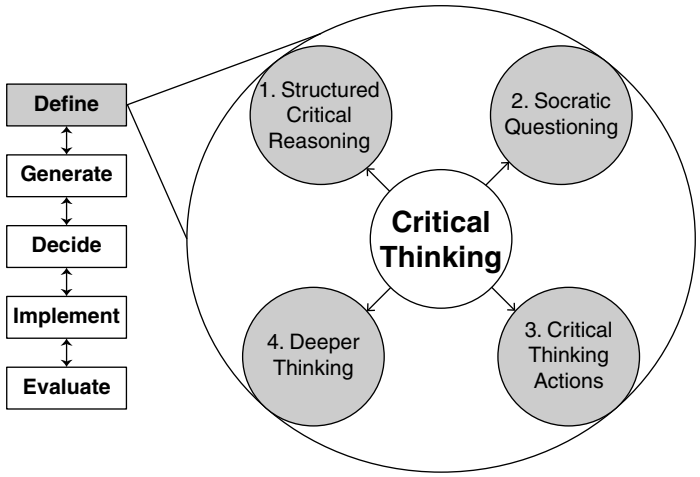
3 SKILLS NECESSARY FOR EFFECTIVE PROBLEM SOLVING



CRITICAL THINKING

Critical thinking is the process we use to recognize underlying assumptions, scrutinize arguments, question problem statements and solutions, and interpret and assess the accuracy of information. Critical thinking involves objectivity, analysis, evaluation, and drawing conclusions in a structured and well-reasoned way. Critical thinkers are persistent in their search for evidence and implications of a viewpoint, and they evaluate the strengths and weaknesses of the evidence. They continually ask probing questions of themselves and others.

Critical thinking is one of the most important skills you can possess and is vital to good problem solving. This skill is applicable in everything you do, whether it's related to work, friends, family, or any other area of your life. Critical thinking can help you to define and solve real problems, to ask the right questions, to decide if a proposition or solution is valid, or to suggest a path forward for an important issue.

There are a number of great books devoted entirely to critical thinking, which we cannot possibly distill here. What we do hope to do is to provide a few central fundamental ideas and useful techniques and exercises that you can use to develop and practice critical thinking skills. The two areas we will focus on are (1) **structured critical reasoning (SCR)**, a critical thinking algorithm used to analyze a document, proposition, or problem solution, and (2) **Socratic questioning**, a way

to ask the right questions in order to distinguish the real problem from the stated or perceived problem.

Structured Critical Reasoning

The algorithm we will use to analyze a proposition, thesis, and so on is sometimes called structured critical reasoning (SCR) and has been used to unravel even the most complex arguments.

The sequence of the SCR analysis is to identify the following:

- Conclusions
- Evidence
- Assumptions
- Strengths and weaknesses of each assumption
- Fallacies in logic

The SCR algorithm for this sequence is based on the work of Browne and Keeley[1] and is expanded in the following table.

Structured Critical Reasoning

Step 1. Identify all of the author's conclusions.

A conclusion is a statement or idea in a document or speech that the writer or speaker wants you to accept. Make a list of all the conclusions in the document/proposition/presentation. When looking for the conclusion, ask yourself first "What are the issues?" To rapidly identify the conclusion, Browne and Keeley[1] suggest looking for indicator words such as *therefore, consequently, which leads us to, proves that, the point is*, and so on in the written statement or presentation you are given.

Step 2. Look for the reasons and evidence the author uses to support each conclusion.

There is an important distinction between reason and evidence.

Reasons are *internal evaluations* that can be based on facts and data but are not necessarily well substantiated. Many times, reasons are based on feelings, personal experiences and observations, intuitions, or beliefs such as "I think this statement is true because …" Reasons are often put forth as evidence and it is up to the analyzer to decide if they are valid.

Evidence is based on *external evaluations*, such as facts, data, laws, observations, case examples, or research findings. All evidence are reasons, but not all reasons are evidence.

For each conclusion make a list of all evidence that has been given that you think supports the conclusion. How strong is each piece of evidence? Does the evidence support the conclusion? What evidence would cause you to reject the conclusion? Is there a general lack of evidence or has significant information been omitted?

Step 3. List all major assumptions.

An assumption is a belief we use to support the evidence. Make a list of the assumptions in each piece of evidence. Look for hidden or unspoken assumptions (e.g., "A company designs a new pencil that will stay sharper much longer than all competing pencils so they project big sales in the first year"). The assumptions might be that customers will want to buy the pencil just because it stays sharper longer than other pencils; that the competition is not also launching a new pencil that will stay sharper longer; and that demand for pencils will not drastically fall in the next year. A hidden assumption is that the new erasable ink pens will not affect the market for the new pencils.

An employee reported to his supervisor that his work team was not functioning well. He spoke generally about friction between members of the team. The supervisor stated that she would look into it. She noted that just prior to the complaint a new member had been added to the team. Her hidden assumption was that, since the complaint and the new member's arrival coincided, there must be a connection. She transferred the new member to a different team and was surprised when the workgroup continued to have friction and communication problems.

Step 4. Evaluate all the assumptions and evidence.

Each assumption must be evaluated to determine whether it is strong or weak and whether it is relevant to the conclusion. If assumptions are irrelevant, or contain contradictions, and/or contain fallacies they likely do not provide support for the conclusion. All assumptions are hypotheses, and it is up to the evaluator to put forward his or her best judgment as to whether or not the assumptions are good or questionable. If you become stuck evaluating an assumption, list all the pros and cons for accepting the hypotheses and then make a decision. A balance must be struck between scrutinizing assumptions and making progress in the analysis.

Step 5. Identify fallacies in logic.

The following table gives 11 common fallacies to look for when evaluating the assumptions used in supporting the evidence and the conclusions. In some instances more than one fallacy can apply to the situation.

Eleven Fallacies in Logic to Look For

1. **Ambiguous or vague words or phrases:** Uses words, phrases, or sentences that have multiple interpretations or really don't say anything.

   "*The model is in close agreement with the data.*" What does the word "close" mean? What is the measure of a "*close agreement*"? Within 10%? 50%?

2. **Citing a questionable authority:** Gives credibility to someone who has no expertise in the area.

   John agrees with me that drinking energy drinks are bad for you. What makes John an expert on the perils of drinking energy drinks? John could be an expert dietician studying the subject or he may have no basis for knowing anything about the effects of energy drinks on the body other than an uneducated opinion.

3. **Straw person:** Discredits an exaggerated version of an argument.

   Recent auto accidents in your neighborhood have led you to propose to the city council that the speed limit along Main Street be reduced to calm the traffic flow. Opponents complain that reducing speed limits all over town is counterproductive and an unnecessary burden on drivers.

   The straw person argument here is the expansion of your proposal from "a lower speed limit on one street" to "speed limits all over town." The acknowledgment of this new alternative argument deflects the focus from your true proposal.

4. **False dilemma (the either-or):** Assumes the choices stated by the author are the only ones that exist, or generally constrains the scope of a discussion to force a point.

   At a recent cocktail party, the conversation has turned to family pets, and your friend asks you "Are you a cat or a dog person?" Your choices here have clearly been limited to two, when in reality there are many others: you may have no interest in pets at all, you may be a bird person, or you may enjoy cats and dogs equally.

5. **Red herring:** Introduces an irrelevant topic to distract the conversation from the main point.

   You call your cell phone provider to complain about how poor your cell phone battery life is after the recent software update. The representative, instead of responding to your concern, praises the provider's new unlimited text-messaging plans that are due to be released in the next month.

Your phone's battery life will not be improved by being able to send more text messages.

6. **Slippery slope:** Assumes that if this fact is true then everything else follows.

   A father talking to his daughter on dating a boyfriend he doesn't like says, "If you continue dating this guy who doesn't take his education seriously, you'll end up dropping out of school, you then won't be able to get a job, and you will get married too young."

   Dating someone who doesn't take education seriously does not mean the daughter will drop out of school herself, marry early, and be unemployable.

