# College Success

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MINNEAPOLIS, MN

# Chapter 3: Thinking about Thought

Figure 3.1

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**Where Are You Now?**

Assess your present knowledge and attitudes.

| | Yes | Unsure | No |
|---|---|---|---|
| 1. I am a good problem solver. | | | |
| 2. I am considered creative by my friends. | | | |
| 3. I have good judgment. | | | |
| 4. I find it easy to make decisions quickly. | | | |
| 5. My decisions usually turn out to be good decisions. | | | |
| 6. I like to think things through before speaking. | | | |
| 7. I am not shy about asking questions when I don't understand something. | | | |
| 8. I enjoy good discussions and arguments. | | | |
| 9. I regularly practice an art form (music, acting, painting, etc.) | | | |
| 10. I enjoy hearing other people's points of view, even when I disagree with them. | | | |
| 11. I usually question information presented as fact on the Internet or television. | | | |

### Where Do You Want to Go?

Think about how you answered the questions above. Be honest with yourself. On a scale of 1 to 10, how would you rate your level of thinking skills at this time?

| Poor thinking skills | | | | | | | | | Excellent thinking skills |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

In the following list, circle the three most important areas in which you think you can improve:

- Applying information
- Analyzing information
- Thinking critically
- Asking questions about information
- Evaluating information
- Coming up with new ideas
- Solving problems
- Making decisions
- Identifying weaknesses in ideas
- Choosing sources for research

Are there other areas in which you can improve your thinking skills? Write down other things you feel you need to work on.

_____

_____

_____

**How to Get There**

Here's what we'll work on in this chapter:

- Understanding what makes thinking in college different from thinking in high school
- Learning how to think
- Knowing the types of thinking
- Recognizing why all types of thinking are important
- Understanding what critical thinking is
- Recognizing and avoiding logical fallacies and faulty assumptions
- Establishing critical thinking habits
- Researching and thinking critically
- Understanding what creative thinking is
- Developing creative thinking habits
- Solving problems
- Making decisions
- Brainstorming

## It's All in Your Head

Throughout this book, we make the case that college is really quite different from high school. Sure, the social life is different, and there are different pressures in college, perhaps a family to support or a job schedule to coordinate with studies. But the two most fundamental differences involve expectations—the expectation that you will be independent and take responsibility for your actions and the expectation that you will think for yourself.

Remember the heavy "thinking" you did in high school? Most of it was recalling facts or information you had previously committed to memory. Perhaps in some courses you were asked to support a statement or hypothesis using content from your textbook or class. Your thinking in high school was very structured and tied closely to reflecting what was taught in class.

In college, you are expected to think for yourself; to access and evaluate new approaches and ideas; to contribute to your knowledge base; and to develop or create new, fresh ideas. You will be required to develop and use a variety of thinking skills—higher-order thinking skills—which you seldom used in high school. In college, your instructors' roles will be not only to supply a base of new information and ideas, as good instructors will challenge you to stretch your skills and knowledge base through critical and creative thinking. Much of their

teaching involves the questions they ask, not the directions they give. Your success in college education—and in life beyond college—is directly linked to becoming a better and more complete thinker. Becoming a better and more complete thinker requires mastering some skills and consistent practice.

## 3.1 Types of Thinking

**Learning Objectives**

1. Understand that there are different types of thinking.
2. Identify how each type of thinking contributes to learning.

So what are the various types of thinking skills, and what kind things are we doing when we apply them? In the 1950s, Benjamin Bloom developed a classification of thinking skills that is still helpful today; it is known as **Bloom's taxonomy**. He lists six types of thinking skills, ranked in order of complexity: knowledge, comprehension, application, analysis, synthesis, and evaluation. Figure 3.2 "Types of Thinking Skills" outlines each skill and what is involved in that type of thinking, as updated by Lorin Anderson and David Krothwohl.

| Thinking Still | What It Involves |
|---|---|
| 1. Remembering and Recalling | Retrieving or repeating information or ideas from memory. This is the first and most basic thinking skill you develop (starting as a toddler with learning numbers, letters, and colors). |
| 2. Understanding | Interpreting, constructing meaning, inferring, or explaining material from written, spoken, or graphic sources. Reading is the most common understanding skill; these skills are developed starting with early education. |
| 3. Applying | Using learned material or implementing material in new situations. This skill is commonly used starting in middle school (in some cases earlier). |
| 4. Analyzing | Breaking material or concepts into key elements and determining how the parts relate to one another or to an overall structure or purpose. Mental actions included in this skill are examining, contrasting or differentiating, separating, categorizing, experimenting, and deducing. You most likely started developing this skill in high school (particularly in science courses) and will continue to practice it in college. |
| 5. Evaluating | Assessing, making judgments, and drawing conclusions from ideas, information, or data. Critiquing the value and usefulness of material. This skill encompasses most of what is commonly referred to as critical thinking; this skill will be called on frequently during your college years and beyond. Critical thinking is the first focus of this chapter. |
| 6. Creating | Putting parts together or reorganizing them in a new way, form, or product. This process is the most difficult mental function. This skill will make you stand out in college and is in very high demand in the workforce. Creative thinking is the second focus of this chapter. |

All of these thinking skills are important for college work (and life in the "real world," too). You've likely had a great deal of experience with the lower-level thinking skills (yellow section). The midlevel skills are skills you will get a lot of practice with in college, and you may be well on your way to mastering them already. The higher-level thinking skills (red section) are the most demanding, and you will need to invest focused effort to develop them.

