**Why a Portfolio?**

The use of a portfolio as an assessment tool was introduced to me when I discovered the Golden State Examination (GSE) biology portfolio component. It was developed to provide "... varied opportunities for students to demonstrate cumulative accomplishments in biology ... classes" (Kreikemeier, 1993) in addition to their performance on examination and laboratory components. The portfolio comprised "... a collection of a student's science work selected by the student and teacher over a period of time" (Kreikemeier, 1993). Although I tried several times to incorporate this format into my classroom, neither my students nor I were satisfied with the results. I finally realized why these attempts had failed: I had never identified why I wanted my students to create a portfolio. I decided that I wanted to know what my students had learned, how they had learned it, what it meant to them, and how they related it to everyday life. I wanted them to tell me what experiences helped them grasp the concept and which ones seemed ineffective. Most of all, I wanted assurance that each student had mastered the concepts defined by the Massachusetts State Curriculum Frameworks.

**What Is in It?**

I chose to use the Massachusetts State Curriculum Frameworks to define the scope of my portfolio. Accordingly, I require six topic sections in the portfolio: The Chemistry of Life, The Structure and Function of Cells, Genetics, Evolution and Biodiversity, Ecology, and The Human Body. I chose...
to add two other portfolio requirements: an initial essay and a summative essay. The portfolio is built over the semester. Each corrected essay and attachments are placed in a binder for submission at the end of the course, when it becomes part of the final assessment grade. Each portfolio must also have a table of contents, and a title page or cover that relates to the course.

Example

Portfolio Requirements Outline

This portfolio is intended to help you assess your understanding of biology. It is an opportunity to reflect upon what you have learned and analyze the impact of this knowledge upon previously acquired concepts and opinions about biology. It will also allow you to analyze assignments so that you come to better understand your learning style. The completed portfolio should provide you with a permanent, meaningful record of your experience in this course that will help you understand how you think, how you learn best, what you think, and why you think it.

Portfolio Structure

A. Title page
B. Table of Contents
C. Theme sections
   1. The Chemistry of Life
   2. Structure and Function of Cells/ Cellular Energy
   3. Genetics
   4. Evolution/Biodiversity
   5. Ecology
   6. The Human Body
D. Summative Essay

Theme Section Content

A. Analytical essay
   This essay will describe what you learned while studying this topic, and should incorporate the vocabulary acquired during study. Its preparation will require your review of the facts and concepts stressed in the unit, as well as re-examination of assignments. You will want to show what you know about this topic and how that knowledge affects your understanding of how the world works. You will choose an activity that was pivotal to your understanding of each concept and how it clarified it. Following each essay will be the pages you referenced.

B. References
   The selection deemed most valuable will appear first, with subsequent selections placed in ranked order.

C. Teacher Evaluation Rubric

The Initial Essay

I assign the initial goals and expectations essay as homework the first day of class. During that class, I provide students with a copy of the curriculum and their textbook, as well as a copy of the rubric I will use to grade this essay.

Students are asked to describe learning techniques that they have used successfully, and what they already know about the six topics addressed by the course. They indicate which of the topics is of greatest interest to them and why. I also ask the students to discuss why they chose to take this course, how s/he will define successful completion of the class, and how to achieve it. Students are also encouraged to address any concerns they may have about the class. This essay is a point of comparison for students at the end of the semester when they are asked to reflect on all that they have mastered in the course. It provides me with an idea of what previous knowledge students bring to the class, what interests them, and what they expect to gain. I also receive insight into how they see themselves as students, what they use to measure success, and what intimidates them about the road ahead.

Example

Initial Essay Requirements

Initial Narrative Essay: Goals and Expectations

This course is meant to be an exciting experience. Part of the purpose of the class is to assist you in discovering how you learn so that you are able to use the most effective study techniques. It presents the curriculum established by the Massachusetts Department of Education in its Science Curriculum Frameworks.

This essay should describe your learning expectations for this class. The first paragraph should describe what you know about how you learn, including study techniques that have been successful for you. What types of learning activities clarify concepts for you? Subsequent paragraphs describe what you already know about each of the six topics and what interests you as well as what else you would like to learn. The
Example

Grading Rubric for Goals & Expectations Essay

A. Description of learning techniques (5 pts)
   ___ You have described how you think you learn best, and more than two study
teachers that have previously brought you a feeling of academic success. You also clearly describe a learning skill you hope to acquire this semester. (5 pts)
   ___ Two (4 pts) or one (3 pts) of the above criteria have been met.
   ___ You have not demonstrated sufficient effort. (2, 0 pts)

B. What knowledge of biology do you bring to this class? (5 pts)
   ___ All six areas of study are addressed. The current level of understanding of these areas is evident, and you have indicated why one of these areas holds particular interest for you. (5 pts)
   ___ Either less than six areas of study are addressed (with all of the criteria outlined above); or although all areas are addressed, not all have the current level of understanding delineated, or you have not indicated why one of these areas holds particular interest. (4, 3 pts)
   ___ Less than six areas of biological study are addressed, and of these, one does not have the current level of understanding clearly delineated. You have indicated why one of these areas holds particular interest. (2, 1 pt)
   ___ You have not put forth acceptable effort. (0 pts)