7. **Appeals to popularity:** Justifies an assumption by stating that large groups have the same concern or that anything favored by a large number of people is desirable.

   An opinion article in a campus newspaper states that in an all-campus survey 95% of students think that tuition should be lowered and therefore tuition should be lowered immediately.

   The students are biased because they have to pay tuition and are not inclined to think of the budget problems that would be caused if the school lowered tuition for all students.

8. **A "perfect" solution:** Assumes that if a part of the problem is not satisfied or solved (even a small part), then the entire solution should be abandoned.

   "Don't waste your money on a home security system; master thieves will still be able to get into your house."

   However, many thieves may be deterred by a security system.

9. **False, incomplete, or misleading facts or statements:** Presents data in such a way that it falsely leads someone to the wrong conclusion.

   "Because 90% of college students polled had no debt, education costs are not a problem."

   It's possible that only 10 college students were polled or the poll was taken at a banquet for scholarship students.

10. **Causal oversimplifications:** Explains an event by attributing it to a single factor, when many factors are involved or by overemphasizing the importance of a single factor.

Continues

At a party you overhear a friend tell her spouse, "I had high blood pressure at the doctor's office today; I really need to reduce the stress in my job."

This friend is obviously attributing the high blood pressure reading to job-related stress, while there may be many additional contributing or more important factors (lack of exercise, poor diet, genetic predisposition, white-coat syndrome, etc.).

11. **Hasty generalizations:** Draws a conclusion about a large group based on the experiences of a few members of the group.

    All engineers are introverts who would rather relate to computers than people. All football players are dumb jocks.

    Clearly there are many engineers who are outgoing and football players who are very intelligent. It is very dangerous to make sweeping generalizations regarding a group based on limited experience.

Bias and Lack of Information

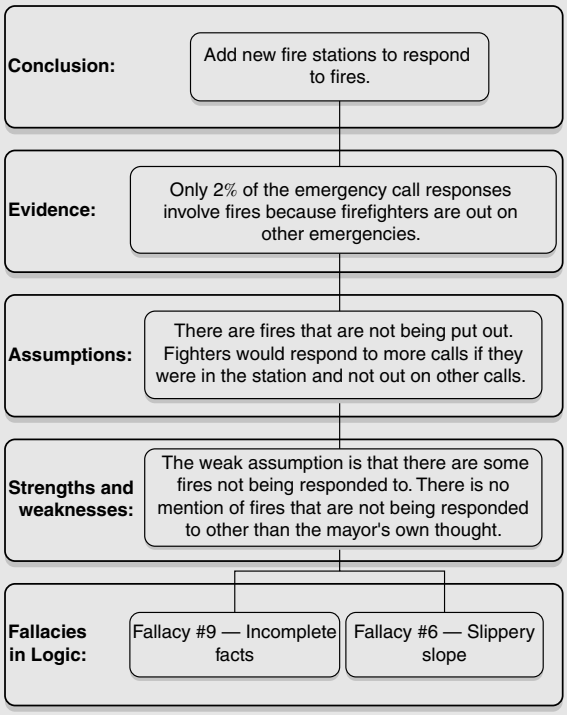
The structured critical reasoning (SCR) heuristic offers a solid foundation upon which to deconstruct *presented* arguments for validity. However, it is also important to recognize what is not presented. Often individuals will omit significant information about an argument in order to make the answer overwhelmingly clear. This can be done because the individual is biased to one side of an argument and knowingly only presents supporting evidence or because that person has a general lack of knowledge of the argument. Regardless of cause, lack of information is important to be aware of as you apply the SCR algorithm. A few ways to check for bias and lack of information are to ask what evidence you think should be required to support a given conclusion, to look into the author's background, or to find information about the topic from a variety of sources to see what evidence is presented.

Now, let's apply SCR. We begin with a confused mayor in California.

Fighting Fires?

In Orange County, California, only 2% of firefighter emergency responses involve fires; the rest are car accidents, fender benders, bicycle accidents, and other small medical emergencies. This unnecessary deployment of firefighters wastes money by sending gas-guzzling fire trucks and full fire crews to situations where they are not needed. The mayor responds to the data by stating that because firefighters are out at the streets on nonfire emergencies, they may not be available to respond to fires in the county. He recommends that new fire stations and detection systems be implemented throughout the region to be available to respond to county fires.

Let's apply SCR to the situation to see if the mayor's conclusion is valid.



It is clear that the mayor's conclusion to add new fire stations is not well supported because the evidence relies on a weak assumption with fallacies in logic. The mayor's solution is Fallacy #6 (slippery slope): if we were to believe that there are fires that are not being responded to, then his solution of more fire stations makes sense. There is incomplete information (Fallacy #9) here as the mayor does not know that there are fires not being responded to. As is sometimes the case, we find two fallacies in logic in the mayor's conclusion. We continue with a more complex example examining an opinion article from a London newspaper.

SCR: Truancy in U.K. Schools

Carry out an SCR analysis of the following synopsis of an article written by a British teacher with 20 years of experience.

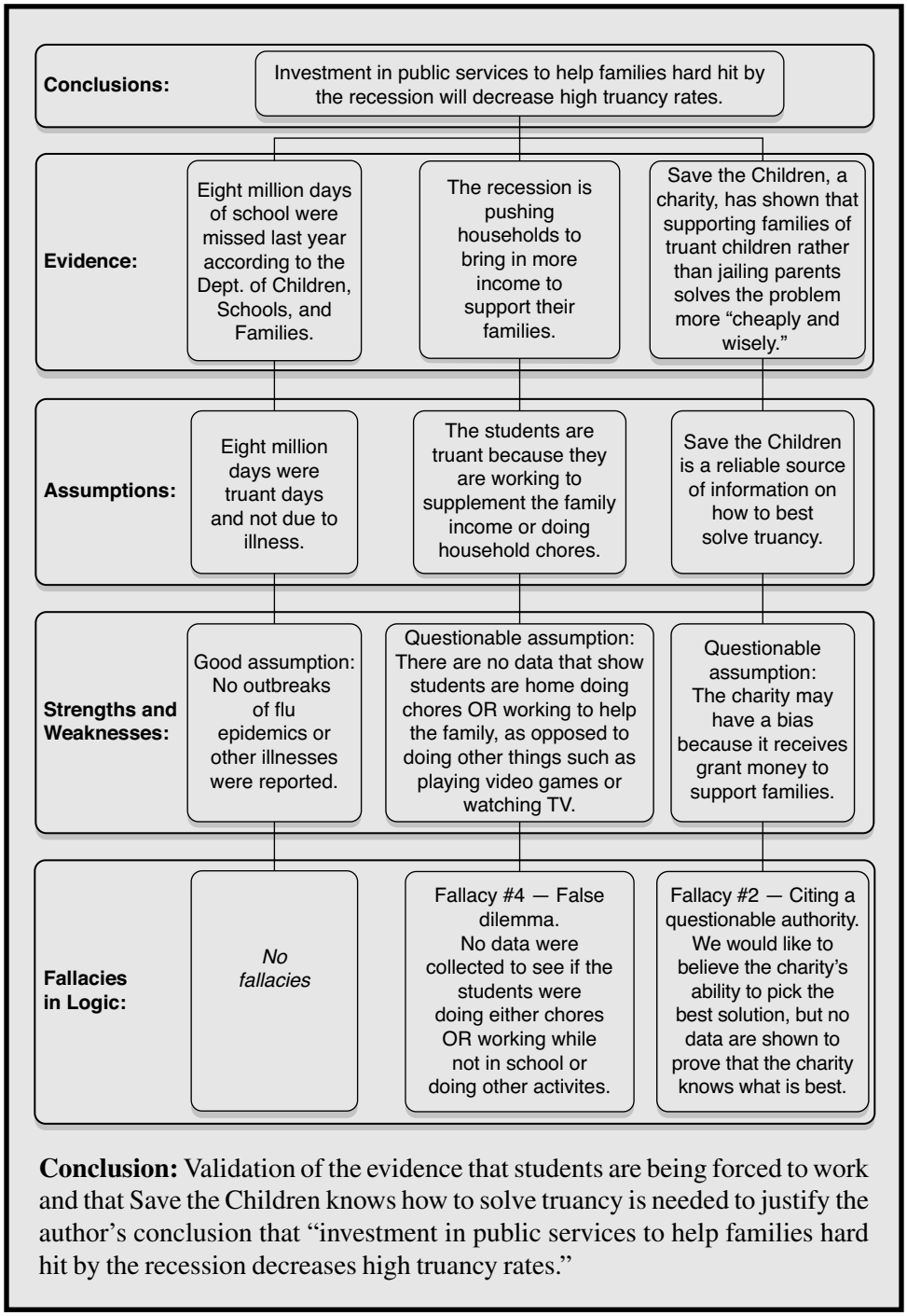
Help recession-hit families to decrease truancy: Soaring truancy rates in the United Kingdom are not surprising to teachers like me. Figures from the Department for Children, Schools, and Families show that children skipped more than eight million days of school last year. There are many reasons for the rising number of truants, but I think there is one big underlying reason: the recession is really beginning to bite in many households.