## Exercise: Thought Inventory

Think about Figure 3.2 “Types of Thinking Skills”. Are you using all six thinking skills? Reflect on your schoolwork in the past three weeks and identify specific examples where you used each of the thinking skills. Use the comment column to write notes about the skills that are second nature to you and those you would like to develop further.

| Skill Set | How You Used It in the Past Three Weeks | Comments |
|---|---|---|
| Remembering and Recalling | | |
| Understanding | | |
| Applying | | |
| Analyzing | | |
| Evaluating | | |
| Creating | | |

Look at the lists of things you actually did in each case. Notice that there are certain verbs that apply to each skill set. When you see those verbs as a prompt in an assignment or an exam, you will know what kind of thinking the instructor expects from you. Table 3.1 “Thinking Verbs” lists some of the most common verbs associated with each thinking skill.

Table 3.1 Thinking Verbs

| Skill Set | Verbs |
|---|---|
| 1. Remembering and Recalling | Bookmark, count, describe, draw, enumerate, find, google, identify, label, list, match, name, quote, recall, recite, search, select, sequence, tell, write |
| 2. Understanding | Blog, conclude, describe, discuss, explain, generalize, identify, illustrate, interpret, paraphrase, predict, report, restate, review, summarize, tell, tweet |
| 3. Applying | Apply, articulate, change, chart, choose, collect, compute, control, demonstrate, determine, do, download, dramatize, imitate, implement, interview, install (as in software), participate, prepare, produce, provide, report, role-play, run (software), select, share, show, solve, transfer, use |
| 4. Analyzing | Analyze, break down, characterize, classify, compare, contrast, debate, deduce, diagram, differentiate, discriminate, distinguish, examine, infer, link, outline, relate, research, reverse-engineer, separate, subdivide, tag |
| 5. Evaluating | Appraise, argue, assess, beta test, choose, collaborate, compare, contrast, conclude, critique, criticize, decide, defend, "friend/de-friend," evaluate, judge, justify, network, post, predict, prioritize, prove, rank, rate, review, select, support |
| 6. Creating | Adapt, animate, blog, combine, compose, construct, create, design, develop, devise, film, formulate, integrate, invent, make, model, modify, organize, perform, plan, podcast, produce, program, propose, rearrange, remix, revise, rewrite, structure |

Throughout this book, we give tips that will help you develop your thinking skills. You have read about the learning cycle and the importance of *applying* your knowledge. You will learn tips for *remembering* information from your notes and classes. Preparing for class requires you to *analyze* what you know and what you need to learn. The sections on listening and reading will help you develop your *understanding* skills. Look for those tips and practice them.

In this chapter, we will focus on critical thinking (evaluating) and creative thinking. They deserve specific focus because they are likely to be the skills you have least practice with. These are the skills most helpful for success in college and in "real life." Creative thinking will help you come up with possible solutions for problems and new ideas. Critical thinking will help you decide which of those ideas have most merit and deserve to be implemented.

## Key Takeaways

- We use different types of thinking skills to address different requirements, and these skills are classified in Bloom's taxonomy.
- You have been using many thinking skills since childhood.
- Two very important thinking skills you will need to develop for success in college and in life are critical (or evaluative) thinking and creative thinking.

### Checkpoint Exercises

1. List three verbs that are associated with application skills.

   _____

   _____

   _____

2. What is another name for “evaluation” thinking skills?

   _____

3. What thinking skills are associated with each of the following?

    1. Compose and design: _____
    2. Tweet and describe: _____
    3. Break down and discriminate: _____
    4. Rank and beta test: _____
    5. Enumerate and google: _____

## References

Anderson, L. W., and David R. Krathwohl, eds., *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives* (Boston, MA: Allyn & Bacon, 2001).

## 3.2 It's Critical

**Learning Objectives**

1. Understand what critical thinking is and why it's important.
2. Identify logical pitfalls.
3. Discover assumptions and biases.
4. Practice problem solving and decision making.
5. Know the power of questions.
6. Evaluate information (on and off the Internet).

**Americans Have Access to...**

- 1 million *new* books each year
- 5,500 magazines
- 10,500 radio stations
- 65,000 iPhone apps
- 1,000,000,000,000 Web pages

In today's environment, it is not so critical to "know" a great deal of information. The list above indicates how much information we can easily access. In fact, the abundance of information might be the greater challenge. Your success will depend on what you can do with the information, not just on what you know. How we filter and use that abundance of data is the reason critical thinking has become so important today.