C. Defining success (5 pts)
   ___ You have discussed why you elected to enroll in this course, how you will define successful completion of the class, and what you think will be necessary to achieve this. You have also addressed any concerns about this class. (5 pts)
   ___ All but one (4 pts), two (3 pts), or three (2 pts) of the above criteria have been met.
   ___ You have not put forth acceptable effort. (1, 0 pts)

D. Grammar and Spelling (5 pts)
   ___ Spelling and grammar are correct throughout the essay. (5 pts)
   ___ There is one error. (4 pts)
   ___ There are two (3 pts) or three (2 pts) errors.
   ___ The number of errors is not acceptable. (1, 0 pts)

Analytical Essays: The Six Topic Sections

Each topic section contains an analytical essay written at the conclusion of study. In it, the student details several new concepts learned during the unit and any additional knowledge or concept clarification acquired. The student describes which activities were most useful in the learning process and why.

Requiring the student to clearly state what is known makes it easy to see if true understanding has occurred or if the student is “lost in space.” This also establishes if what the student knows is correct, providing the opportunity to communicate with that student directly if necessary.

Students submit those activities that proved to be most enlightening while learning the topics. Examples may include a completed handout, lab report, review sheet, copies of class notes, or information from the book. The student describes how these activities provided the “ah-ha!” moment of understanding.

Each student is also asked to relate new facts and concepts to prior knowledge, reinforcing and expanding connections. The student is encouraged to relate the knowledge to other science topics, leading students to view science as a whole instead of discrete classifications of knowledge. Finally, the student is asked to relate this new knowledge to the world around him/her. What does this information mean to him/her and the ability to understand current events, the nature of illnesses, or why our fingertips wrinkle when we soak in the tub? This reflection should help students view concept mastery as relevant and important rather than as a requirement to be met.

Example

Analytical Essay Rubric

What I learned (10 pts):
___ Essay includes explanation of several new concepts learned and additional knowledge or concept clarification gained in several areas during the unit of study (10, 9, 8 pts).
initial essay and consider how their perceptions have changed. A reflection of the way these changes have affected how and what they think is also included.

Each student is asked to describe two learning experiences (lab activities, projects, etc.) or intellectual discoveries that affected them, and how and why they did so. This section stands in contrast to the first in that only new knowledge about biology or new experiences are discussed. This section helps identify the most thought-provoking classroom activities, and helps the students identify their interests and which types of activities stimulate their curiosity.

Students are next asked to describe areas of personal growth. It encourages students to contrast who they were to who they have become and contemplate the differences. Although these topics are not in Bloom’s definition of mastery learning, which is purely cognitive, they serve as steps towards the self-actualization described by Maslow, whose ideas reflect a form of self-mastery.

Finally, students are asked for their constructive evaluation of the portfolio as a learning process and suggestions for improvement. I write a personal note to each student here, conveying my perception of his/her growth and achievements over the course.

Example

Portfolio Summative Essay Grading Rubric

A. Knowledge of biological concepts before taking this course:

This section deals with ideas that you formerly held as true concerning one of the topics addressed in class that has changed. It can also refer to a topic that was introduced during class that caused you to view biology specifically or science in general as more relevant. This new topic and your reactions to it are explained in detail. (10 pts)

____ False assumptions about three biological concepts held by you prior to taking the course are described, along with how knowledge gained from the course content has changed each of these assumptions. Alternatively, three new topics and how they have affected your thinking about science or biology are described. A combination of the two, reflecting description of three topics, is also acceptable. (10, 9 pts)

____ False assumptions about two (8, 7 pts) or one (6, 5 pts) biological concept(s) held by you prior to taking the course are described and how knowledge gained from the course content has changed each one. Additionally, you have
described one new topic and how it affected your thinking about science.

--- False assumptions about one biological concept are described, along with how knowledge gained from the course content has changed them. Alternatively, you have described one new topic and how it has affected your thinking about science or biology (4, 3 pts), or this section of the essay is unclear and does not convey understanding of the referenced material. (2, 1 pt)

--- This parameter was not addressed. (0 pts)

B. Specific examples of how the content of this course has increased your knowledge of biology as a subject and yourself as a learner:

This section should describe specific educational activities, such as labs, packets, reading assignments, etc. that were particularly effective learning tools for you. Indicate your favorite activity and describe why it was your favorite (10 pts).

--- You have indicated more than four (10, 9 pts), four (8, 7 pts), three (6, 5 pts) or two (4, 3 pts) educational activities that were of particular value and described their impact on your understanding and development as a learner. You have indicated your favorite activity and why it was chosen. (2, 1 pt)

--- This parameter was not addressed. (0 pts)

C. How skills acquired or honed during this course have affected your thought process (5 pts):

--- Five (5 pts), four (4 pts), three (3 pts), two (2 pts), or one (1 pt) specific skill(s) acquired or honed during this course have been explained. You describe how they have affected your thinking and/or ability to communicate scientific information/data effectively.

