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HOW TO IMPROVE STUDENT LEARNING

30 Practical Ideas Based on Critical Thinking Concepts and Principles

FOUNDATION FOR CRITICAL THINKING

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Introduction

When students think within the content of our courses, they take ownership of the most basic principles and concepts within the subjects we teach. The instructional ideas in this guide are premised in this understanding. Most of our suggestions represent possible teaching strategies. They are based on a vision of instruction implied by critical thinking and an analysis of the weaknesses typically found in most traditional didactic lecture/quiz/test formats of instruction. We begin with two premises:

- that to learn a subject well, students must master the thinking that defines that subject, and
- that we, in turn, as their instructors, must design activities and assignments that require students to think actively within the concepts and principles of the subject.

Students should ***master*** fundamental concepts and principles before they attempt to learn more advanced concepts. If class time is focused on helping students perform well on these foundational activities, we feel confident that the goals of most instruction will be achieved.

It is up to you, the instructor, to decide which of these ideas you will test in the classroom. Only you can decide how to teach your students. Our goal is not to dictate to you, but to provide you with possible strategies with which to experiment. The specific suggestions we recommend represent methods and strategies we have developed and tested with our students. Judge for yourself their plausibility. Test them for their practicality. Those that work (i.e., improve instruction) keep; those that do not work, abandon or re-design.

The suggestions overlap each other and make most sense when taken together, as an interrelated network. Often one suggestion is made intelligible in the light of two or three others. So if one is not clear to you, read on. The strength of each of them, in re-enforcing each other, will then become increasingly clear.

Recommended Design Features

Idea # 1:

Design instruction so that students engage in routine practice in internalizing and applying the concepts they are learning (and in evaluating their understanding of each).

For students to learn any new concept well they must initially internalize the concept, then apply the concept to a problem or issue so that they come to see the value of understanding the concept. At the same time, they need to evaluate how well they are internalizing and applying the concepts they are learning.

If students are to acquire understandings and skills, we need to provide many opportunities for them to

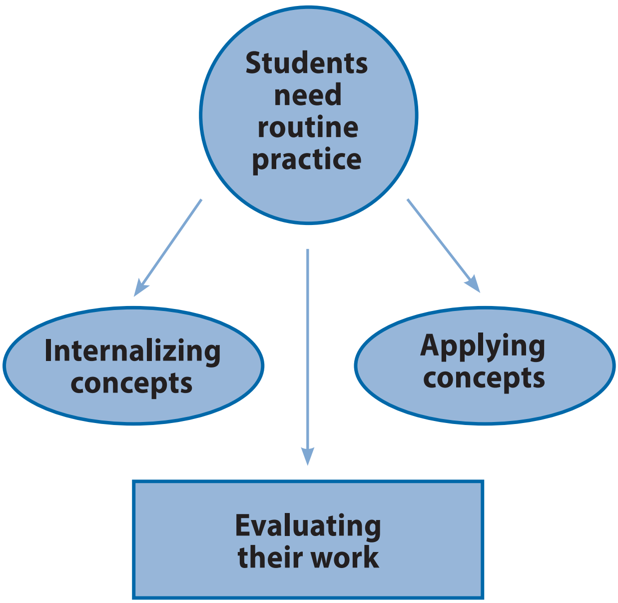
1. ***internalize*** the key concepts in the subject, and to

2. ***apply*** those concepts to problems and issues (in their lives or in their coursework).

It is only when students apply what they are learning to actual situations or problems that they come to see the value in what they are learning. And only when they see the value in learning the content will they be internally motivated to do so.

At the same time students are internalizing concepts and applying them in a meaningful way, they need practice in *evaluating* their work. Self-assessment is an integral part of educated thinking; it would be unintelligible to say of a person that he is thinking in an educated manner, but is not skilled in evaluating his thinking. In the same way, it would be unintelligible to say of a student that she is learning a subject well but does not know how to evaluate her learning.

High quality thinking comes with routine practice in internalizing and applying theoretical structures



Idea # 2:

Teach students how to assess their reading.

In a well-designed class, students typically engage in a great deal of reading. Hence, it is important that they learn to "figure out" the logic of what they are reading (the logically interconnected meanings). Good reading is a dialogue between the reader and the text. The writer has chosen words to convey his/her thoughts and experiences. The reader must translate from those words back into his/her own thoughts and experiences, and thereby capture the meaning of the author. This is a complex process. One effective way to teach students this process is by modeling it as follows:

Place the students into groups of three, each with a letter assigned (A, B, or C). You then read a paragraph or two out of the text aloud slowly, commenting on what you are reading as you are reading, explaining what is making immediate sense to you and what you need to figure out by further reading. After modeling in this manner for a couple of paragraphs, you ask A to take over and read aloud to B and C, explaining to them, sentence by sentence, what he/she is able to figure out and what he/she is not. After A is finished with two paragraphs, then B and C comment on what they do and do not understand (in the paragraphs that A read). Then you read aloud to the whole class the two paragraphs that A read, commenting as you go. Then B takes over and reads the next two paragraphs to A and C. Then A and C add their thoughts. Then you read aloud what B read. Then you go on to C who reads the next two paragraphs to A and B. And so on. As the students are reading in their groups of three, you are circulating around the room listening in and getting an idea of the level of proficiency of their critical reading. The more you use this process, the better students become at critical reading. When they become proficient at it, they begin to ask questions in their own minds as they read, clarifying as they read, questioning what they do not understand.