In the United Kingdom, four million children live below the poverty line, and that number is rising. Charities, such as Save the Children, are seeing families of four trying to feed themselves on 20 to 25 British pounds a week. That means that many children are living in households under severe stress, frequently working illegally or carrying out household chores for parents who need them at home. One student I taught some time ago wound up spending quite a few days at home taking care of her younger brother and sister while her mom went out to work. She skipped school at the insistence of her mother.

The statistics show that these cases are more and more common and now, unlike in previous years, increasing numbers of parents are being jailed for having truant children. Ministry of Justice figures released this year reveal that the number of court-issued penalty notices went up by 12% last year to 7,793. It is clear that families are being torn apart by truancy.

Rather than addressing the root causes of truancy, the government is too keen to criminalize desperate parents. Work by charities such as Save the Children shows that when needy families with truant students are helped properly, the truancy issue can be solved much more cheaply and wisely than by incarcerating a child's main caregiver. Proper investment in public services for recession-hit families is vital for decreasing truancy rates.

Source: www.guardian.co.uk/commentisfree/2009/oct/21/education-bullying-truancy-recession-care.



Conclusion: Validation of the evidence that students are being forced to work and that Save the Children knows how to solve truancy is needed to justify the author's conclusion that "investment in public services to help families hard hit by the recession decreases high truancy rates."

The conclusion of this article is the idea that is found both at the beginning and end of the author's statement: Investment in public services to help families who are hard hit by the recession will decrease high truancy rates.

By looking for evidence, we find three main points. In the first paragraph the author says that truancy rates are soaring to convey the idea that there is a lot of truancy. In the second paragraph the idea is presented that students are being forced to work because of the recession, causing truancy. In the third and fourth paragraphs, we read that jailing parents is not working and instead we should invest in social services.

On page 49 we put the conclusion and these three pieces of evidence in flowchart form and continue our analysis by examining the assumptions in the evidence, the strengths and weaknesses of the assumptions, and, finally, the fallacies in logic.

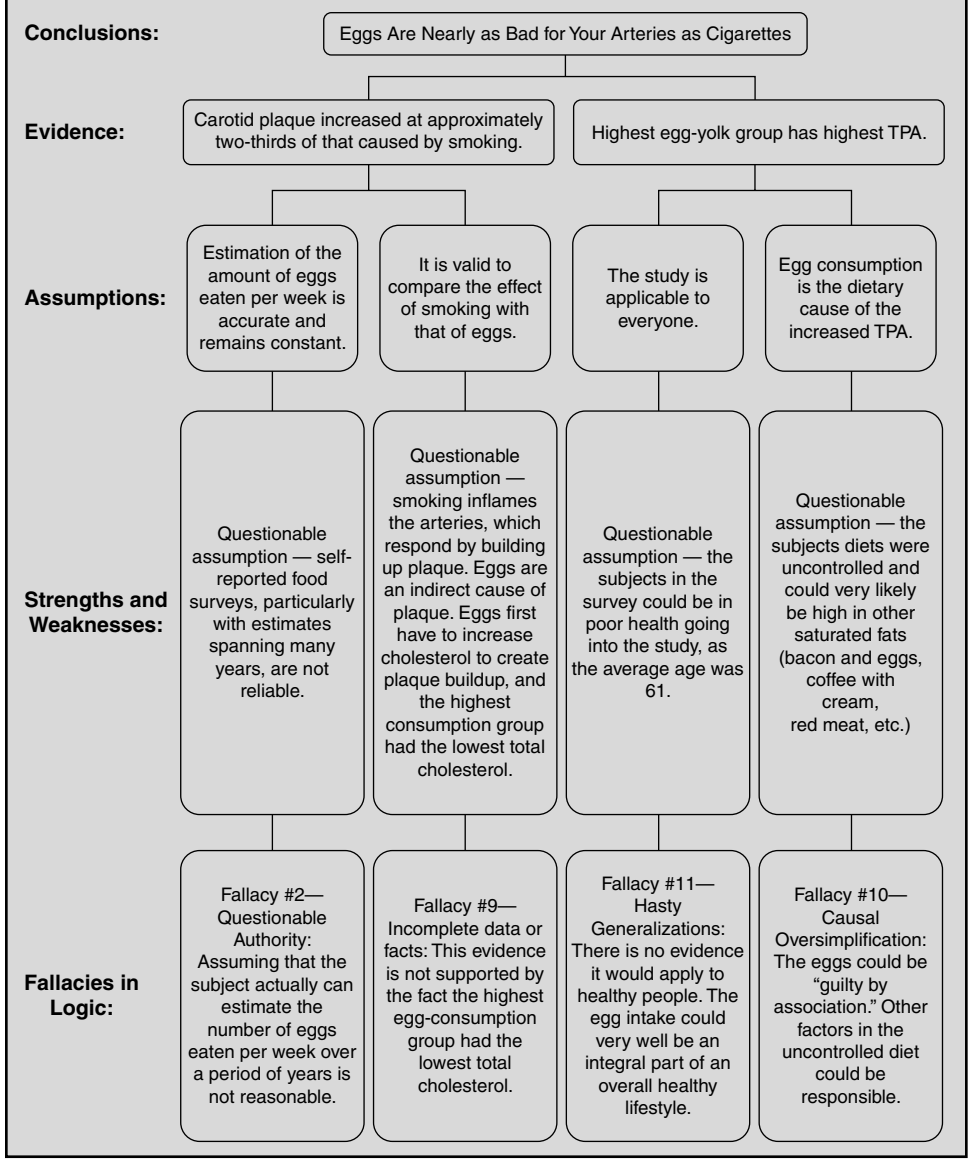
SCR: A Public Health Hazard—Eggs[2]

Carry out an SCR analysis of the following synopsis of some articles written about a recent study examining the health effects of eggs.

A recent study performed by Canadian medical researchers on the health effects of eggs has caused quite a stir. They compared the cardiovascular risks associated with eggs to that of smoking. This led to a series of news reports with sensationalized titles like "Eggs Are Nearly as Bad for Your Arteries as Cigarettes" and "Are Eggs the New Cigarettes?" The study involved approximately 1,200 subjects about equally split between men and women who were being treated for cardiovascular diseases. The average age was 61. On their first visit to the Canadian vascular prevention clinics, the subjects were surveyed for some baseline characteristics, including blood cholesterol, blood pressure, and body mass index, and their total carotid plaque area (mm^2), TPA, was measured ultrasonically. Personal habits were also tabulated with a lifestyle survey at the initial visit. Egg consumption and smoking behavior were estimated by the subjects. For egg consumption, if a subject said he or she consumed two eggs per week for the past 50 years, a "score" of 100 egg-yolk years was given. Similarly, smoking was estimated by the number of packs per day times the number of years the individual was a smoker (30 years as a smoker of 0.5 packs per day = 15 pack-years). Alcohol consumption and exercise were not taken into account because the textual responses were too hard to quantify

("quit drinking six years ago" and "plays golf twice a week"). The study concluded that the effect of egg consumption was approximately two-thirds of the deleterious effect produced by smoking on cardiovascular health because the TPA increased for egg-yolk years at two-thirds of the rate it did for pack-years. Interestingly, the group with the highest egg-consumption (average age, 69.77; egg-yolk years greater than 200 years) had the lowest total cholesterol and the lowest body mass index but the highest TPA of all the groups surveyed.

