Diane F. Halpern
Critical Thinking Handout

Critical Thinking Workshop for Helping our Students Become Better Thinkers

Background
Critical Thinking Can Be Improved With Instruction

One of the goals of education is to facilitate a student's ability to think clearly about a wide range of topics encountered in academic settings as well as everyday events. Daily issues arising from our increasing dependence on science and technology as well as the pressures of competing social and cultural influences require the use of data analysis, synthesis, and evaluation. There seems to be unanimous agreement that we need to promote good thinking in our students. Yet, there are still many schools that do not have explicit programs in thinking skills instruction. In a review of research on instruction in high school programs, Marzano (1998) found that programs that taught heuristics (i.e., thinking skills) had an overall effect size of d = 1.17!. This is an effect size that is so large that Cohen, the statistician who popularized the use of effect size statistics claimed we do not need statistical tests. With effect sizes as large as this, we need to move from do thinking skills programs "work" to how can we make them "work best?"

Moseley et al. (2005) worked with multiple teams of educators from all sectors in education in England to classify thinking skills programs. They were charged with answering an important question on behalf of the Learning and Skills Development Agency (LSDA) in England. Based on their extensive review, would they recommend that all their post-16 schools (which are similar to the community colleges in the United States) require critical thinking coursework? They conducted an extensive classification and evaluation of all critical thinking programs they could locate and produced several hundred pages of categorized reviews, including empirical evidence of effectiveness. Following their careful review of the critical thinking literature, they concluded that approaches that were skill-based are especially useful because skill-based approaches had specific educational objectives, and thus are easier to assess and communicate to students and other stakeholders in education. Critical thinking approaches that are skill-based are also easier for the practice of teaching because the teachers can keep the framework in mind as a guide during lessons and unexpected questions.

Thinking Critically About Critical Thinking: Lessons Learned from Cognitive Psychology

A working definition of critical thinking:

Critical thinking is the use of those cognitive skills or strategies that increase the probability of a desirable outcome. It is purposeful, reasoned, and goal directed. It is the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods, and making decisions. Critical thinkers use these skills appropriately, without prompting, and usually with conscious

intent, in a variety of settings. That is, they are predisposed to think critically. When we think critically, we are evaluating the outcomes of our thought processes--how good a decision is or how well a problem is solved. Critical thinking also involves evaluating the thinking process--the reasoning that went into the conclusion we've arrived at or the kinds of factors considered in making a decision.

Critical thinking is effortful, careful, consciously controlled processing that maximizes the use of all available evidence and cognitive strategies, and purposefully strives to overcome individual biases" (Riggio & Halpern, 2006) (for reviews see Ennis, 1993; Halpern, 2013; Moseley et al. 2005; Sternberg, Roediger, & Halpern, 2007)

Researchers generally agree that critical thinking is attempting to achieve a desired outcome by thinking rationally in a goal-oriented fashion.

Instruction in critical thinking is predicated on two assumptions:

(1) that there are clearly identifiable and definable thinking skills which students can be taught to recognize and apply appropriately, and (2) if recognized and applied, the students will be more effective thinkers. Let me give you some examples of what I mean by the term "thinking skills." A general list of skills that would be applicable in almost any class would include: understanding how cause is determined, recognizing and criticizing assumptions, analyzing means-goals relationships, giving reasons to support a conclusion, assessing degrees of likelihood and uncertainty, incorporating isolated data into a wider framework, and using analogies to solve problems.

A Four-Part Model for Improving Critical Thinking

1. Explicitly teach the skills of critical thinking
2. Develop the disposition for effortful thinking and learning
3. Direct learning activities in ways that increase the probability of transcontextual transfer (structure training)
4. Make metacognitive monitoring explicit and overt

On the following pages is a taxonomy of critical thinking skills. It is not meant to be definitive or exhaustive--it is just a useful list that may help to clarify some of underlying concepts.

A Taxonomy of Critical Thinking Skills

1. Verbal Reasoning Skills
   The skills listed under this rubric include those that are needed to comprehend and defend against the persuasive techniques that are embedded in everyday language (also known as natural language). Thinking and language are closely tied constructs, and the skills included in this section recognize the reciprocal relationship between language and thought in which an individual's thoughts determine the language used to express them, and the language that is used shapes the thoughts.