See also the thinker's guide to *How to Read a Paragraph* (The Art of Close Reading).

Idea # 3:

Teach students how to assess their writing.

Good thinking is thinking that (effectively) assesses itself. As a critical thinker, I do not simply state the problem; I assess the clarity of my own statement. I do not simply gather information; I check it for its relevance and significance. I do not simply form an interpretation; I check to make sure my interpretation has adequate evidentiary support.

Because of the importance of self-assessment to critical thinking, it is important to bring it into the structural design of the course and not just leave it to random or chance use. Here are a variety of strategies that can be used for fostering self-assessment through peer-assessment:

Assessing Writing

When students are required to bring written papers to class, the activities below can be used as strategies for fostering high quality peer-assessment:

1. **First Strategy**. Working in groups of four, students choose the best paper (using standards of clarity, logic, etc. as well as any other criteria you have given them). Then they join with a second group and choose the best paper of the two (one from each group). These papers (chosen by the 8-person groups) are collected and read to the class as a whole. A class-wide discussion is held, under your direction, to make clear the strengths and weaknesses of the competing remaining papers, leading to the class voting on the best paper of the day (again, always using explicit intellectual standards in the assessment).
2. **Second Strategy**. Working in groups of three or four, students write out their recommendations for improvement on three or four papers (from students not in the group). The written recommendations go back to the original writers who do a revised draft for the next class. Using this method every student receives written feedback on their papers from a "team" of critics.
3. **Third Strategy**. Working in groups of three or four, students take turns reading their papers aloud slowly and discussing the extent to which they have or have not fulfilled the performance criteria relevant to the paper.
4. **Fourth Strategy**. One student's paper is read aloud slowly to the class while the instructor leads a class-wide discussion on how the paper might be improved. This discussion serves as a model of what is expected in the assessment process. Then the students work in groups of two or three to try to come up with recommendations for improvement for the students in their group (based on the model established by the instructor).

See also the thinker's guide to *How to Write a Paragraph* (The Art of Substantive Writing).

Idea # 4:

Teach students how to assess their speaking.

In a well-designed class, students often engage in oral communication. They articulate what they are learning: explaining, giving examples, posing problems, interpreting information, tracing assumptions, etc… They learn to assess what they are saying, becoming aware of when they are being vague, when they need an example, when their explanations are inadequate, etc… Here are three general strategies you can use to teach students to assess their speaking abilities.

1. **First Strategy**. Students teaching students. One of the best ways to learn is to try to teach someone else. If we have trouble explaining something, it is often because we are not clear about what we are explaining.
2. **Second Strategy**. Group Problem Solving. By putting students in a group and giving them a problem or issue to work on together, their mutual articulation and exchanges will often help them to think better. They often help correct each other, and so learn to "correct" themselves. Make sure that they are routinely applying intellectual standards to their thinking as they discuss issues.
3. **Third Strategy**. Oral test on basic vocabulary. One complex tactic that aids student learning is the oral test. Students are given a vocabulary list. They spend time studying the key concepts for the course. They are then put into groups of twos or threes and are asked to take turns explaining the concepts to each other. They are encouraged to assess each other's explanations. Wander about the class listening in and choose two students who seem prepared for the oral exam. Stop the class and announce that the oral test is going to begin and that you have chosen "X" and "Y" to be tested first. After you test these two students (and they pass), announce to the class that X and Y have passed and that they are now "certified" to test others. However, anyone "certified" by a student tester must be "spot-tested" by you on one item. If any such student fails your spot test, the person who certified them is "de-certified" (and must repeat the exam). Everyone who passes becomes a certifier and gets paired with a student who has not taken the test. By this method, you only test the first two students. For the rest of the process you direct "traffic" and spot-check those who are "certified" by a peer. During this assessment the tester should be looking for a *beginning* understanding of the concepts, and the ability to give examples of the concept. Since the students who pass become "certifiers" or "tutors" and are assigned to assess other students (or tutor them), everyone gets multiple experiences explaining, and hearing explanations of, the basic vocabulary. We give a vocabulary list to the students on the first day of class so they know exactly which concepts they will be expected to explain during the oral exam. We give this exam during the first few weeks of the class so students learn the most basic vocabulary early in the course, vocabulary that is then used on a daily basis in class. You might want to modify this exam by giving parts of it during or after each chapter (of the textbook).

Idea # 5:

Teach students how to assess their listening.