**Critical thinking** is the ability to discover the value of an idea, a set of beliefs, a claim, or an argument. It requires you to use logic and reasoning to evaluate evidence or information to make a decision or reach a conclusion. Critical thinking is

- a foundation for effective communication,
- the principal skill used in effective decision making,
- at the core of creating new knowledge,
- a way to uncover bias and prejudices.

Critical thinking is a part of everyday life, too. Decisions you make can have a lasting impact on your life, and these decisions benefit from critical thinking. Did you ever decide to quit smoking or to lose weight? Were you

successful? How did you decide to attend the college you are in? Was that the right choice for you? In any of these cases, could you have made a better decision if you had better or more information?

## The Critical Thinking Process

The critical thinking process is really nothing more than asking the right questions to understand a problem or issue and then gathering the data you need to complete the decision or take sides on an issue.

**What is the problem or issue I am considering really about?** Understanding this is key to successful critical thinking. What is the objective? A position? A decision? Are you deciding what candidate in an election will do a better overall job, or are you looking to strengthen the political support for a particular cause? Are you really against a recommendation from your dad, or are you using the issue to establish your independence?

Do you understand the terms related to the issue? Are you in agreement with the proponent's definitions? For example, if you are evaluating a quotation on the health-care system for use in a paper, your objective might be to decide to use the quotation or not, but before you can make that decision you need to understand what the writer is really saying. If a term like "family" is used, for example, does it mean direct relations or extended family?

**What are my options?** What are choices that are available to you (if you are making a decision), or what are the "sides" (in the case of a position) you might choose to agree with? What are their differences? What are the likely consequences of each option? In making a decision, it might be helpful to ask yourself, "What is the worst thing that might happen in each scenario?" Examining different points of view is very important; there may be dozens of alternative viewpoints to a particular issue—and the validity of each can change depending on circumstances. A position that is popular or politically correct today may not have been a year ago, and there is no guarantee it will be right in the future. Likewise, a solution to a personal problem that was successful for your roommate may not apply to you. Remember also that sometimes the best option might be a combination of the options you identify initially.

**What do I know about each option?** First, make sure you have all the information about each option. Do you have all the information to support each of your likely options? What is still missing? Where can you get the information you need? Keep an open mind and don't dismiss supporting information on any position before you evaluate it carefully.

**How good is my information?** Now it's time to evaluate the quality of the support of each option or point of view. Evaluate the strengths and the weaknesses of each piece of supporting evidence. Are all the relevant facts presented? Are some facts presented in misleading ways? Are enough examples presented to support the premise? Consider the source of the supporting information. Who is the expert presenting the facts? That "expert" may have a vested interest in the position. Consider that **bias**, more for understanding the point of view than for rejecting it. Consider your own opinions (especially when working with emotional issues); are your emotional ties to a point of view getting in your way of clear thinking (your own biases)? If you really like a particular car model, are you giving the financial implications of buying that car a fair consideration? Are there any errors or fallacies in your logic? (See Table 3.2 "Fallacies and How to Avoid Them".)

**Fallacies** are defects in logic that weaken arguments. You should learn to identify them in your own thinking so you can strengthen your positions, as well as in the arguments of others when evaluating their strength.

Table 3.2 Fallacies and How to Avoid Them

| Fallacy | Description | Examples | How to Avoid It in Your Own Thinking |
|---|---|---|---|
| **Generalizations** | Making assumptions about a whole group of people based on an inadequate sample. | Engineering students are nerds.<br><br>My economics class is boring, and my friend says her economic class is boring, too—therefore all economics classes are boring. | What kind of sample are you using? Is it large enough to support the conclusions? You may want to increase your sample size or draw a more modest conclusion by using the word "some" or "many." |
| **False Cause** | Drawing improper conclusions through sequencing. If A comes before B, then A causes B. | I studied biology last term, and this term I'm taking organic chem, which is very confusing. Biology makes chemistry confusing. | When making causal statements, be sure you can explain the process through which A causes B beyond their mere sequence. |
| **Personalizations** | Also known by their Latin names (*ad hominem*, or "against the man," and *tu quoque*, or "you too"). Inserting personalities inappropriately into an argument. Common in political arguments. | *Against the man:* I won't support Senator Smith's education bill. He's had a mistress and marital problems. | Focus on the merits and supporting data of an argument, not on the personality or behavior of the people making the arguments. |
| **Everyone Does It** | Also known by its Latin name (*ad populum*, or "against many"). Justifying an issue based solely on the number of people involved. | *You too:* A parent explains the evidence of the risks of binge drinking. The child rejects the arguments, saying, "When you were my age, you drank too."<br><br>It's healthy to drink only soda; millions of American kids do. | The popular position is not always the right one. Be wary of arguments that rely exclusively on one set of numbers. |
| **Appealing to Authority** | Using an endorsement from someone as a primary reason for supporting a point of view. | We should oppose higher taxes; Curt Schilling does.<br><br>Pitcher Curt Schilling may be a credible authority on baseball, but is he an authority on taxes? | Quoting authorities is a valuable tool to build an argument; make sure the authorities you quote are truly subject matter experts on the issue you are discussing. |