2. Argument Analysis Skills
   An argument is a set of statements with at least one conclusion and one reason that supports the conclusion. In real life settings, arguments are complex with reasons that run counter to the conclusion, stated and unstated assumptions, irrelevant information, and intermediate steps. Arguments are found in commercials, political speeches, textbooks, and anywhere else where reasons are presented in an attempt to get the reader or listener to believe that the conclusion is true. The skills of identifying conclusions, rating the quality of reasons, and determining the overall strength of an argument should be sharpened in college course work.

3. Skills in Thinking as Hypothesis Testing
   The rationale for this category is that much of our day-to-day thinking is like the scientific method of hypothesis testing. In many of our everyday interactions, people function like intuitive scientists in order to explain, predict, and control the events in their life. The skills used in thinking as hypothesis testing are the same ones that are used in scientific reasoning--the accumulation of observations, formulation of beliefs or hypotheses, and then using the information collected to decide if it confirms or disconfirms the hypotheses.

4. Using Likelihood and Uncertainty
   Because very few events in life can be known with certainty, the correct use of probability and likelihood plays a critical role in almost every decision. Huff's (1954) tiny, popular book How To Lie With Statistics is still widely quoted because it explains how easy it is to mislead someone who does not understand basic concepts in probability. The critical thinking skills that are subsumed under this heading are an important dimension of a college-level critical thinking taxonomy.

5. Decision Making and Problem Solving Skills
   In some sense, all of the critical thinking skills are used to make decisions and solve problems, but the ones that are included here involve the generation and selection of alternatives and judging among them. Many of these skills are especially useful in quantitative reasoning problems.

Taken together these five categories define an organizational rubric for a skills approach to critical thinking. They have face validity and can be easily communicated to the general public and students and offer one possible answer to the question of what college students need to know and be able to do to compete and cooperate in the world's marketplace and function as effective citizens in a democratic society.

An Example:

Sometimes, we unwittingly encourage the exact opposite of what we want students to learn. Consider for example, many writing assignments where we ask students to take a position on a controversial issue in psychology and then to write a position paper. This is exactly the sort of learning activity that would strengthen the bias to seek and consider only confirming evidence. Instead, we need to help student understand and be able to explain evidence on two or more sides of an issue, such the evidence for and against evolutionary hypotheses of mate selection or for and against the idea that parents are important influences on their children. We want to teach students to gather and assess evidence to determine the best conclusion or conclusions and not start with what they believe is true and consider only supporting evidence. Here is an applied example that forces students to consider evidence that supports and fails to support a hypothesis:

Making Arguments Worksheet

Example 1 Does violence on television really have a negative influence on children's behavior?

1. State your conclusion. (although you may begin your formal writing here, but sure that the conclusion follows from your reasons). As you work, this is the last part this is filled in, not the first.

2. Give three reasons (or some other number) that support your conclusion.

a.

b.

c.

3. Rate each reason as weak, moderate, strong, or very strong.

Rating for a:

Rating for b:

Rating for c:

4. Give three counterarguments (or some other number) that weaken your conclusion. Rate how much each counterargument weakens the conclusion: little, moderate, much, or very much.

a.

Rating for a:

b.

Rating for b:

c.

Rating for c:

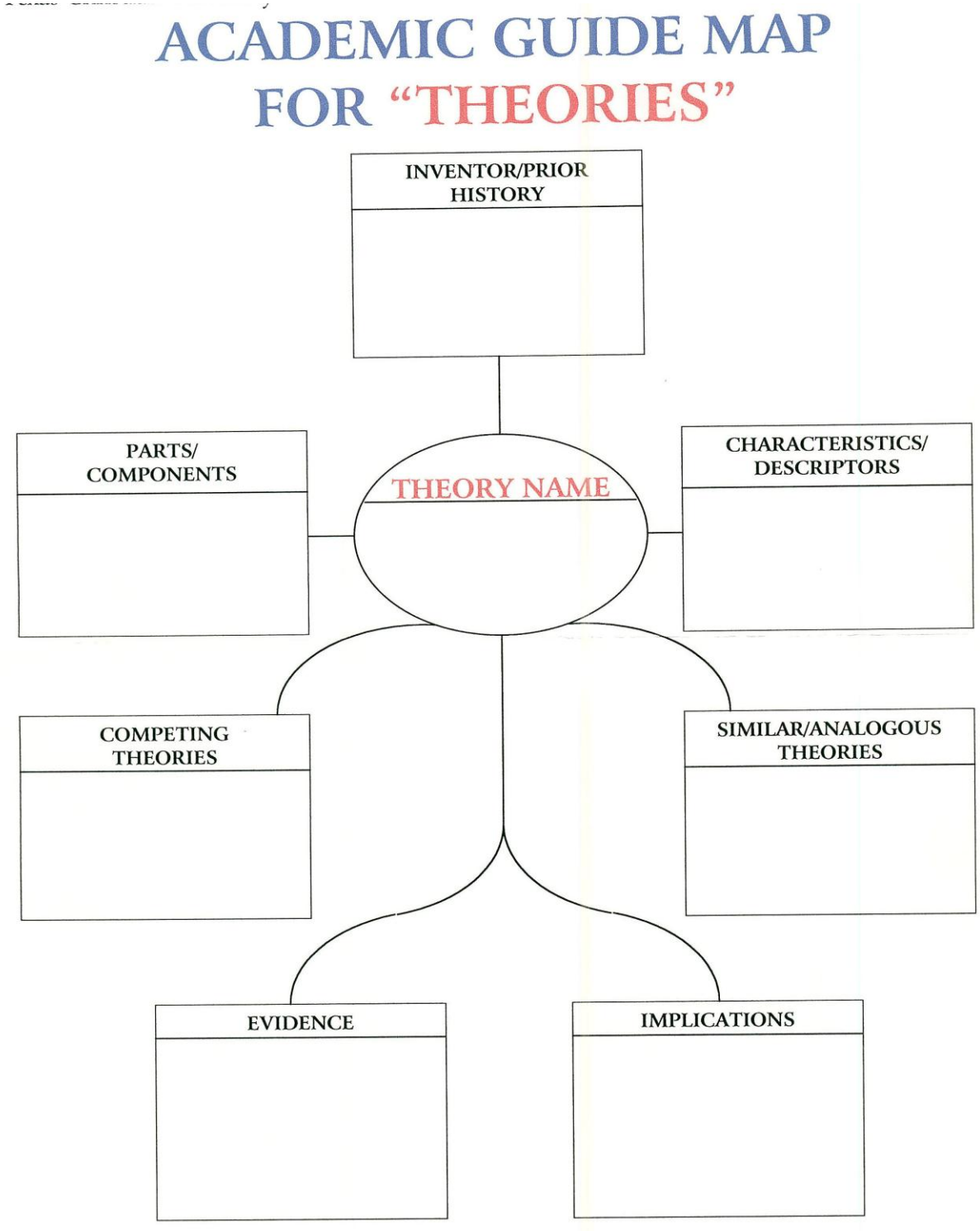
5. List any qualifiers (limitations on the reasons for or against—for example some evidence may be restricted to early childhood)

6. List any assumptions.

7. Are your reasons and counterarguments directly related to your conclusion?

8. What is the overall strength of your argument: weak, moderate, strong, or very strong?

Now that you have completed this worksheet, rate the overall strength of your argument.



A generic fill-in-the-blank concept map that can be used to understand any theory in any domain of knowledge. When you fill in the various "boxes"—for example, giving evidence for the theory—you will be developing a "deep" knowledge of the theory. (Dansereau, 2001).

Guiding Thought-Provoking Questioning

(King, 1994)

Generic Questions	SpecificThinking SkilIs Induced
What is a new example of. ..?	Application
How could. ..be used to. ..?	Application
What would happen if. ..?	Prediction/hypothesizing
What are the implications of. ..?	Analysis/inference
What are the strengths of . . .?	Analysis/inference
What are the weaknesses of. ..?	Analysis/inference
What is. ..analogous to?	Identification and creation of analogies and metaphors
What do we already know about.?	Activation of prior knowledge
How does. ..affect. ..?	Activation of relationship (cause-effect)
How does. ..tie in with what we learned before?	Activation of relationship
How does. ..apply to everyday life?	Application
What is the counterargument for. ..?	Different perspectives