Since students spend a good deal of their time listening, and since developing critical listening skills is difficult to achieve, it is imperative that faculty design instruction that fosters critical listening. This is best done by holding students responsible for their "listening" in the classroom. Here are some structures that help students develop critical listening abilities:

1. **First Strategy**. Call on students regularly and unpredictably, holding them responsible either to ask questions they are formulating as they think through the content or give a summary, elaboration, or example of what others have said.

2. **Second Strategy**. Ask every student to write down the most basic question they need answered in order to understand the issue or topic under discussion. Then collect the questions (to see what they understand or don't understand about the topic). Or you might:

   (a) call on some of them to read their questions aloud, or

   (b) put them in groups of two with each person trying to answer the question of the other.

Through activities such as these students learn to monitor their listening, determining when they are and when they are not following what is being said. This should lead to their asking pointed questions. Reward students for asking questions when they do not understand what is being said.

Idea # 6:

Design tests with the improvements of student thinking in mind.

In planning tests, be clear about your purpose. A test in any subject matter should determine the extent to which students are developing useful and important thinking skills with respect to that subject. The best tests are those most reflective of the kinds of intellectual tasks students will perform when they apply the subject matter to professional and personal issues in the various domains of their lives. Since "multiple choice" tests are rarely useful in assessing life situations, they are rarely the best overall test, though they can assess some supplementary understandings at an entry level.

One type of test that does target more realistic skills is an analytic test of the students' ability to take thinking apart and elaborate accurately each of its elements. Another type tests the student's ability to evaluate those elements using intellectual standards. In other words, students should learn how to analyze and evaluate thinking within the subjects they are studying.

Part One. Analyzing Thinking. After students have learned the fundamentals of critical thinking, and have reasoned through the logic of several chapters and/or articles you have given them, you might have them figure out the logic of an article during one class period (or the logic of a section of the textbook). Through this test, you can determine the extent to which they can accurately state an author's purpose, key question, information, conclusions, concepts, assumptions, implications, and point of view.

Part Two. Evaluating Thinking. Having completed part one above, you might then have students evaluate the author's logic using the following format (included in *The Miniature Guide to Critical Thinking*):

- Is the **question** at issue clear and unbiased? Does the expression of the question do justice to the complexity of the matter at issue?
- Is the writer's **purpose** clear?
- Does the writer cite relevant evidence, experiences, and/or **information** essential to the issue?
- Does the writer clarify key **concepts** when necessary?
- Does the writer show a sensitivity to what he or she is **assuming** or taking for granted? (Insofar as those assumptions might reasonably questioned)?
- Does the writer develop a definite line of reasoning, explaining well how he or she is arriving at his or her **conclusions**?
- Does the writer show a sensitivity to alternative **points of view** or lines of reasoning? Does he or she consider and respond to objections framed from other points of view?
- Does the writer show a sensitivity to the **implications** and consequences of the position he or she has taken?

In giving this sort of test, we are trying to determine whether students are learning to enter viewpoints that differ from their own. You can give multiple tests using this same format by changing only the written piece to be analyzed (selecting, of course, pieces whose point of view is significantly different from that of most students). Of course, this test does not determine whether a student will actually empathize with opposing views in real life situations (especially when their vested interest is involved).

Orientation (first few days)

Idea # 10:

Give students a thorough orientation to the course.

Students should know from the beginning how a class is going to be taught, how they are going to be assessed, and what they should be striving to achieve. They should know, from the beginning, what they are going to be doing most of the time and what exactly is expected of them in that process. The aim of the course should be carefully spelled out. If you are emphasizing critical thinking, it is helpful to contrast the aim and design with that of standard didactically taught courses. You might begin the course with something like the following introduction:

> ***"This class is going to be different from any class you have taken thus far because the emphasis will be on actively developing your thinking. Everything we do in this class will be designed to help you become better and better at thinking within the subject. You will therefore not be asked to memorize information rotely. Instead, you will be required to internalize information by using it actively in every class and in class assignments. Each day we will be attempting to improve your thinking. Think of learning about thinking (within the field) as you would of learning a sport. To learn to play tennis, you need to first learn the fundamentals of tennis at an elementary level and then practice those fundamentals during every practice session. The same is true of learning to think better within this field. You must be introduced to the fundamentals of sound thinking. Then you must regularly practice those fundamentals. Therefore I will design every class day with the primary purpose of helping you develop your thinking or reasoning skills. Why is this important? The quality of every decision you make will be directly determined by the quality of your reasoning abilities. In fact the quality of your life in general will be determined by how well you think in general."***

Idea # 11:

Develop a syllabus which highlights your expectations for the students.

You may want to consider using — or modifying for use — the following class syllabus. The requirements are based on a two-class-per-week schedule. It is developed with a science class in mind. Modify it to fit your subject.