| Fallacy | Description | Examples | How to Avoid It in Your Own Thinking |
|---|---|---|---|
| **Weak Analogy** | Using irrelevant similarities in two objects to draw a conclusion. | Cars and motorcycles are both driven at high speeds on the highway. Car drivers aren't required to wear helmets, so motorcycle riders shouldn't have to either. | You can draw an analogy between just about any two objects or ideas. If you are using an analogy, make sure you identify the properties relevant to the argument you are making and see if both share those properties. (In the example, the motorcycle does not provide protection to the rider, but the car does. Equating the two vehicles based on traveling speed is not relevant to the argument.) |
| **False Dichotomy** | Setting up a situation in which it looks like there are only two possible options. If one option is discredited, the other must be accepted. | The classic example here is "America, love it or leave it." | Examine your own thinking. Are there really only two options? Look for the third option. If you were asked to develop a compromise between the two positions, what would it look like? What would its strengths and weaknesses be? |

You will need to use critical thinking throughout your college years and beyond. Here are some common critical thinking situations and the kinds of questions you should ask to apply critical thinking. Note that critical thinking is central to themes covered in detail throughout this book.

- **Personal choices.** Examples include "What should I major in?" and "Should I buy a new car?" What do you know about each of your options? What is the quality of that information? Where can you get more (reliable) information? How do those options relate to your financial and emotional needs? What are the pros and cons of each option? Are you open to the points of view of others who may be involved? (See Chapter 11 "Taking Control of Your Finances" and Chapter 12 "Taking Control of Your Future".)
- **Reading, listening, note taking, and studying.** What are the core messages of the instructor or author? Why are they important? How do these messages relate to one another or differ? (This is covered in much more detail in Chapter 4 "Listening, Taking Notes, and Remembering" and Chapter 5 "Reading to Learn".)
- **Research papers.** What evidence do you need to support your thesis? What sources are available for that evidence? Are they reliable sources? Are there any fallacies in your argument? (This is covered in more detail in Chapter 8 "Writing for Classes".)
- **Essay questions on exams.** What is the professor really asking you to do? What do you know about the question? What is your personal belief about the question? What are the beliefs or biases of the professor or quoted authors? What are the arguments against your point of view? What are the most important pieces of evidence you should offer to support your answer? (This covered in more detail in Chapter 6 "Preparing for and Taking Tests".)

### Tips for Critical Thinking

- Consider all points of view; seriously consider more than two (look for grey areas).
- Keep an open mind.
- Answer three questions about your supporting data:
    1. Is it enough support?
    2. Is it the right support?
    3. Is it credible?
- Look for evidence that contradicts your point of view. Pretend to disagree with the position you are supporting. What parts of your argument are weak? Do you have the supporting facts to overcome that evidence?
- Create a set of criteria you will use to evaluate the strength of information you want to use to support your argument. Ask questions like these:
    - What is the source of this information?
    - Is the author well respected in the field?
    - When was this information developed? Is that important? Why?
    - Does the author or publisher have an agenda for publishing the information? How does that agenda affect the credibility of the information?
- Create a table on which you list your main points, then for each one, list the evidence you have to support it. This method will help you visually identify where you have weak evidence and what points actually lack evidence.
- Be willing to admit that you lack information to support a point of view or make a decision. Ask questions or do some focused research to get what you still need.
- Make sure that your assumptions and points of view are supported by facts, not opinions.
- Learn what types of fallacies you use habitually, and then be on the lookout for them. Writers will often rely on certain types of arguments as a matter of habit. Review some of your old papers to identify which fallacies you need to avoid.
- Question your characterizations of others. Are those authorities truly competent in the area you are considering? Are you attacking the opponents of your point of view rather than attacking their arguments?
- Be careful of broad generalizations. Claims that use absolute words like "all," "none," "always," "never," "no one," and "everyone" require much more proof than claims that use words like "most," "some," "often," "rarely," "sometimes," and so on.

### Where Did That Come From?

One of the most consistent uses for critical thinking in your college work is in considering the value of research material and deciding how to use it. The Internet gives you access to an almost unlimited amount of data, and you must choose what to use carefully. Following are some guidelines.

1. Look at the **URL**, the Web address. It can give you important information about the reliability and intentions

of the site. Start with the page publisher. Have you heard of this source before? If so, would you consider it a reliable source for the kind of material you are about to read? Now consider the domain type in the URL, which follows the period after the publisher: ".com" and ".biz" are used by commercial enterprises, ".org" is normally used by nonprofit organizations, and ".edu" is reserved for educational institutions. None of these is necessarily bad or good, but they may give you a sense behind the motivation for publishing this material. Are you dealing with a company or the Web site of an individual—and how might that affect the quality of the information on that site?