Answer



Applying SCR: Examining Information

The previous examples have demonstrated how to deconstruct a conclusion presented to you in written form, and the same process applies when you listen to an argument. You simply process the information as it is being said rather than reading. It is often advantageous to take notes and construct an SCR analysis during a presentation in order to find weak assumptions and fallacies in logic. You can practice this by watching TV pundits speak on their views. Ask yourself, "What are the conclusions being drawn?" and then look for evidence, assumptions, strengths of assumptions, and fallacies in logic.

Applying SCR: Presenting Information

We move now to constructing your own positions using SCR. There are two ways we will consider presenting information: verbally and in written form. Both follow the same process. Begin by examining all information available and then draw your conclusions. Next, organize your evidence to support your conclusion, making sure you use referenced facts, a variety of reputable sources, and strong assumptions with no fallacies in logic in order to gain validity. Once you have your information organized, you can communicate it orally or in written form simply by following the flow of information you created with the SCR. This process can be used in essay writing, sales, debate, and more. When open to bias as previously mentioned (lack of information, one-sidedness), this process will ensure you construct a thorough analysis of your positions. It is also possible to move this information into paragraph or presentation form. Moreover, SCR can be used to examine topics on which no irrefutable conclusion can be drawn. Policy, politics, and more are all up for debate but it is still possible to choose a strong position with SCR. Examine all evidence available and draw your best conclusion. Even if your SCR is not flawless, you will understand the areas an argument is lacking: weak assumptions and xfallacies in logic.

Socratic Questioning

Asking the right questions in a presentation, meeting, or conversation to get at the heart of an issue is a skill that sets critical thinkers apart from others. Asking critical thinking questions (CTQs) in these situations will put you in a strong leadership position in your organization. This skill of asking the right questions can be learned and practiced with Socratic questioning. *Socratic questioning lies at the heart of critical thinking*. When you are given a problem or problem statement rather than discovering it yourself, it is important that you make sure the problem you were given accurately reflects the true situation. Asking Socratic questions will help you ferret out the real problem. It helps identify the boundaries of the problem and helps you learn if you are getting to the heart of the problem as you continue to question.

Our studies on problem-solving techniques in industry revealed that one of the major differences between experienced, successful problem solvers and novice problem solvers is their ability to ask questions that go to the heart of the problem. Experienced solvers tend to interview as many people as necessary that might

possess useful information about the problem and to use critical thinking to reflect on, assess, and judge the assumptions underlying the information they collect. We will use R. W. Paul's six types of Socratic questions[3] to explore the proposed problem statement and/or a question that has been asked. While many types of Socratic questions exist, we have selected six types to apply in the following critical thinking questions (CTQs) examples shown in the right-hand side of the table. For a more complete listing, refer to the Web site's Summary Notes for this chapter.

Six Types of Socratic Questions and Examples of CTQs

1. Questions about the question or problem statement The purpose of this question is to find out why the question was asked, who asked it, and why the question or problem needs to be solved.	• What was the point of this question? • Why do you think I asked this question? • Why is it important you learn the answer to that question? • How does that question relate to our discussion? • Where did the problem originate?
2. Questions for clarification The purpose of this question is to find missing or unclear information in the problem statement question; identify multiple interpretations and ambiguous words and phrases.	• What do you mean by _____? • Why do you say that? • What do we already know about that? • Could you explain further? • Could you put that another way?
3. Questions that probe assumptions The purpose of this question is to find out if there are any hidden, misleading, or false assumptions.	• What could we assume instead? • How can you verify or disapprove that assumption? • Explain why_____. (Explain how_____.) • What would happen if _____? • What are the strengths and weaknesses of that assumption?
4. Questions that probe reasons and evidence The purpose of this question is to explore whether facts and observations support an assertion or conclusion.	• What would be an example that supports the evidence? • What are you assuming to be true when you say this is evidence? • What do you think causes _____? Why? • What evidence is there to support your conclusion? • Have you examined the evidence for any fallacies in logic?

Continues

Six Types of Socratic Questions and Examples of CTQs (*Continued*)

5. Questions that probe viewpoints and perspectives The purpose of this question is to learn how things are viewed or judged and consider things not only in a relative perspective but also as a whole.	• What is a counterargument for _____? • What are the strengths and weaknesses of that viewpoint? • What are the similarities and differences between your point of view and someone else's point of view? • Compare _____ and _____ with regard to _____. • What is your perspective on why it happened?
6. Questions that probe implications and consequences The purpose of this question is to help understand the inferences or deductions and the end result if the inferred action is carried out.	• What are the consequences if that assumption turns out to be false? • What will happen if the trend continues? • Is there a more logical inference we might make in this situation? • How are you interpreting her behavior? Is there another possible interpretation? • Could you explain how you reached that conclusion? • Given all the facts, is that really the best possible conclusion?

When applying the example questions on the right-hand side of the above table, make them as specific as possible to the problem at hand. Make it clear which assumption or viewpoint you are challenging as is done in the following example about a new energy drink.

Concerns about a New Energy Drink

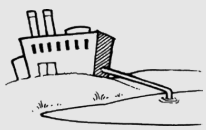
A new energy drink is on the market that combines vitamins with staying-alert power, while other energy drinks contain no vitamins. The company said the new drink had all the daily requirement of vitamins needed to stay healthy and feel energized. The drink's ability to keep people awake works especially well for college-age adults and pretty well for older adults. A study shows no harmful effects were observed in the vast majority of test subjects. While slightly more expensive than the other energy drinks, it is affordable to those who need it.

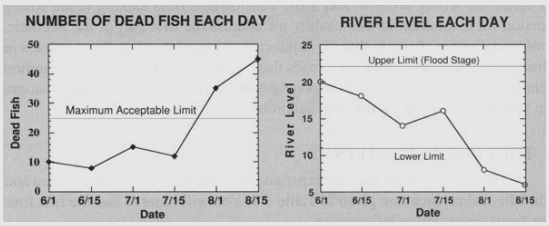
1. **Questions about the question/problem statement:**
   Why do we need to add to the cost by adding vitamins to the energy drink?
   Is there room in the market for another energy drink?
   How many of the test-market cases caused a harmful effect and what was the effect?
2. **Questions for clarification:**
   Here we see a number of ambiguous words or phrases:
   How are you defining "staying-alert" power?
   What "harmful effects" did the study look for?
   What does "feel energized" mean?
   What is a "vast majority"?
   What does "slightly more expensive" mean?
   What is "well affordable"?
3. **Questions that probe assumptions:**
   What would happen if consumers don't see a cost-effective advantage to the added vitamins?
   Will consumers believe that the new drink is safe because the "vast majority" suffered no harmful effects?
   Do consumers perceive that they need another source of vitamins?
   Can you explain why you think consumers will be willing to pay the cost differential for the new drink?
4. **Questions that probe reasons and evidence:**
   What marketing data suggest that the consumer will want vitamins in the drink?
   What evidence is there that the consumers are getting greater benefits from the new drink?
5. **Questions that probe viewpoints and perspectives:**
   What are the most positive and negative consequences of bringing the new energy drink to market?
   What are the similarities and differences with drinks currently on the market?
   What are the advantages and disadvantages of the product over products now on the market?
6. **Questions that probe implications and consequences:**
   Why is the drink not as effective in energizing older adults?
   Are there any dangers of taking vitamin supplements every morning?