Another Example:
A complementary approach to critical thinking instruction is based on eliminating or reducing common thinking fallacies. Consider, for example, this exercise in counterfactual reasoning that has been used successfully to help college students overcome two cognitive biases--"overconfidence" and "confirmation bias." These terms refer to the over-reliance on evidence that confirms the beliefs that we hold. The original research on counterfactual reasoning was conducted by Koriat, Lichtenstein, and Fischhoff (1980); It has been replicated and extended many times. In a typical demonstration of overconfidence, people are asked a variety of common knowledge questions. For example, "The Sabines were part of (a) ancient India or (b) ancient Rome." Try it--answer the question by selecting either option a or option b. Okay, now, judge how confident you are about the answer that you selected. Use 1.00 if you are absolutely certain that you are correct, .5 if you just guessed, so your chance of being correct is 50%. Use the numbers between .50 and 1.00 to assess how confident you are in your response. Standard and often replicated results show that, in general, people are over confident in their knowledge. Answers endorsed with absolute certainty, that is, people who believe they are 100% confident that they are correct, are, in fact, wrong 20% of the time. There is a strong tendency for people tend to be confident that they are correct when they are often wrong. Koriat, Lichtenstein, and Fischhoff (1980) have defined overconfidence as an unwarranted belief in the correctness of one's answers. In a study designed to determine if people can improve in their ability to assess how confident they should be when answering common knowledge questions, the researchers added another condition. After selecting answers and judging their confidence in their answers, subjects were told:

> Spell out all the possible reasons that you can find favoring and opposing each of the answers. Such reasons may include facts that you know, things that you vaguely remember, assumptions that make you believe that one answer is likely to be correct or incorrect, gut feelings, associations and the like.

Subjects were then instructed to write each reason in the appropriate cell of a 2 X 2 table like the one shown below:

	Reasons For	**Reasons Against**
Answer A:		
Answer B:		

Subjects were encouraged to put responses in all four cells and then to rate each reason on a 7-point scale according to how strongly it was for or against the corresponding answer (1. weakest possible and 7. strongest possible). Readers should try this for themselves.

Results showed that after listing reasons and judging the strength of each reason, college students became much more accurate in assessing the true probability that they were correct. This is an interesting study for many reasons. First, the students did not receive any feedback about the correctness of their responses--they became more accurate in knowing what they know and don't know by focusing on information that they had stored in memory and considering the strength of the evidence that they had. In other words, the improvement resulted from their own actions.

There is a long history in cognitive psychology showing that "the head remembers what is it does." As teachers, what we ask students to do with information to be learned will affect what is learned and how and when the information will be retrieved at some time in the future.

None of this is easy, but helping our students improve in their ability to think clearly is the most important goal that we will ever have. Whenever you feel discouraged, recall Hitler's now infamous quote, "What luck for rulers that men do not think."

About the Halpern Critical Thinking Assessment (HCTA)

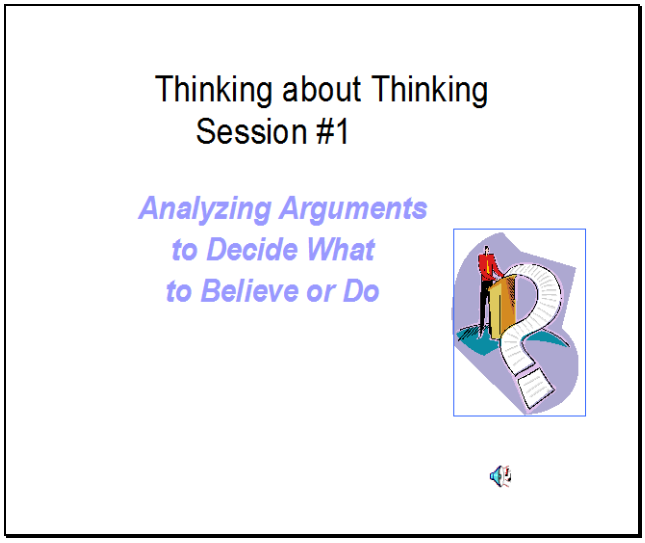
The HCTA uses believable examples with an open-ended response, followed by specific questions that probe for the reasoning behind an answer. If, for example, the thinking skill of understanding and recognizing the distinction between correlation and cause were being assessed, it would be tested with examples taken from medical research (e.g., coffee drinkers reported more headaches), social policy analysis (e.g., welfare mothers who received job training were more likely to be employed after one year than welfare mothers who did not receive job training), and numerous other believable scenarios. Such materials are ecologically valid in that they are representative of the many examples that could be found in newspapers and everyday discussions. The open-ended portion of the question allows test-takers to demonstrate whether or not they spontaneously use the skill. For example, do the test-takers recognize that these are correlational designs that do not permit causal statements when there are no obvious hints to consider the issue of design?