--- This parameter was not addressed. (0 pts)

D. Your evaluation of this portfolio as a learning process (5 pts):

--- You have included a constructive evaluation of the portfolio and one or two suggestions for improvement. (5, 4 pts)

--- You have included an evaluation of the portfolio but no suggestions for improvement. (3, 2 pts)

--- This parameter was not addressed. (0, 1 pt)

E. Personal reflection (10 pts):

If you could view yourself from a distance over time, seeing yourself during the first week of the semester and again now, what would you want me to know about how you have changed? What differences do you notice in yourself intellectually, emotionally, and/or personally?

--- Initial impressions of the classroom experience are described, as are impressions and feelings that developed throughout the semester. There is some evidence of thought and reflection. (10, 9, 8 pts)

--- You have described initial impressions of the classroom experience and impressions and feelings that developed over the semester. There is some evidence of thought and reflection. (7, 6, 5 pts)

--- You have described initial impressions of the classroom experience and impressions and feelings that developed over the semester. There is little evidence of thought and reflection. (4, 3 pts)

--- You have attempted to describe initial impressions of the classroom experience as well as impressions and feelings that developed over the semester. There is no evidence of thought and reflection. (2, 1 pt)

--- This parameter was not addressed. (0 pts)

F. Grammar and Spelling (5 pts):

Refer to previous example.

The Portfolio Grade

The portfolio grade is part of the final assessment for the course, in conjunction with an exam. The initial essay and each topic's analytical essay are graded as they are submitted, and they are compiled by the student into the binder that will become the portfolio. At the end of the semester most of the grading has already been accomplished, and most of the student's task has been completed as well. All that is left for the student to do is the summative essay, the cover, and the table of contents. I only need to grade the summative essay and the assembled portfolio. Students are provided with the grading rubrics for each of these before the portfolios are due. Construct
your portfolio grading rubric using those elements you chose to include in the Portfolio Requirements Outline.

This Is Not an English Class

My students are stunned when they learn that I will grade spelling and grammar. Why should they count? Spelling and grammar are important, and both are used as evaluators of competence upon first impression. I use the portfolio to encourage students to reacquaint themselves with grammar and punctuation rules, and to master them. Percentage of correct grammar and spelling is estimated based upon a word count per sentence (average) and sentences per page (average).

How Can You Make This Work for You?

First, you must decide what is it that you want to document in this portfolio and why is it valuable to you and your students. Second, you must make it reflect your curriculum. You can use the National Science Education Standards, or even your textbook unit headings as your guide. You must next decide on how to incorporate student work. This decision took the most time for me. Student selection served my purpose best. It provides students with control and ownership and me with an idea of what activities they perceive as effective.

Once these decisions have been made, create a draft describing the portfolio structure, contents, and purpose and share it with other teachers. My colleagues provided numerous suggestions and also asked me many questions about why I had chosen to include items described in the draft. This interaction helped me focus my purpose for the portfolio and clearly define how my students could meet my expectations. Next, begin developing the rubrics. Finally, when you think that you have finished creating your newest assessment tool, show it to a former student. He or she may raise some points concerning timing, grading, or content that you had not considered.

What It Can Mean

From my students’ words, I get a clear picture of what concepts were mastered easily and which required the most work. This gives me an indication of where I need to focus my development of new techniques and activities for my classroom.

What the Students Think

It seems only fitting that I include some student impressions of the effect of the portfolio experience on their learning.
Meet...

Jan Leach, Ph.D.
• Professor, Colorado State University
• Molecular biologist who studies plant-microbe interactions
• Fellow of The American Phytopathological Society
• Institute Adjunct Scientist, International Rice Research Institute
• Grateful student of elementary teacher Frieda Mason who encouraged her interest in science

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I think the most difficult adjustments I've had to make this semester are how I compare myself to others and how much emphasis I put on my grades. The majority of the semester I have been struggling to resist the urge to compare myself to my classmates. I've only recently begun to realize how damaging that's been to my self-confidence. I've always had the frame of mind that my work wasn't good enough unless it was the best. I still compare myself to others much more than I should, but I've learned to lighten up a little. I'm also trying to remind myself that there's more to me than just grades, marking another area of growth for me.

Caroline, age 15

I have learned more in these few months since August than I thought humanly possible. The word "biology" has taken on a completely new meaning for me. Now, when I hear the word biology, I think of amino acids and proteins and organelles and plants and trees and Neanderthals and the time that I spent in the classroom. As I hiked up the stairs more and more often, biology became clearer to me. The separate chapters and separate modules and separate concepts fused together. Biology ceased to become a bunch of little pieces, and at the completion of the course, I truly see the world through a different pair of eyes. Biology isn't a textbook, or a series of tests, or even a class. Biology is the study of life, and biology truly is life. It shocked me to see the pieces come together, and truly explain everything that I see and feel and touch....

Andrew, age 16

To me, these excerpts justify the use of the portfolio as a measure of student understanding of biology and of the student's personal growth. Revelations from each student that contain this level of self-examination, higher order thinking and analysis, and honesty display the ability of these teens to value aspects of their education beyond test grades. No exam could ever measure such a display of mastery.

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References