Before moving on to critical thinking actions, let's look at the following reconstruction of a case history of a real-life example where Socratic questioning was used to uncover the real problem.

Dead Fish

Application of Critical Thinking Using Socratic Questioning





Chris Shannon is a waste treatment manager with eight years of experience with the company. One day the section head comes into Chris's office and says, "We need to design a new waste treatment plant to reduce the toxic waste stream flowing into the river by a factor of 10." Chris carries out a quick back-of-the-envelope calculation and realizes that the plant could cost several million dollars. Chris is really puzzled because the concentrations of toxic chemicals have always been significantly below governmental regulations and company health specifications that are even stricter than the recommendation of the Environmental Protection Agency. Has Chris been given a real problem or a perceived problem to solve?

Let's apply CTQs to this situation.

1. **Chris begins with a question about the question:**

   Q. Chris asks his supervisor, "Where did the problem originate?"
   A. His supervisor says it came from bad publicity in the newspapers.

2. **Chris knows that someone in the company must have read the newspaper for the company to be acting on the problem and asks a question for clarification:**

   Q. He asks his supervisor, "Who posed the problem in the first place?"
   A. The supervisor says, "Upper management."

3. **Chris thinks that the newspaper might not have included all the facts and asks a question that probes assumptions:**

   Q. Chris asks his supervisor, "Can you explain the reasoning management used to arrive at the problem statement?"
   A. The supervisor explains that fish are dying because of the low water level caused by an ongoing drought. Toxic chemicals become more concentrated—and hence more toxic—when the discharge is the same but the water level is lower.

4. **Chris wants to know how strong the assumption is about the fish dying due to toxic chemicals and asks a question that probes reasons and evidence:**

   Q. Chris asks whether the concentration of chemicals in the river is approaching the LD50 level (meaning that 50% of the fish will die at this concentration).

   A. Chris is informed that the concentration in the river was not measured.

5. **If the LD50 level is not being reached, Chris thinks the assumption that the fish are dying due to a toxic level of chemicals is weak. Chris calls a biology professor at a state university and asks a question about viewpoints and perspectives:**

   Q. Chris asks the professor, "Is there is an alternative explanation as to why the fish are dying?"

   A. The professor explains that the low water levels and higher water temperatures make fish more susceptible to disease—perhaps fungi in this case.

6. **Chris wonders whether there are other locations in the area where fish are dead or sick, such as upstream of the plant or in surrounding lakes and rivers where the toxic chemicals are not present. Chris calls the state Department of Natural Resources (DNR) and asks a question that probes implications and consequences:**

   Q. Chris asks the DNR, "Have the fish upstream of the plant or in surrounding lakes and rivers where the toxic chemicals were not present been dying?"

   A. A government official at the DNR says dead fish have been found upstream of the plant and in nearby lakes.

7. **Chris nows knows that there is no way the toxic chemicals could diffuse upstream of the chemical plant or get into surrounding lakes. Chris asks a question that probes reasons and evidence:**

   Q. Chris asks the DNR, "Did the dead fish tested show any fungi or strange bacteria?"

   A. The DNR replies to say that the fish were infected with fungi in both the river and the lakes.

Keep digging to learn the motivation (who, why) for issuing the instructions to solve the perceived problem.

Epilogue

Chris's company was grateful that the real problem had been uncovered and that they did not go ahead and try to solve the perceived problem by building the multimillion-dollar plant. In regard to solving the problem about the fungi that are causing the fish to die, the company will leave that to the DNR.

Another component of critical thinking is the actions that one takes. Rubenfeld and Scheffer[4] list seven types of **critical thinking actions**, shown in the following table.

Types of Critical Thinking Actions	Examples of Critical Thinking Actions
1. Predicting: envisioning a plan and its consequences	I could imagine that happening if I . . . I anticipated … I was prepared for … I made provisions for … I envisioned the outcome to be … My prognosis was … I figured the probability of … I tried to go beyond the here and now …
2. Analyzing: separating or breaking a whole into parts to discover their nature, function, and relationships	I dissected the situation … I tried to reduce things to manageable units … I detailed a schematic picture of … I sorted things out … I looked for the parts … I looked at each piece individually …
3. Information seeking: searching for evidence, facts, or knowledge by identifying relevant sources and gathering objective, subjective, historical, and current data from those sources	I made sure I had all the pieces of the picture … I knew I needed to look up, or study … I wondered how I could find out … I asked myself if I knew the whole story … I kept searching for more data … I looked for evidence of … I needed to have all the facts …
4. Applying standards: judging according to established personal, professional, or social rules or criteria	I judged that according to … I compared this situation to what I knew to be the rule … I thought of/studied the policy for … I knew I had to … There are certain things you just have to account for … I thought of the bottom line that is always … I knew it was unethical to …

5. Discriminating: recognizing differences and similarities among things or situations and distinguishing carefully as to category or rank	I grouped things together … I put things in categories … I tried to consider what was the priority of … I stood back and tried to see how those things were related … I wondered if this was as important as … I thought of the discrepancies in the study … What I heard and what I saw were consistent/inconsistent with… This situation was different from/the same as …
6. Transforming knowledge: changing or converting the condition, nature, form, or function of concepts among contexts	I wondered if that would fit in this situation … I took what I knew and asked myself if it would work … I improved on the basics by adding … At first I was puzzled; then I saw that there were similarities to … I figured if this was true then that would be too.
7. Logical reasoning: drawing inferences or conclusions that are supported in or justified by evidence	I deduced from the information that … I could trace my conclusion back to the data … My diagnosis was grounded in the evidence … I considered all the information and then inferred that … I could justify my conclusion by … I moved down a straight path from the initial data to the final conclusion … I had a strong argument for … My rationale for the conclusion was …

Let's now apply Rubenfeld and Scheffer's[4] seven critical thinking actions to expand on the case of the dead fish.

Critical Thinking Actions

1. Predicting: envisioning a plan and its consequences

Chris **envisioned** that the proposed plant would cost millions of dollars and wanted to make sure that such an expenditure would solve the perceived problem.

Continues

2. **Analyzing:** separating or breaking a whole into parts to discover their nature, function, and relationships

Chris examined the available data presented by his supervisor and **sorted out** the relevant information and facts from perceptions to find that it was the newspaper data and not actual measurements of contamination that prompted the order of the new waste treatment plant.

3. **Information seeking:** searching for evidence, facts, or knowledge by identifying relevant sources and gathering objective, subjective, historical, and current data from those sources

Chris **contacted** the biology professor to learn possible causes for the dead fish problem.

4. **Applying standards:** judging according to established personal, professional, or social rules or criteria

Chris attempted to find out if the concentration of toxic chemicals in the river was above the **standard LD50**.

5. **Discriminating:** recognizing differences and similarities among things or situations and distinguishing carefully as to category or rank

Chris analyzed the fish kill data and **grouped them according** to **location**. Chris determined that the other locations in which fish are dying could not be affected by the plant's discharge. Chris questioned whether the fish in all the locations were dying from the same cause.

6. **Transforming knowledge:** changing or converting the condition, nature, form, or function of concepts among contexts

Chris recalled news items in the past where fish and other forms of water life have been harmed solely by natural causes and **wondered if that might apply to the current situation**. Chris contacted the state biologist. She informed him that fungi had indeed been found in several areas of water that were reporting high levels of fish dying and that this, coupled with the recent weather conditions, could be killing off the fish.

7. **Logical reasoning:** drawing inferences or conclusions that are supported in or justified by evidence

Chris **deduced** that it was possible that the fish are dying in the river owing to a fungal infection, rather than because of high levels of toxic chemicals.