Introduction to Science
Sample Class Syllabus

The Key Concept of the Course

This course is entirely concerned with the development of scientific thinking. Humans do not naturally think scientifically; our thinking is often unscientific, or pseudo-scientific. Yet, as humans we live with the unrealistic but confident sense that we, in forming our beliefs, have fundamentally figured out the true nature of things, and that we have done this objectively. We naturally believe in our intuitive perceptions about the physical world — however inaccurate. We do not naturally raise to consciousness our assumptions about how the physical world works, the unscientific way we use information, the uncritical way we interpret data. We do not naturally question our concepts and ideas, or the fact that we often reason from an unscientific perspective.

All of this is true, despite the fact that most people take many years of “science” in school. To become a scientific thinker is to reverse this process by learning to take charge of the ideas one has about the physical world. It is to think consciously and deliberately and skillfully about that world. In short, it means training our minds to think scientifically.

A critical approach to learning science certainly entails organizing and internalizing facts, taking command of technical terminology, and coming to understand scientific procedures— but not in isolation. Our goal in this course will be to learn science as a system of integrally connected meanings that are tied to important ideas in other disciplines. Learning key organizing ideas in science should fundamentally transform the way we see the physical world. We should take these ideas with us throughout our lives and use them to think through the scientific issues we face.

A critical approach to learning science requires us to ponder questions, propose solutions, and think through possible experiments. Yet many texts treat the concept of “the scientific method” in a misleading way. Not all scientists do the same kinds of things—some experiment, others don't, some do field observations, others build models, and so on. For example, chemists, theoretical physicists, zoologists, and paleontologists pursue different types of questions; the nature of these questions will determine the scientific processes they need to use and the thinking they need to do to answer them. Furthermore, scientific thinking is not a matter of following a step-by-step procedure. Rather it is a kind of thinking in which scientists continually move back and forth between questions they ask about the world, observations they make, and in many instances, experiments they devise to test out various hypotheses, guesses, hunches, and models. Following their lead, when we thinking scientifically, we continually think hypothetically: "If this idea of mine is true, then what will happen under these or those conditions? Let me see, suppose we try this. What does this result tell me? Why did this happen? If this is why, then that should happen when I..." It is more important for you to get into the habit of thinking scientifically than to get the correct answer through a rote process you do not understand. The essential point is this: you should do your own thinking about scientific questions from the start. Your role is not to passively take in what scientists or textbooks tell you. Rather it is to grasp the spirit of scientific thinking.

Scientific Thinking Seeks to Quantify, Explain and Predict Relationships in Nature

Scientific thinking is based on a belief in the intelligibility of nature, that is, upon the belief that the same cause operating under the same conditions, will result in the same effects at any time. As a result of this belief, scientists pursue the following goals.

1. **They observe**. (What conditions seem to affect the phenomena we are observing?) In order to determine the causal relations of physical occurrences or phenomena, scientists seek to identify factors that affect what they are studying.
2. **They design experiments**. (When we isolate potential causal factors, which seem to most directly cause the phenomena, and which do not?) In scientific experiments, the experimenter sets up the experiment so as to maintain control over all likely causal factors being examined. Experimenters then isolate each variable and observe its effect on the phenomena being studied to determine which factors are essential to the causal effect.
3. **They strive for exact measurement**. (What are the precise quantitative relationships between essential factors and their

effects?) Scientists seek to determine the exact quantitative relationships between essential factors and resulting effects.

4. **They seek to formulate physical laws**. (Can we state the precise quantitative relationship in the form of a law?) The quantitative cause-effect relationship, with its limitations clearly specified, is known as a physical law. For example, it is found that for a constant mass of gas, at a constant temperature, the volume is inversely related to the pressure applied to it; in other words, the greater the pressure the less the volume—the greater the volume the less the pressure. This relationship is constant for most gases within a moderate range of pressure. This relationship is known as Boyle's Law. It is a physical law because it defines a cause-effect relationship, but it does not explain the relationship.
5. **They study related or similar phenomena**. (When we examine many related or similar phenomena, can we make a generalization that covers them all?) A study of many related or similar phenomena is typically carried out to determine whether a generalization or hypothesis can be formulated that accounts for, or explains, them all.
6. **They formulate general hypotheses or physical theories**. A theoretical generalization is formulated (if one is found to be plausible). For example, the kinetic theory of gas was formulated to explain what is documented in Boyle's Law. According to this theory, gases are aggregates of discrete molecules that incessantly fly about and collide with themselves and the wall of the container that holds them. The smaller the space they are forced to occupy, the greater the number of collisions against the surfaces of the space.
7. **They seek to test, modify, and refine hypotheses**. If a generalization is formulated, scientists test, modify, and refine it through comprehensive study and experimentation, extending it to all known phenomena to which it may have any relation, restricting its use where necessary, or broadening its use in suggesting and predicting new phenomena.
8. **They seek to establish general physical laws as well as comprehensive physical theories**. General physical laws and comprehensive physical theories are broadly applicable in predicting and explaining the physical world. The Law of Gravitation, for example, is a general physical law. It states that every portion of matter attracts every other portion with a force directly proportional to the product of the two masses, and

inversely proportional to the square of the distance between the two. Darwin's Theory of Evolution is a comprehensive physical theory. It holds that all species of plants and animals develop from earlier forms by hereditary transmission of slight variations in successive generations and that natural selection determines which forms will survive.