2. What can you learn from poking around with navigation tabs or buttons, and what do they tell you about the objective of the Web site? Look for a tab labeled "About Us" or "Biography."
3. Consider what others are saying about the site. Does the author offer references, reviews, or quotations about the material? What do they say? Check the blogosphere to see what other people think of the author or Web site.
4. Trust your own impressions about the material. Is the information consistent with what you already know?
5. Ask yourself why the Web site was written. (To inform? To provide data or facts? To sell something? To promote a cause? To parody?)

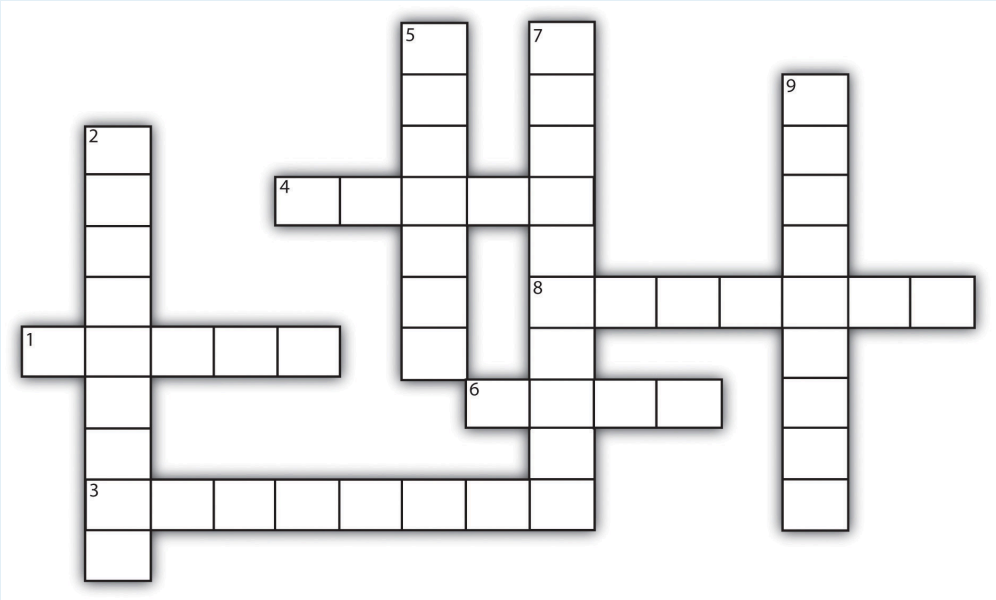
Based on what you learned, ask yourself if the information from this Web site is reliable for your needs. These steps are covered in more detail in Chapter 5 "Reading to Learn".

## Key Takeaways

- Critical thinking is evaluating the strength of your arguments, data, and information.
- Three questions to ask about the support for an argument or position:
    1. Is it enough support?
    2. Is it the right support?
    3. Is it credible?
- Weaknesses in arguments are most commonly logical fallacies. Recognizing them will help evaluate the strength of an argument effectively.

## Checkpoint Exercises

Figure 3.3 Crossword: Full of Fallacies




| Across | Down |
|---|---|
| 1. Fallacy is an error in _____. | 2. Appealing to _____ |
| 3. Also known as the "you too" fallacy | 5. Ad _____; everybody does it |
| 4. False _____; a fallacy based on the order of events | 7. To draw conclusions based on a small sample |
| 6. A tendency or inclination which prevents fair consideration of a point of view | 9. False _____; a fallacy on forced choice between only two options |
| 8. Weak _____; irrelevant comparison | |

# References

McLeod, S., and Karl Fisch, "Did You Know? 4.0," video, http://www.youtube.com/watch?v=6ILQrUrEWe8 (accessed January 10, 2010).

## 3.3 Searching for “Aha!”

**Learning Objectives**

1. Use creative thinking: the competitive advantage in the twenty-first century.
2. Understand the difference between creative thinking and free-form thinking.
3. Practice guidelines for creating ideas.
4. Use rules and directions to create effectively.
5. Understand group creativity: how to conduct effective brainstorming.

America still has the right stuff to thrive. We still have the most creative, diverse, innovative culture and open society—in a world where the ability to imagine and generate new ideas with speed and to implement them through global collaboration is the most important competitive advantage.

Thomas Friedman

Let’s face it: many jobs are subject to outsourcing. The more menial or mechanical the job, the greater the likelihood that there will be someone overseas ready to do the job for a lot less pay. But generating new ideas, fostering innovation, and developing processes or plans to implement them are something that cannot be easily farmed out, and these are strengths of the American collegiate education. Businesses want problem solvers, not just doers. Developing your creative thinking skills will position you for lifelong success in whatever career you choose.

**Creative thinking** is the ability to look at things from a new perspective, to come up with fresh solutions to problems. It is a deliberate process that allows you to think in ways that improve the likelihood of generating new ideas or thoughts.