Deeper Thinking

Don't close your mind just because you think you have found a good solution.[5] Although the first solution may appear to solve the problem, you must resist the temptation to blindly implement the solution. It is necessary to be aware of unintended consequences that can crop up: the hidden assumptions or additional alternatives that may present themselves before or during implementation of the solution. The following is a real-life example that illustrated the need to apply critical thinking actions and Socratic questions (CTQs) through the problem-solving process.

On the job, it is important to not get stuck in an infinite loop of constantly second-guessing your solutions to the point where no progress is ever made. However, as the case study shows, deeper thinking can save time and energy by bringing up potential pitfalls before they arise. Even when pressed for time, taking even just a few moments to dive into deeper thinking is almost always worth it.

Blind to the Cause

Pepsi-Cola developed an advertising campaign, "Take the Pepsi Challenge," that it hoped would increase Pepsi's market share at the expense of its bitter rival, Coca-Cola. As part of this campaign, Pepsi set up stations at various locations, such as shopping malls, where it conducted blind tastings of both Pepsi and Coke. As the individuals took the taste test, they were videotaped. The television commercials focused on videos where the tasters chose Pepsi. The management at Coca-Cola was very concerned about this advertisement, which showed Pepsi as the overwhelming favorite.

Find a solution to address Coke's concern about Pepsi's advertising campaign.

Let's develop a hypothetical critical thought process for how Coke could have responded to the Pepsi campaign. First let's look at the *critical thinking actions* Coke might have taken.

Information seeking: How many tasters chose Coke but were not shown on TV? Are there precedents for this type of consumer-comparison commercial? Has it affected market share of either product? Would the results be the same if

Continues

the tasters were required to drink at least eight ounces of both Pepsi and Coke before choosing?

Analyzing: Did Coke look for unstated or hidden assumptions? For example, was there an outside influence, such as the geographical part of the country where Pepsi is known to be popular; temperature (was it a hot day, was the Pepsi cold and the Coke warm?); time of day (just before or after lunch?); age of the tasters; presentation of the drinks by personnel at the stations?

Discriminating: What was it about the taste of the Pepsi that the tasters preferred? Was it sweeter? More carbonated?

Predicting: With increased showing of the Pepsi TV commercials, will Coke lose market share?

Now let's look at Coke's response to the advertising campaign. Coke quickly responded by coming out with a new product with a "better" taste. The preceived problem statement: ***Make a new soft drink to challenge the perceived preferred taste of Pepsi.*** *They dubbed this new product "New Coke" and put it on the market to replace the existing version of Coke.*

Did Coke apply Socratic questions, such as the following?

Question the solution of developing and marketing New Coke.

Which problem does creating New Coke solve? *(Question that explores viewpoints and perspectives)*

Will New Coke be able to negate Pepsi's advertisement campaign? *(Question that probes assumptions)*

Will New Coke increase or maintain Coke's market share? *(Question that probes reasons and evidence)*

What are the implications of creating New Coke in terms of cost, marketing, and acceptance? *(Question that probes implications and consequences)*

Did Coke carry out a *potential problem analysis* (see Chapter 8) of what could go wrong with their decision or probe the assumption that the change to New Coke will be for the better?

Were other solutions proposed for competing with Pepsi? *(Question for clarification)*

Examples of other solutions might be the following:

- Create a new advertising campaign by videotaping a tasting in a predetermined location and demographics where it is known that Coke will be preferred.
- Create a new advertising campaign by videotaping a tasting where the two drinks are not compared and the tasters are only asked what they like about Coke.

Coke's initial solution turned out to be one of the biggest product change mistakes in history. Customers tried New Coke but did not like it. The product was withdrawn from the market after 77 days and was replaced by the original Coca-Cola recipe, which was called "Classic Coke."

Subsequent studies showed that successful taste tests of Pepsi and New Coke versus Classic Coke did not suggest that people wanted an entire serving of the new formula(s). The increased sweetness of Pepsi and New Coke made them beat Classic Coke in taste tests when small quantities of the products were consumed. However, when drinking an entire serving, the preference switched to Classic Coke.

Challenge the Problem Statement

The real problem statement should have been "Develop a marketing strategy to regain Coke's market share."

SUMMARY

This chapter focuses on thinking skills that, if studied and practiced, will serve you well throughout your entire life, regardless of what discipline or job you choose.

- **Structured Critical Reasoning (SCR)**
  The sequence of the analysis is to identify:
  - Conclusions
  - Evidence
  - Assumptions
  - Strengths and weaknesses of each assumption
  - Fallacies in logic
- **The 11 Fallacies in Logic**
  - Ambiguous or vague words or phrases
  - Citing a questionable authority
  - Straw person
  - False dilemma
  - Red herring
  - Slippery slope

Continues

  - Appeal to popularity
  - The "perfect" solution
  - False, incomplete, or misleading facts or statements
  - Causal oversimplifications
  - Hasty generalizations
- **Six Types of Socratic Questions**
  - Questions about the question/problem statement
  - Questions for clarification
  - Questions that probe assumptions
  - Questions that probe reasons and evidence
  - Questions about viewpoints and perspectives
  - Questions that probe implications and consequences
- **Critical Thinking Actions**
  - Predicting
  - Analyzing
  - Information seeking
  - Applying standards
  - Discriminating
  - Transforming knowledge
  - Logical reasoning

WEB-SITE MATERIAL (WWW.UMICH.EDU/~SPCS)

- **Learning Resources**
  Summary Notes
  Self-Tests
  1. Matching the Socratic Question Example to a Definition
  2. Identifying the Type of Socratic Question
  3. Matching Critical Thinking Actions

- **Professional Reference Shelf**
  1. Structured Critical Reasoning (SCR) Examples
     a) The Draft Once Again
     b) Downed Powerlines
     c) Continents in Motion
  2. Critical Thinking Questions
     a) Fires in Orange County
     b) A Real Toothache

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4. Rubenfeld, M. G., and B. Scheffer, *Critical Thinking TACTICS for Nurses: Achieving the IOM Competencies*, Second Edition, Jones & Bartlett Publishers, Sudbury, MA, 2010.
5. Zyman, S., and A. A. Brott, *Renovate Before You Innovate*, Portfolio, a member of the Penguin Group, New York, 2005.

EXERCISES

3.1. Carry out a structured critical reasoning (SCR) analysis on the following situation. It has been recently shown that gun control works better in small towns or villages than in large cities. Small towns have more of a family atmosphere and people are more likely to help one another; as a result people never have a need to feel unsafe or need firearms. The mayor of Long Bridge, Michigan, population of 440, has said in this day and age no one needs a firearm because if trouble did arise, they have one of the best law enforcement officers, Sheriff Bradshaw, to take care of it.

3.2. Apply SCR to the following Editorial Opinion (EdOp).

People are flocking to buy electric cars, and they will soon take over the mass market. The electric car company Tesla's stock has increased 250 percent in the past six months, and electric car charging stations can now be seen in Whole Foods parking lots, as well as a few University of Michigan parking lots in Ann Arbor. Ryan Davis, a very successful businessperson and proud owner of a new Tesla, said that the Tesla is inexpensive, with model prices starting at $60,000, compared with the new BMW 750 Li, which he also considered and which sells for $100,000. He continued, "Soon, charging stations will be as common around the city as parking meters. Besides, people want to reduce their carbon footprint and dependence on foreign oil, and electric cars will help do that. I expect Tesla sales to increase by a factor of 3-4 over the next several years."

Sergey Furtaev/Shutterstock

3.3. Apply SCR to the synopsis of the editorial opinion article related to "Why We Don't Talk Anymore? Tracking Phone Call Lengths."

"'It is,' once mused an actor of London's east-end origins, 'good to talk'." Since mobile phones tipped into the mainstream in the late Nineties, we've had voice contact with everyone from loved ones to the local pizza delivery place a pocket's

distance away. But, according to the CTIA, the trade group representing the U.S. wireless industry, the average length of our mobile phone calls has dropped drastically in the last six years. In 2006 the average call was 3.03 minutes long. By the end of 2011 they were down to 1.78 minutes. Why have we stopped talking (or, at least, paying to talk)?