9. **They continually seek revolutionary ways of seeing the physical world that emerge out of their research and theory development.** Skilled scientists are not locked into traditional ways of looking at the physical world. They continually seek to develop scientific theory in light of new information. They don't just assimilate new information into existing theories. Rather, when it makes sense to, they reconstruct prior theories and reevaluate prior facts, a revolutionary process that can take many years and many scientists working on the issues. When this happens, whole networks of theories can shift, changing the very way in which scientists understand and deal with the physical world.

   Consider this example:
   Until Copernicus (1473-1543), people thought the earth was the center of the universe. This erroneous belief was based on the Ptolemaic system and had prevailed since the 2nd century A.C.E. The Copernican revolution was based on the theory that the earth at once revolved around its axis and around the sun in circular orbit. Though he loved the circular beauty of Copernicus's circular orbits, Johann Kepler (1571-1630) abandoned the circle for an elliptical orbit. He suggested that planets travel in such elliptical orbits with the sun in one focus and that the speed of the planets varies with their distance from the sun. He offered a mathematical calculation for tying planets into a harmonious system. If Kepler was right, his theory would required that Aristotle's physics and astronomy be discarded, which had dominated for more than 1000 years. It was Galileo (1564-1642) who conclusively refuted Aristotle, establishing the principle of inertia, which he applied equally to celestial and terrestrial bodies. This principle showed that force is needed, not to keep a body going (as Aristotle had argued) but to stop it or deflect it from its course. Thus Galileo freed science from the qualitative thinking of Aristotle and prepared the way for Newton's work. Galileo's principles and discoveries were fused into one integrated system by Isaac Newton. Newton's three laws of motion dominated the world of physics until Einstein.

The General Plan for the Course

The class will focus on practice not on lecture. It will emphasize your figuring out things about the physical world using your own mind, not memorizing what is in a textbook. On a typical class day you will be in small groups practicing "disciplined scientific" thinking. You will be regularly responsible for assessing your own work using criteria and standards discussed in class. If at any time in the semester you feel unsure about your "grade," you should request an assessment from the instructor.

For every class day you will read sections of the textbook. You will also have a written assignment which involves "disciplined scientific" thinking (most of which will be taken directly from the text).

Whenever you are doing a task in or for the class, ask yourself, would an independent observer closely watching you conclude that you were engaged in "taking charge of your mind, of your ideas about the physical world, of your thinking about that world." Or would such a person conclude that you were "merely going through the motions of doing an assignment," trying to succeed by rote memorization?

Requirements

You must complete all of the following:

1. 27 short written assignments, one due for every class day. Each of these must be typed—so that you can easily revise them. If your assignment for the day is not completed you are not prepared to do the "in-class" work of the day and will be asked to leave.
2. An oral exam. This is a mastery exam involving the basic vocabulary of science. All entries must be passed to pass the exam.
3. A final exam.
4. A Self-Evaluation, in which you "make a case" for receiving a particular grade using criteria provided in class and citing evidence from your work across the semester.
5. Consistent classroom attendance and active, skilled participation.

Grading

The class will not be graded on a curve. It is theoretically possible for the whole class to get an A or an F. You will not be competing against each other and there will be every incentive to help each other improve. No letter grades will be given before the final grade—unless you make a specific request to the professor. You should focus on improving your performance as a scientific thinker, increasing your strengths and diminishing your weaknesses, not in looking for a grade.

- Final Exam: about 20%
- Out of class writing: about 30%
- Self-evaluation: about 25%
- Active, Skilled Participation: about 10%
- Journal: about 15%
- Penalty for Missed Classes: You may miss two classes without receiving any formal penalty (though it is clearly in your interest to attend every class and participate actively). Every two unexcused absences after the first two results in a 1/3 of a grade penalty (Hence, with four absences: if your final grade would have been C+, it would be reduced to a C; if C- it would be reduced to D+). Attendance is taken by way of "stamped in" class assignments.

Since the final grade is not based on points and is not mathematically calculated, the above percentages are approximations to suggest emphasis, not precise figures. In assigning your final grade the instructor will lay all of your work out and match your work as a whole against the criteria passed out in class. You should read and re-read these criteria many times through-out the semester to ensure that you are clear about what you are striving to achieve.

Grading Policies

If you are to develop as a scientific thinker, you will need to develop as a scientific writer as well. And to develop as a writer, you must impose upon yourself the same standards that good writers impose upon themselves. The key question I will ask myself as I grade your written work is "What specifically does your writing demonstrate about your ability to reason scientifically?"