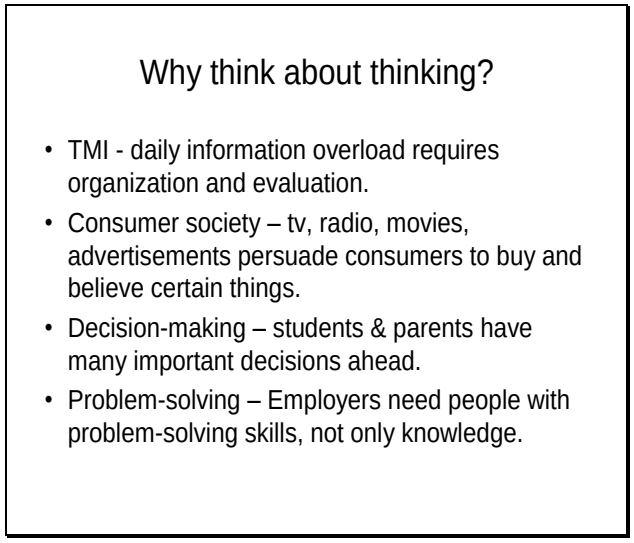
Specific probes in the form of alternatives for the forced-choice questions follow the open-ended responses. These probes allow test takers to demonstrate their understanding of the concepts, such as whether they are able to recognize the problem of determining cause when they are provided with hints. (e.g., In understanding these results, is it important to know if the participants were assigned randomly to the different conditions?) These additional probes show if test-takers are able to use the skill when they are told that it is needed in a specific situation, even if the test-taker did not spontaneously recognize that it was needed.

A good critical thinking question with several sequential parts allows for different types of information about the test taker with a minimal number of questions. The open-ended or constructed response portion is a test of the type of remembering that cognitive psychologists call "free recall" because there are few restraints on the type of response that the test-taker can generate. The multiple-choice or multiple-rating portion shows whether the respondents were

able to recognize the appropriate skill when it was presented in a list of alternatives. This sort of response is a measure of "recognition memory." Cognitive psychologists distinguish between recall and recognition paradigms in the assessment of memory. It is believed that these two types of recollection utilize different cognitive processes and that students prepare differently for tests that require free recall (e.g., essay tests) than those that require recognition (e.g., multiple choice tests). In general, lower scores are expected on free recall tests than recognition tests because free recall requires a search through memory plus some sort of verification that the answer retrieved is correct; recognition requires only the verification stage and provides a less stringent measure of memory. For more information contact mayr@schuhfried.at

In one research project, Marin and Halpern (2011) provided critical thinking instruction for high school seniors in very low performing schools. Here are some samples of our materials:





During this and the following sessions, we'll learn & think about thinking…

Some of our goals are to help you:

- Be more aware of your thinking.
- Develop a critical thinking approach to the things you see & hear in the media, including music and tv, radio,magazines.
- Think carefully about arguments people use to persuade you.

More goals…

- Identify how reasons can be good or bad.
- Look for hidden assumptions.
- Recognize that if two things are related doesn't mean one causes the other.
- Teach you to use a decision making tool so you can make decisions you can live with!

We'll begin with this question…

- How do you define an

ARGUMENT?

In critical thinking terms,

- **An argument is not a disagreement!**

An argument is a set of statements that contains at least one conclusion and one reason for believing that the conclusion is true.