The answer, at least according to a lengthy report in *The Wall Street Journal*, is—like so many things—attributed to Apple and its 2007 release of the iPhone, which allowed users to communicate via numerous non-call routes including voice-over-internet protocol, email and (the fee-free) iMessage. The other smartphones that followed Apple only furthered this troublesome development for the phone networks (who will counter it with increased unlimited-call packages).

It's not just smartphones, though. Since 2006, Facebook has gained as many users as there were on the entire Web at its inception in 2004. Twitter has no doubt eaten into the SMS market, too. Do we need to ring cousin Dave to see how his newborn is doing, when we can see pictures of the baby on Facebook and get instant updates from the delivery room? Possibly not, but we won't stop chatting. The launch of Sean Parker and Shawn Fanning's peer-to-peer chat network, Airtime, hopes to do to the phone industry what their Napster did to music. This could be great news, unless you own shares in AT&T."

Source: *The Independent* (a British newspaper), June 7, 2012.

3.4. Carry out an SCR analysis on the following memo.

Memorandum

To: Harley Davidson, Director of Housing

From: Natalie Dressed, Northend Residence Hall Manager

Subject: Northend Residence Hall Problems

The Northend residence hall was completed in the center of campus just in time for the start of the 2010 Fall term. After the first week of classes the resident dorm counselor told the supervisor of all university housing that the dorm was in chaos. The counselor complains it is so overcrowded that they never should have built so many dorm rooms on each floor. The students have to live in cramped quarters, often with up to three students living in a room. The cafeteria is a disaster as is clearly demonstrated by the long lines to get served and the almost shoulder-to-shoulder crowds at lunch hour. The cafeteria ran out of food on one of the five days during the first week of class after it opened. There was such poor planning that students were sitting on the floor with their food trays on their laps, a violation of the health code. Backpacks were piled up, blocking the walking spaces between the dining room tables, a violation of the fire code.

The counselor, busy with putting out other "first-week fires," has not visited the cafeteria in the morning or evening but imagines it is even worse then. However his

friend John stopped by Friday night and said that it was not crowded at all, perhaps due to a football pep rally over by the Union, otherwise it would be mobbed the same as it is at lunchtime. There are just too many students in the new dorm. The university should remodel some of the three-bedroom suites to turn them into two-bedroom suites so there will be less crowding.

3.5. A survey of the students in the senior-year Engineering 405 class showed that more than 75% of the students either now play or have played a musical instrument for at least three years. Consequently, taking three years of music lessons sometime during the K–12 years will better prepare you for a career in engineering. Write CTQs you would use to challenge this conclusion. State the type of CTQ you are asking.

3.6. Choose one or more of the following SCR examples and make a list of CTQs you would ask to challenge the reasons and evidence in each example. For example, in "Truancy in U.K. Schools" the evidence is given that "eight million days of school were missed last year according to the Department of Children, Schools, and Families." A CTQ to challenge this would be a question probing the assumption that this is out of the ordinary: "Is this always the case?" A question probing reasons and evidence is "How many days of school were missed two years ago?"

1. "Fighting Fires?"
2. "Truancy in U.K. Schools"
3. "A Public Health Hazard—Eggs"

3.7. Review the perceived problem/real problem examples in Chapter 1. Make a list of CTQs you would have asked for one or more of the following:

1. "Better Printing Inks"
2. "Making Gasoline from Coal"
3. "A Picture Is Worth a Thousand Words"
4. "Dam the Torpedoes or Torpedo the Dam?"

3.8. You are an MI6 agent assigned to investigate the following case, "Spy Found Dead in a Bag."

A. Make a list of the critical thinking actions and questions that you would use in order to gather information about this case. In formulating your CTQs, state to whom you would ask each question.

B. Carry out an SCR analysis.

"[An] MI 6 officer was found dead stuffed inside a padlocked duffle bag at his central London flat. His flat was very secure as only 'vetted' people were admitted to building. The flat showed no signs of forced entry and everything seemed in place except a red female wig hanging on the back of a chair. They also found £20,000 worth of women's clothes in his closet. The MI 6 agent, a math prodigy who

received his Ph.D. at age 21, was a code breaker who one of his peers described as extremely conscientious and the most scrupulous risk-assessor he had ever known. The dead agent was due to leave Central London to join the eavesdropping agency in Cheltenham as he had told his sister he had become unhappy with the London office culture of post-work drinks, competition and rat-race at the office. He said that they had dragged their feet on his transfer out of the office for several months until the London office spy chiefs agreed to the transfer a week ago.

Make-up and lipstick that were described as being in pristine condition were also found in his apartment along with the wig. His lifelong girlfriend insisted he was not a cross-dresser. His naked body was stuffed in a red North Face duffel bag and there appeared to be no signs of a struggle as his hands were folded across his body and his face was calm. The cause of death is uncertain because of the length of time between his death and the discovery of his body. DNA different from the victims was found on the padlock on the duffel bag. The agent was fit and muscular and an avid cyclist. One of the investigators suggested that a third party must have been involved.

The landlady reported that three years earlier she had heard him shouting in the early morning hours and got the key to his room and she and her husband went in to look and found him with both hands tied to the bed board with a knife on the table beside the bed. When asked, 'What the bloody hell are you doing?' he replied that he just wanted to see if he could get free. The husband said, 'We can't have this here,' and cut him free."

Sources: From *London Metro*, Morning Edition, April 24, 2012, page 5; *London Metro*, April 26, 2012, page 11; and *London Metro*, May 2, 2012, page 31.

3.9. "Mysterious Disease"

During spring 2011, an enterohemorrhagic E. coli (EHEC) infection spread throughout Europe. The bacteria infected thousands of people and several died from the disease. Everyone that was infected had been in Germany and had eaten vegetables in Germany.

While the infection struck visitors to Germany, imported cucumbers from Spain were blamed for the outbreak. These were later excluded as the source, and the false accusations cost the Spanish farmers around 280 million dollars. The food market grew skeptical toward European vegetables, and Russia totally stopped the import of vegetables from European countries during this time.

It was found that the probability of being infected was nine times higher among people who had eaten bean sprouts from Germany. This source was later excluded as well.

Although there was no definite proof that vegetables were causing the infection, a high-ranking official in the German government told farmers they had to destroy their harvest, losing hundreds of thousands of dollars each.

Which type of critical thinking action is each of the following?

A. Blaming bean sprouts as the cause because the probability of being infected was nine times higher among people who had eaten bean sprouts from Germany _____

B. Applying safety precautions from other food epidemics _____

C. Finding out what method the German scientists used to detect the bacteria _____

D. Finding out what bacteria caused the illness _____

E. Blaming German vegetables _____

F. Finding out what vegetables the infected people had eaten _____

3.10. Choose one of the following statements. Take a side for or against it, and prepare a one-page argument, keeping in mind that other readers would use the SCR method and Socratic questioning when examining your argument. Alternatively, for a class exercise, prepare a three-minute PowerPoint presentation describing your argument.

A. For higher education, online courses are a more beneficial option for students than universities.

B. Coke is better than Pepsi.

C. The legal drinking age should be 18.

D. Reality TV does more good than harm.

E. The United States should establish a colony on the moon.

F. Ultimate Frisbee should be an Olympic sport.

G. Autumn is the best season.

H. Single-sex schools are good for K–12 education.

1. Turn in the SCR analysis for your chosen debate topic along with a number of Socratic questions that would challenge your presentation.
2. For a class exercise, your instructor will distribute the SCR topics of the other class members. Prepare a critical thinking question for each of the topics chosen by the other members of the class.

3.11. Socratic Questions: Pick three of the issues listed in the debate issues in problem 3.10 and imagine you are going to see a presentation about one of them. Prepare three Socratic questions you would want to ask presenters of arguments for each topic.