Let’s start by killing a couple of myths:

- **Creativity is an inherited skill.** Creativity is not something people are born with but is a skill that is developed over time with consistent practice. It can be argued that people you think were “born” creative because their parents were creative, too, are creative simply because they have been practicing creative thinking since childhood, stimulated by their parents’ questions and discussions.
- **Creativity is free-form thinking.** While you may want to free yourself from all preconceived notions, there is a recognizable structure to creative thinking. Rules and requirements do not limit creative thinking—they provide the scaffolding on which truly creative solutions can be built. Free-form thinking often lacks direction or an objective; creative thinking is aimed at producing a defined outcome or solution.

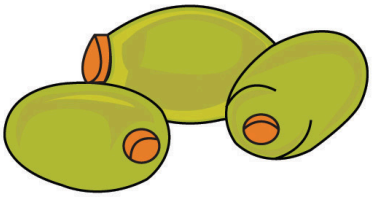
Creative thinking involves coming up with new or original ideas; it is the process of seeing the same things others see but seeing them differently. You use skills such as examining associations and relationships, flexibility, elaboration, modification, imagery, and metaphorical thinking. In the process, you will stimulate your curiosity, come up with new approaches to things, and have fun!

## Tips for Creative Thinking

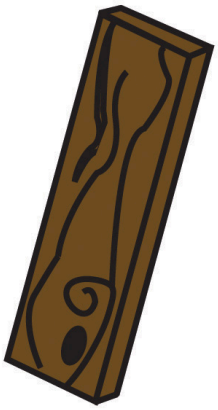
- **Feed your curiosity.** Read. Read books, newspapers, magazines, blogs—anything at any time. When surfing the Web, follow links just to see where they will take you. Go to the theatre or movies. Attend lectures. Creative people make a habit of gathering information, because they never know when they might put it to good use. Creativity is often as much about rearranging known ideas as it is about creating a completely new concept. The more “known ideas” you have been exposed to, the more options you’ll have for combining them into new concepts.
- **Develop your flexibility** by looking for a second right answer. Throughout school we have been conditioned to come up with the right answer; the reality is that there is often more than one “right” answer. Examine all the possibilities. Look at the items in Figure 3.4. Which is different from all the others?

Figure 3.4

a. Apple



b. Olives



c. Board

d. Clams

If you chose C, you're right; you can't eat a board. Maybe you chose D; that's right, too—clams are the only animal on the chart. B is right, as it's the only item you can make oil from, and A can also be right; it's the only red item.

Each option can be right depending on your point of view. Life is full of multiple answers, and if we go along with only the first most obvious answer, we are in danger of losing the context for our ideas. The value of an idea can only be determined by comparing it with another. Multiple ideas will also help you generate new approaches by combining elements from a variety of "right" answers. In fact, the greatest danger to creative thinking is to have only one idea. Always ask yourself, "What's the *other* right answer?"

- **Combine old ideas in new ways.** When King C. Gillette registered his patent for the safety razor, he built on the idea of disposable bottle caps, but his venture didn't become profitable until he toyed with a watch spring and came up with the idea of how to manufacture inexpensive (therefore disposable) blades. Bottle caps and watch springs are far from men's grooming materials, but Gillette's genius was in combining those existing but unlikely ideas. Train yourself to think "out of the box." Ask yourself questions like, "What is the most ridiculous solution I can come up with for this problem?" or "If I were transported by a time machine back to the 1930s, how would I solve this problem?" You may enjoy watching competitive design, cooking, or fashion shows (*Top Chef*, *Chopped*, *Project Runway*, etc.); they are great examples of combining old ideas to make new, functional ones.
- **Think metaphorically.** Metaphors are useful to describe complex ideas; they are also useful in making problems more familiar and in stimulating possible solutions. For example, if you were a

partner in a company about to take on outside investors, you might use the pie metaphor to clarify your options (a smaller slice of a bigger pie versus a larger slice of a smaller pie). If an organization you are a part of is lacking direction, you may search for a "steady hand at the tiller," communicating quickly that you want a consistent, nonreactionary, calm leader. Based on that ship-steering metaphor, it will be easier to see which of your potential leaders you might want to support. Your ability to work comfortably with metaphors takes practice. When faced with a problem, take time to think about metaphors to describe it, and the desired solution. Observe how metaphors are used throughout communication and think about why those metaphors are effective. Have you ever noticed that the financial business uses water-based metaphors (cash *flow*, *frozen* assets, *liquidity*) and that meteorologists use war terms (*fronts*, wind *force*, storm *surge*)? What kinds of metaphors are used in your area of study?

- **Ask.** A creative thinker always questions the way things are: Why are we doing things this way? What were the objectives of this process and the assumptions made when we developed the process? Are they still valid? What if we changed certain aspects? What if our circumstances changed? Would we need to change the process? How? Get in the habit of asking questions—lots of questions.