As you write, here are some key points you should keep in mind:

- When you write sentences that can be interpreted in many different ways (and you do not make clear which meaning you intend), you demonstrate that you are writing, and presumably, thinking in a vague way. You should therefore strive to write so that you make clear precisely what you mean. Scientific thinking must be clear and precise.
- When you give concrete examples and illustrations to make your point clear, you demonstrate that you know how to clarify your thought. You should therefore give scientific examples and illustrations wherever clarification of your meaning is needed.
- When you make clear—with appropriate transitional words and critical vocabulary—the logical relations between the sentences

you write, you make evident that you are thinking in terms of the logic of scientific thought and that you understand the structure of your own reasoning. You should therefore make clear the logical relations between the sentences and paragraphs you write.

- When you analyze key scientific concepts and demonstrate how to lay bare the logic of them, you make evident that you are skilled at conceptual analysis. You should therefore analyze key scientific concepts in your written work wherever it is needed.
- When you make clear the scientific question or issue you are dealing with and you stick to that issue you show that you have the intellectual discipline and focus to appreciate what each issue you raise requires of you. You demonstrate that you appreciate the importance of relevance. You should therefore clarify the scientific question you are focused on and stick to that question throughout the written piece showing how each point is relevant to that question.
- When you make only those assertions that you have sufficiently analyzed empathetically, you demonstrate intellectual humility. You should show in your writing that you have fully considered all reasonable ways of looking at the issue. Scientific thinking does not jump to conclusions.

The Weighting of Papers in the Portfolio

The semester will be divided into thirds. At the end of the course, to determine your grade on the portfolio, I will grade one paper randomly chosen from the first third, two from the second third, and three from the final third. At any point in the course you may turn in your portfolio for grade-level assessment. However, if you are routinely assessing your own work—as scientific thinking requires—you should be able to recognize the level at which you are performing.

Idea # 12:

Give students grade profiles.

What Each Grade Represents

These grade profiles define outlines for grades of A,B,C,D and F. They are suggestive of common denominator academic values and can be contextualized at two levels: the department level (to capture domain-specific variations) and at the course level (to capture course-specific differences.

The Grade of A

(The essence of A-level work. Excellence overall, no major weaknesses). A-level work implies excellence in thinking and performance within the domain of a subject and course. It also implies development of a range of knowledge acquired through critical thought. The work at the end of the course is, on the whole, clear, precise, and well-reasoned, though with occasional lapses into weak reasoning. In A-level work, terms and distinctions are used effectively. The work demonstrates a mind beginning to take charge of its own ideas, assumptions, inferences, and intellectual processes. The A-level student usually analyzes issues clearly and precisely, usually formulates information clearly, usually distinguishes the relevant from the irrelevant, usually recognizes key questionable assumptions, usually clarifies key concepts effectively, typically uses language in keeping with educated usage, frequently identifies relevant competing points of view, and shows a general tendency to reason carefully from clearly stated premises, as well as noticeable sensitivity to important implications and consequences. A-level work displays excellent reasoning and problem-solving skills. The A student's work is consistently at a high level of intellectual excellence.

The Grade of B

(The essence of B-level work is that it demonstrates more strengths than weaknesses and is more consistent in high level performance than C-level work. It has some distinctive weaknesses, though no major ones). The grade of B implies sound thinking and performance within the domain of a subject and course. It also implies development of a range of knowledge acquired through critical thought, though this range is not as high as A level work. B-level work at the end of the course is, on the whole, clear, precise, and well-reasoned, though with occasional lapses into weak reasoning. On the whole, terms and distinctions are used effectively. The work demonstrates a mind beginning to take charge of its own ideas, assumptions, inferences, and intellectual processes. The student often analyzes issues clearly and precisely,

often formulates information clearly, usually distinguishes the relevant from the irrelevant, often recognizes key questionable assumptions, usually clarifies key concepts effectively, typically uses language in keeping with educated usage, frequently identifies relevant competing points of view. It shows a general tendency to reason carefully from clearly stated premises, as well as noticeable sensitivity to important implications and consequences. B-level work displays good reasoning and problem-solving skills.

The Grade of C

(The essence of C-level work is that it demonstrates more than a minimal level of skill, but it is also highly inconsistent, with as many weaknesses as strengths). The grade of C implies mixed thinking and performance within the domain of a subject and course. It also implies some development of knowledge acquired through critical thought. Thus C-level work at the end of the course shows some emerging thinking skills within the subject, but also pronounced weaknesses. Though some assignments are reasonably well done, others are poorly done; or at best are mediocre. There are more than occasional lapses in reasoning. Though terms and distinctions are sometimes used effectively, sometimes they are used quite ineffectively. Only on occasion does C-level work display a mind taking charge of its own ideas, assumptions, inferences, and intellectual processes. Only occasionally does C-level work display intellectual discipline and clarity. The C-level student only occasionally analyzes issues clearly and precisely, formulates information clearly, distinguishes the relevant from the irrelevant, recognizes key questionable assumptions, clarifies key concepts effectively, uses language in keeping with educated usage, identifies relevant competing points of view, reasons carefully from clearly stated premises, or recognizes important implications and consequences. Sometimes the C-level student seems to be simply going through the motions of the assignment, carrying out the form without getting into the spirit of it. On the whole, C-level work shows only modest and inconsistent reasoning and problem-solving skills and sometimes displays weak reasoning and problem-solving skills.