Good thinking requires Information & Evidence

- Facts
- Opinions
- Arguments based on reason, not emotion
- A healthy skepticism is good---ask questions to help you evaluate the evidence

Persuasion – how your thinking can be influenced

- What are fallacies?
  - Poor reasoning
  - Errors in argument
- **Four Fallacies**
  - Guilt/virtue by association
  - Popularity
  - Weak Analogies
  - Tradition

Welcome to Session Three *Thinking About Thinking*

What are Mental Models?

Before we begin…

- Use the paper and pencil provided to Draw A Scientist.
- We will collect these later.

What are Mental Models?

Mental models are ways of thinking that become automatic --- we don't stop to think about our thinking.

- Assumptions
- Beliefs
- Prejudices

Why think about what we're thinking?

- Assumptions may be wrong.
- Beliefs may be inaccurate.
- Prejudices may be unfair or unjust.
- Faulty thinking can occur.
- Faulty thinking = Problems!

Let's check out a common mental model…

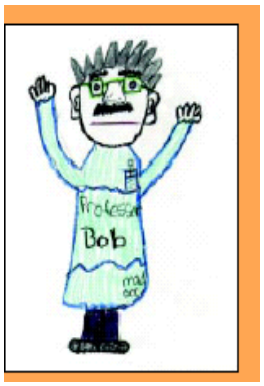
How about this:

- Before we started, you were asked to draw a picture of a scientist.
- What did you draw?
- Something like this?

→→→

If so, you're not alone!

- **When asked to "Draw-A-Scientist", most people (children, teenagers & adults) draw:**
- *White men*
- *White lab coats*
- *Bushy eyebrows!*
- *Glasses*
- *Wild Hair*



Drawing From Breaking Science Stereotypes, by Bodzin & Gehringer, Science & Children, January 2001

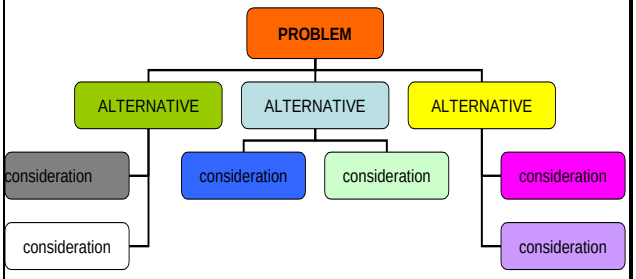
Session # 4: Making Decisions

The Worksheet Method

Decision Making…

- Takes effort.
- It's not simple! There's usually no simple either/or.
- It involves several alternatives.
- Each alternative also has considerations.

Mapping a Decision



1. Defining the Problem

- For example, your parents want you to be more productive during the hours after school.
- Here's the **problem:**

"What to do in the hours after school?"

2. What are some alternatives?

Here are some possible alternatives:

1. Get a part-time job.
2. Participate in academic club.
3. Sports.
4. Volunteer at the local library.

But wait! Are all of these equally good alternatives?

- Probably not. Alternatives, the possible actions, are not created equal.

Some alternatives have more going for them than others…let's take a closer look…

References: For additional examples and references see

Halpern, D. F. (2013). Thought and Knowledge: An Introduction to Critical Thinking (5th ed.). New York, NY: Psychology Press.

Marin, L., & Halpern, D. F. (2011). Pedagogy for developing critical thinking in adolescents: Explicit instruction produces greatest gains. *Thinking Skills and Creativity*, *6*, 1-13. Doi: 10.1016/j.tsc.2010.08.002

Butler, H. A., & Halpern, D. F. (2011). Critical Thinking. *Oxford Bibliographies Online*. New York, N.Y.: Oxford University Press. Available from OBO website: http://aboutobo.com/

Halpern, D. F. (2006). The nature and nurture of critical thinking. In R. Sternberg, R. Roediger, & D. F. Halpern (Eds.). *Critical Thinking in Psychology* (pp. 1-14). Cambridge, MA: Cambridge University Press.

Riggio, H. R. & Halpern, D. F. (2006). Understanding Human Thought: Educating Students as Critical Thinkers. In W. Buskist & S. F. Davis (Eds.), *Handbook of the Teaching of Psychology* (pp.78-84). Malden, MA: Blackwell Publishing.

Butler, H. A., (2012). Halpern Critical Thinking Assessment predicts real-world outcomes of critical thinking. *Applied Cognitive Psychology*, doi: 10.1002/acp.2851