## Key Takeaways

- Creative thinking is a requirement for success.
- Creative thinking is a deliberate process that can be learned and practiced.
- Creative thinking involves, but is not limited to, curiosity, flexibility, looking for the second right answer, combining things in new ways, thinking metaphorically, and questioning the way things are.

## Checkpoint Exercises

1. **Feed your curiosity.** List five things you will do in the next month that you have never done before (go to the ballet, visit a local museum, try Moroccan food, or watch a foreign movie). Expand your comfort "envelope." Put them on your calendar.
    1. _____
    2. _____
    3. _____
    4. _____
    5. _____
2. **How many ways can you use it?** Think of as many uses for the following common items as possible. Can you name more than ten?

| **Peanut Butter** (PBJ counts as one, regardless of the flavor of jelly) | **Paper Clips** | **Honors Level: Pen Caps** |
|---|---|---|
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3. **A metaphor for life.** In the movie *Forrest Gump*, Forrest states, "Life was like a box of chocolates; you never know what you're gonna get." Write your own metaphor for life and share it with your classmates.

   _____

4. **He has eyes in the back of his head.** What if we really had eyes in the backs of our heads? How would life be different? What would be affected? Would we walk backward? Would we get dizzy if we spun in circles? Would it be easy to put mascara on the back eyes? Generate your own questions and answers; let the creative juices flow!

_____
_____
_____
_____

## References

Friedman, T. L., “Time to Reboot America,” *New York Times*, December 23, 2008, http://www.nytimes.com/2008/12/24/opinion/24friedman.html?_r=2 (accessed January 14, 2010).

## 3.4 Problem Solving and Decision Making

### Learning Objectives

1. Learn to understand the problem.
2. Learn to combine creative thinking and critical thinking to solve problems.
3. Practice problem solving in a group.

Much of your college and professional life will be spent solving problems; some will be complex, such as deciding on a career, and require time and effort to come up with a solution. Others will be small, such as deciding what to eat for lunch, and will allow you to make a quick decision based entirely on your own experience. But, in either case, when coming up with the solution and deciding what to do, follow the same basic steps.

- **Define the problem.** Use your analytical skills. What is the real issue? Why is it a problem? What are the root causes? What kinds of outcomes or actions do you expect to generate to solve the problem? What are some of the key characteristics that will make a good choice: Timing? Resources? Availability of tools and materials? For more complex problems, it helps to actually write out the problem and the answers to these questions. Can you clarify your understanding of the problem by using metaphors to illustrate the issue?
- **Narrow the problem.** Many problems are made up of a series of smaller problems, each requiring its own solution. Can you break the problem into different facets? What aspects of the current issue are "noise" that should not be considered in the problem solution? (Use critical thinking to separate facts from opinion in this step.)
- **Generate possible solutions.** List all your options. Use your creative thinking skills in this phase. Did you come up with the second "right" answer, and the third or the fourth? Can any of these answers be combined into a stronger solution? What past or existing solutions can be adapted or combined to solve this problem?

### Group Think: Effective Brainstorming

**Brainstorming** is a process of generating ideas for solutions in a group. This method is very effective because ideas from one person will trigger additional ideas from another. The following guidelines make for an effective brainstorming session:

- Decide who should moderate the session. That person may participate, but his main role is to keep the discussion flowing.
- Define the problem to be discussed and the time you will allow to consider it.

- Write all ideas down on a board or flip chart for all participants to see.
- Encourage everyone to speak.
- Do not allow criticism of ideas. *All* ideas are good during a brainstorm. Suspend disbelief until after the session. Remember a wildly impossible idea may trigger a creative and feasible solution to a problem.

- **Choose the best solution.** Use your critical thinking skills to select the most likely choices. List the pros and cons for each of your selections. How do these lists compare with the requirements you identified when you defined the problem? If you still can't decide between options, you may want to seek further input from your brainstorming team.

## Decisions, Decisions

You will be called on to make many decisions in your life. Some will be personal, like what to major in, or whether or not to get married. Other times you will be making decisions on behalf of others at work or for a volunteer organization. Occasionally you will be asked for your opinion or experience for decisions others are making. To be effective in all of these circumstances, it is helpful to understand some principles about decision making.

First, define who is responsible for solving the problem or making the decision. In an organization, this may be someone above or below you on the organization chart but is usually the person who will be responsible for implementing the solution. Deciding on an academic major should be your decision, because *you* will have to follow the course of study. Deciding on the boundaries of a sales territory would most likely be the sales manager who supervises the territories, because he or she will be responsible for producing the results with the combined territories. Once you define who is responsible for making the decision, everyone else will fall into one of two roles: giving input, or in rare cases, approving the decision.

Understanding the role of input is very important for good decisions. Input is sought or given due to experience or expertise, but it is up to the decision maker to weigh the input and decide whether and how to use it. Input should be fact based, or if offering an opinion, it should be clearly stated as such. Finally, once input is given, the person giving the input must support the other's decision, whether or not the input is actually used.