The Grade of D

(The essence of D-Level work is that it demonstrates only a minimal level of understanding and skill in the subject). The grade of D implies poor thinking and performance within the domain of a subject and course. One the whole, the student tries to get through the course by means of rote recall, attempting to acquire knowledge by memorization rather than through comprehension and understanding. On the whole, the student is not developing the skills of thought and knowledge requisite to understanding course content. Most assignments are poorly done. There is little evidence that the student is critically reasoning through assignments. Often the student seems to be

merely going through the motions of the assignment, carrying out the form without getting into the spirit of it. D work rarely shows any effort to take charge of ideas, assumptions, inferences, and intellectual processes. In general, D-level thinking lacks discipline and clarity. In D-level work, the student rarely analyzes issues clearly and precisely, almost never formulates information clearly, rarely distinguishes the relevant from the irrelevant, rarely recognizes key questionable assumptions, almost never clarifies key concepts effectively, frequently fails to use language in keeping with educated usage, only rarely identifies relevant competing points of view, and almost never reasons carefully from clearly stated premises, or recognizes important implications and consequences. D-level work does not show good reasoning and problem-solving skills and frequently displays poor reasoning and problem-solving skills.

The Grade of F

(The essence of F-level work is that the student demonstrates a pattern of unskilled thinking and/or fails to do the required work of the course). The student tries to get through the course by means of rote recall, attempting to acquire knowledge by memorization rather than through comprehension and understanding. The student is not developing the skills of thought and knowledge requisite to understanding course content. Here are typical characteristics of the work of a student who receives an F. A close examination reveals: The student does not understand the basic nature of what it means to think within the subject or discipline, and in any case does not display the thinking skills and abilities which at the heart of the course. The work at the end of the course is vague, imprecise, and unreasoned as it was in the beginning. There is little evidence that the student is genuinely engaged in the task of taking charge of his or her thinking. Many assignments appear to have been done pro forma, the student simply going through the motions without really putting any significant effort into thinking his or her way through them. Consequently, the student is not analyzing issues clearly, not formulating information clearly, not accurately distinguishing the relevant from the irrelevant, not identifying key questionable assumptions, not clarifying key concepts, not identifying relevant competing points of view, not reasoning carefully from clearly stated premises, or tracing implications and consequences. The student's work does not display discernible reasoning and problem-solving skills.

Idea # 13:

Use a "student understanding" form.

It is important that students clearly understand what instructors expected of them. We therefore recommend the use of a "student understandings" form. This form should be given to students during the orientation to the course, with an explanation of each item. Students then initial each item as you explain it, indicating their understanding. Here are sample items one might include in such a form:

Student Understandings

1. I understand that there are intellectual standards in this course and that I am responsible for monitoring my own learning.______
2. I understand that the class will focus on practice not on lecture.______
3. I understand on a typical class day I will be working in a small group and that I will be responsible to take an active part in advancing the assigned work of the group.______
4. I understand that I will be held regularly responsible for assessing my own work using criteria and standards discussed in class.______
5. I understand that if at any time in the semester I feel unsure about my "grade," I may request an assessment from the instructor(s).______
6. I understand that I must keep a journal, using a special format and including 20 entries in the course of the semester.______
7. I understand that there are <u>27 short written assignments</u>, one due for several class days.______
8. I understand that if an assignment is due for a class day and it is not completed, then I am not prepared to do the "in-class" work of the day and will be asked to leave. I understand that I may return to class once the assignment is completed.______
9. I understand that there is an <u>oral exam</u> that is a mastery exam. I understand that all entries must be passes to pass the course.______
10. I understand that there is a final exam in the course.______
11. I understand that I must do <u>A Self-Evaluation</u>, in which I "make a case" for receiving a particular grade using criteria provided in class and citing evidence from my work across the semester.______
12. I understand that the work of the course requires <u>Consistent classroom attendance</u> and active participation.______
13. I understand that the class will not be graded on a curve. I understand that it is theoretically possible for the whole class to get an A or an F.______
14. I understand the basis of the final grade as outlined in the syllabus.______
15. I understand that since the final grade is not based on points and is not mathematically calculated; the percentages outlined in the syllabus are approximations to suggest emphasis, not precise figures. In assigning my final grade the professor will lay all of my work out before her and match my work as a whole against criteria passed out in class and using the weighting above.

NAME *(print and sign)*____

Idea # 15:

Explain the key concepts of the course explicitly during the first couple of class meetings.

