total possible volume in this micropipettor?   _____

11. Pipet 75 microliters into the tube and raise your hand.   _____
(If you are not sure how to use micropipettor, do not force anything!)

Animal Physiology Example

What wavelength is the spectrophotometer set to?   _____

What is the absorbance of the sample?   _____

Calculation of glucose concentration:

$$\frac{Au}{As} \times Cs = Cu$$

Au = absorbance of unknown
As = absorbance of standard
Cs = concentration of glucose standard
     (10 mg/100 ml of hemolymph)
Cu = concentration of unknown

What is the concentration of unknown if the absorbance of the standard = 2.00 and the absorbance of the unknown = 0.25?
Show your calculations and report your concentration in **mg/100 ml**   _____