Group Topic _____

Question 1. _____ (Category _____)

Question 2. _____ (Category _____)

Question 3. _____ (Category _____)

Group Topic _____

Question 1. _____ (Category _____)

Group Topic _____

Question 1. _____ (Category _____)

3.12. Match the question with the type of Socratic question:

Critical Thinking Questions

- How are ___ and ___ similar? Answer: (5) Questions about viewpoints and perspectives
- Why do you say that? _____
- What is the difference between ____ and ____? _____
- Compare ____ and ____ with regard to____ . _____
- What could we assume instead? _____
- What was the point of this question? _____
- What would be an example? _____
- What would be an alternative? _____

3.13. A student comes to the professor's office to say that her group did not get the team assignment finished. She says that one member of the group of four is not carrying his fair share of the load and is coming to meetings unprepared. She goes on to say that another group member is an effective team member but has missed about one-third of the group meetings. List as many CTQs as you can that the professor should ask the student. Identify the category for each question.

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

3.14. Match the following critical thinking action with the appropriate type of critical thinking action.

Critical Thinking Actions

I dissected the situation … Answer: (1) Predicting: envisioning a plan and its consequences.

I knew I had to compare … _____

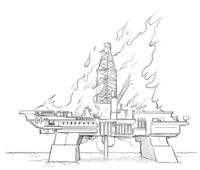
I grouped things together … _____

I made sure I had all the pieces of the picture … _____

I deduced from the information that … _____

I could imagine that happening if I did … _____

Although this situation was somewhat different, I knew … _____



3.15. "Finding Out Where the Problem Came From: The Deepwater Horizon Oil Spill"

A. Prepare six CTQs (one for each type) you would have asked during the drilling (or after the accident if you prefer) of the Deepwater Horizon accident described in the following text.

Deepwater Horizon, an ultra-deepwater offshore oil drilling rig, had been leased to BP ever since its maiden voyage [in] 2001. BP used it for drilling in the Gulf of Mexico and the rig was reported to cost as much as $600,000 per day.

BP, one of the largest companies in the world, has had a spotty reputation for safety. Among other BP accidents is an explosion at a Texas refinery in 2005 where 15 workers died, and in 2006 there was a major oil spill from a badly corroded BP pipeline in Alaska.

In April 2010, the BP team onboard the Deepwater Horizon worked at the Macondo well. According to their plan, they decided to skip the usual cement evaluation if the cementing went smoothly. Generally, the completion rig would perform this test when it reopened the well to produce the oil the exploratory drilling had discovered. The decision was made to send the cement team home at 11:00 a.m. on the 20th of April, thus saving time and the $128,000 fee. BP Wells Team Leader John Guide noted, "Everyone involved with the job on the rig site was completely satisfied with the [cementing] job."

The rig crew began the negative-pressure test. After relieving pressure from the well, the crew would close it off to check whether the pressure within the drill pipe would remain steady. But the pressure repeatedly built back up. As the crew conducted the test, the drill shack grew crowded. The night crew began arriving to relieve the day shift, and some VIP's from a management visibility tour came in as part of their guided tour around the platform. There seemed to be a problem but "tool pusher" Jason Anderson insisted that senior tool pusher Randy Ezel should go and eat with the dignitaries before going off his shift, being sure Anderson would call him if there was a problem. Tool pusher Wyman Wheeler was convinced that something wasn't right, but had to go off his shift and leave the situation in the hands of the night shift.

Later the same evening assistant driller Steve Curtis called Senior Toolpusher Randy Ezel who had left his day pass. "We have a situation…. The well is blown out…. We have mud going to the crown." Ezel was horrified. "Do y'all have it shut in?" Curtis: "Jason is shutting it in now… Randy, we need your help." Ezell: "Steve, I'll be—I'll be right there."

At approximately 9:45 p.m. on April 20, 2010, methane gas from the well, under high pressure, shot all the way up and out of the drill column, expanded onto the platform. The gas reached the engine room and a spark ignited the gas and the disaster ensued. Fire engulfed the platform and the workers left for the lifeboats. Eleven of the workers on Deepwater Horizon were never found.

The emergency disconnect switch (EDS), which was supposed to unlatch the blowout preventer (BOP) and shut the well, was turned on. Unfortunately the BOP did not seal the well. A few brave men stayed at the burning platform to manually try to unlatch the BOP, but without succeeding.

When the leak was finally stopped it had released about 4.9 million barrels of crude oil. The total cost is still unknown but BP has established a trust fund of $20 billion to cover expenses.

Sources: www.bp.com/sectiongenericarticle800.do?categoryId=9036575&contentId=7067541
www.epa.gov/BPSpill/
www.oilspillcommission.gov/sites/default/files/documents/DEEPWATER_ReporttothePresident_FINAL.pdf

In (1) through (6) below identify the line number and then ask a specific question using the type of Socratic question identified.

1. Question for clarification, line number: _____
2. Question about the question, line number: _____
3. Question that probes assumptions, line number: _____
4. Question that probes reasons and evidence, line number: _____
5. Question about view points and perspectives, line number: _____
6. Question that probes implications and consequences, line number: _____

B. Write a critical thinking question you would ask at line ____ (your choice).

C. What critical thinking action was taken at line ____ (your choice)?

D. What critical thinking action would you have taken at line ____ (your choice)?

3.16. Create an example of (a) three, (b) six, or (c) all of the 11 fallacies similar to the ones shown in the table "Eleven Fallacies in Logic to Look For."

3.17. Recall the "Blind to the Cause" example about Coca-Cola's failed attempt to respond to the Pepsi challenge by introducing New Coke.

A. Suggest CTQs and critical thinking actions that Coke might have applied before making the decision to discontinue New Coke after only 77 days on the market. *Example: Why is New Coke not preferred when we tried to make it similar to Pepsi?*

B. Brainstorm solutions that Coke could have done to not discontinue New Coke. *Example: Have Coke do its own testing with both drinks at the same temperature but either extremely cold or at a lukewarm temperature to see if the flavors vary with temperature.*

3.18. It is possible to use critical thinking actions and CTQs to resolve fallacies in logic. For example, in "Draft Once Again" on the Professional Reference Shelf on the Web site, we found Fallacy #9, "False, incomplete, or misleading facts or statements," because no budget information was provided to support the authors' supposed cost savings of the government using cheap labor to save money. A critical thinking action of "information seeking" could be used such as "*Looking for more data* on the possibility of cost savings" or a question for clarification such as "Could the government's cost savings by using cheap labor *be explained more*?"

Describe which critical thinking action or critical thinking question you would use to resolve each of the fallacies found in the SCR examples.

A. "Fighting Fires?"

B. "Truancy in U.K. Schools"

C. "A Public Health Hazard—Eggs"

3.19. Identify the type of fallacy in each of the situations below.

A. Would you like red or white wine with your meal?

B. If you continue playing these video games all the time, your grades will plummet, you won't be able to get into college, and your health will suffer from a lack of fresh air and exercise.

C. If we just raise taxes on the rich, the debt problem will be solved.

D. I didn't like the first song on the album so I didn't even bother listening to the rest.

E. Despite complaints that the car manufacturer has received recently regarding their new model SUV's poorly designed interior, the company's vehicles have an outstanding safety record.

F. The restaurant is far away and we have a deadline coming up soon, but I still think we have plenty of time to eat there later.

G. That Band-Aid is only going to stop the bleeding temporarily: don't even bother putting it on.

H. I know that Weight Watchers is an effective diet for many people because of its balanced approach, but I don't have the willpower to give up all of my favorite foods so I don't think I'll join.

I. I got 6/10 on my quiz, so I excitedly told my mom I only got four wrong and she was so happy.

J. I found it on seven Internet sites, so it has to be true.

K. My mother always used to say, "Don't sit so close to the television, you'll hurt your eyes."

L. Because everyone thinks we should get paid more, management should just get moving and get us all the raise.

3.20. Carry out the interactive exercises in the Summary Notes for Chapter 3 on the Web site.

FURTHER READING

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