It is helpful to students if from the outset of the course they are clear about the key or "organizing idea" of the course. This is the foundational or guiding concept underlying everything you will be teaching in a given course. We suggest that you use as the organizing idea the mode of thinking that underlies the course. For example, the key idea behind most history courses should be "historical thinking." For most biology courses: "biological thinking." For most nursing courses: "thinking like a professional nurse." To help students understand the guiding idea for the course, discuss the logic of it with them. For example, "The purpose of scientific thinking is …," "The kinds of questions, chemists raise are…," "The kind of information they collect is…," and so forth. Give examples of the thinking in action and give the students an activity in which they can experience doing the thinking in an elementary way.

If the course is interdisciplinary or deals with a range of modes of thinking (as, say, many English classes are), then we suggest that you choose as your guiding idea: "thinking critically about X, Y, and Z." For example, "We will focus in this class on thinking critically in reading and writing, and with respect to novels, poems, and plays."

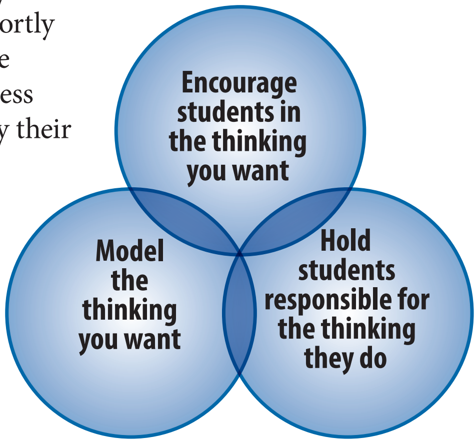
Idea # 16:

Discuss class time as a time in which the students will PRACTICE thinking (within the content) using the fundamental concepts and principles of the field.

When teaching historical thinking, biological thinking, mathematical thinking, sociological thinking, anthropological thinking, thinking like an engineer, thinking like a professional nurse, thinking like an effective student, etc…

1. Approach every class session with a clear sense of the relevant thinking you are looking for in the students.
2. Be prepared to model or dramatize (in front of the students) the thinking you want.
3. Design activities so that students both generate and assess thinking

In other words, in teaching for critical thinking in a subject, you should design the class so that you model the thinking you are looking for. This requires you either to think aloud in front of the class or to present the class with thinking in written form. Once modeled for the students, we should look for the students to engage in practice that emulates the model (not slavishly but in the spirit of the model of course). Shortly after the students engage in some guided practice, they need to assess that practice, discovering thereby their strengths and weaknesses — their present level of understanding. This discovery should become a daily part of their learning, not something they discover six weeks down the line after receiving the results of a quiz.



Idea # 17:

Make the point that the content is a SYSTEM of interconnected ideas.

Explain that this system is used, by professionals, to ask questions, gather data or information, make inferences about the data, trace implications, and transform the way we see and think about the dimension of the world that the subject represents. For example, the following ideas are part of a system that defines modern chemistry: matter, physical properties, chemical properties, atoms, compounds molecules, the periodic table, law of conservation of mass, atomic and molecular weights, mass number, atomic number, isotopes, ions, etc.... Each idea is explained in terms of other ideas. The ideas together form an interrelated system. Model the system of ideas in the content you are teaching by thinking aloud slowly and deliberately before the students. Explain what you are doing and how you are doing it. Proceed in such a way that the students can replicate your example.

Daily Emphasis

Idea # 20:

Encourage students to think — quite explicitly — about their thinking.

Give them specific suggestions for how to go about it. For example, most students left to themselves do not think very effectively as learners. Many have poor reading and listening habits. Most rarely ask questions. Most could not explain the thinking they are using in the learning process. Much of their thinking turns out to be short-term memorization (rote learning). We suggest that you discuss with students the kind of thinking they need to do to master the content you are teaching.

You should point out to students the danger of relying on rote memorization and periodic cramming as a way to try to pass the course. You should tell the students on the first class day that thinking through the content is the key agenda in the course and that this task will be the business of the class.

Idea # 21:

Encourage students to think of content as a form of thinking.

For example, encourage students to recognize that the key to history (as a body of content) is historical thinking; that the key to biology is biological thinking, etc…. Discuss the purposes that define the field of study — "Biologists have the following aims:…". Name and explain some of the kinds of questions, problems, and issues that people in the field answer, solve, or resolve. Give examples of the way in which data is collected in the field and of the way those data are processed (the inferences or conclusions that professionals come to). Discuss the point of view or perspective that the field involves. How do biologists look at the world (or at the data they collect)? How do anthropologists? How do artists? Nurses? Lawyers? Doctors?

There is a particular set of performances we are striving for in teaching any body of content. We want basic concepts to be internalized. We want students to leave our classes with the content of the course available to them in their minds, so that they can actually use the content they learned in the "real" world. Thinking is the only vehicle for that internalization and use. When students think poorly while learning, they learn poorly. When they think well while learning, they learn well.