Consider a team working on a project for a science course. The team assigns you the responsibility of analyzing and presenting a large set of complex data. Others on the team will set up the experiment to demonstrate the hypothesis, prepare the class presentation, and write the paper summarizing the results. As you face the data, you go to the team to seek input about the level of detail on the data you should consider for your analysis. The person doing the experiment setup thinks you should be very detailed, because then it will be easy to compare experiment results with the data. However, the person preparing the class presentation wants only high-level data to be considered because that will make for a clearer presentation. If there is not a clear understanding of the decision-making process, each of you may think the decision is yours to make because it influences the output of your work; there will be conflict and frustration on the team. If the decision maker is clearly defined upfront, however, and the input is thoughtfully given and considered, a good decision can be made (perhaps a creative compromise?) and the team can get behind the decision and work together to complete the project.

Finally, there is the approval role in decisions. This is very common in business decisions but often occurs in college work as well (the professor needs to approve the theme of the team project, for example). Approval decisions are usually based on availability of resources, legality, history, or policy.

## Key Takeaways

- Effective problem solving involves critical and creative thinking.
- The four steps to effective problem solving are the following:
    1. Define the problem
    2. Narrow the problem
    3. Generate solutions
    4. Choose the solution
- Brainstorming is a good method for generating creative solutions.
- Understanding the difference between the roles of deciding and providing input makes for better decisions.

## Checkpoint Exercises

1. Gather a group of three or four friends and conduct three short brainstorming sessions (ten minutes each) to generate ideas for alternate uses for peanut butter, paper clips, and pen caps. Compare the results of the group with your own ideas. Be sure to follow the brainstorming guidelines. Did you generate more ideas in the group? Did the quality of the ideas improve? Were the group ideas more innovative? Which was more fun? Write your conclusions here.

    _____

    _____

    _____

    _____

    _____

2. Using the steps outlined earlier for problem solving, write a plan for the following problem: You are in your second year of studies in computer animation at Jefferson Community College. You and your wife both work, and you would like to start a family in the next year or two. You want to become a video game designer and can benefit from more advanced work in programming. Should you go on to complete a four-year degree?

    1. Define the problem: What is the core issue? What are the related issues? Are there any requirements to a successful solution? Can you come up with a metaphor to describe the issue?

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        _____

        _____

        _____

_____

2. Narrow the problem: Can you break down the problem into smaller manageable pieces? What would they be?

   _____
   _____
   _____
   _____
   _____

3. Generate solutions: What are at least two "right" answers to each of the problem pieces?

   _____
   _____
   _____
   _____
   _____

4. Choose the right approach: What do you already know about each solution? What do you still need to know? How can you get the information you need? Make a list of pros and cons for each solution.

   _____
   _____
   _____
   _____
   _____

## 3.5 Chapter Activities

**Chapter Takeaways**

- Your ability to think critically and creatively is a key to your success in college and in life. You should develop and practice these skills.
- Bloom's taxonomy provides a framework to describe the many kinds of thinking we need to do. Up to this point, you probably have practiced most of the lower-level thinking skills but have not had much experience with the higher-level skills (critical thinking and creative thinking).
- Critical thinking involves evaluating the strength of ideas or concepts by asking questions about them. Critical thinking will also allow you to identify and weed out logical fallacies that weaken the value of an idea.
- Creative thinking is the process of generating new ideas, concepts, or solutions. This often involves adapting existing ideas or combining them in new ways to create a new solution.
- Problem solving is effectively achieved by applying both critical thinking and creative thinking to generate viable solutions and decisions.

### Chapter Review

1. List the six levels of thinking described in Bloom's taxonomy.

   _____

   _____

   _____

   _____

   _____

   _____

2. Which thinking skill is most important for short answer quizzes? Why?

   _____

   _____

3. List five verbs that describe the application level of thought.

   _____

   _____

4. What thinking skills are you using if you are blogging? How do you use each one?

   _____

   _____

_____

_____

5. What is critical thinking?

_____

_____

6. Why is it important to pose some questions about the source of the material you read? What kinds of questions should you ask?

_____

_____

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_____

7. What is a logical fallacy? Give an example of two types.

_____

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8. List six words that signal a broad generalization and a recommended alternative that would resolve that problem of each.

_____

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_____

9. What are some ways in which you can feed your curiosity?

_____

_____

10. Why is brainstorming more effective at generating new ideas than individual work?

_____

_____

11. List the four steps of problem solving.

    1. _____
    2. _____
    3. _____
    4. _____

12. How do you use critical thinking and creative thinking in solving problems?

_____

_____

## Make an Action List

| Two things I will do to practice | Action | By when I expect to take the action | The expected results of that action |
|---|---|---|---|
| My critical thinking | 1. | | |
| | 2. | | |
| My creative thinking | 1. | | |
| | 2. | | |
| My problem solving | 1. | | |
| | 2. | | |