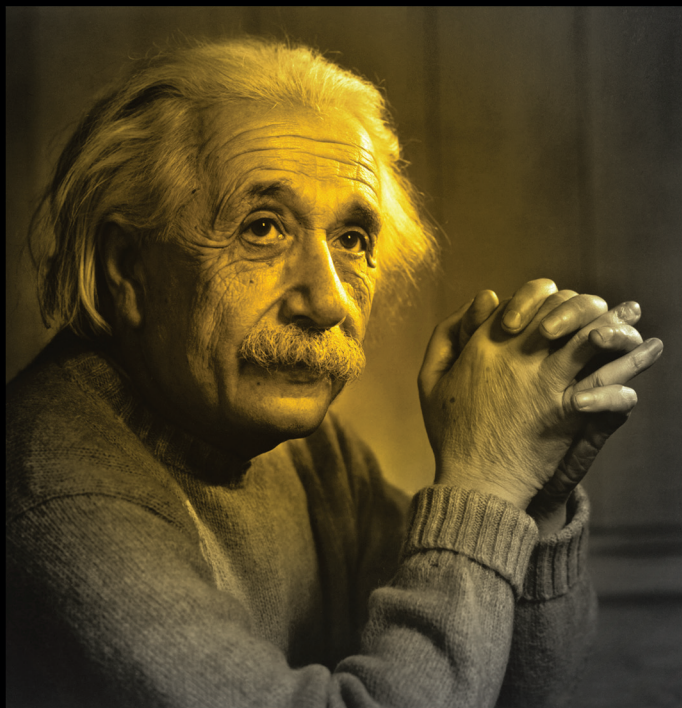


*“The value of an education...is not the learning of many facts  
but the training of the mind to think...”* —ALBERT EINSTEIN

# THE THINKER'S GUIDE TO ANALYTIC THINKING



How to Take Thinking Apart  
and What to Look for When You Do

By DR. LINDA ELDER and DR. RICHARD PAUL

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## Why a Guide on Analytic Thinking?

Analysis and evaluation are recognized as crucial skills for all students to master. And for good reason. These skills are required in learning any significant body of content in a non-trivial way. Students are commonly asked to analyze poems, mathematical formulas, biological systems, chapters in textbooks, concepts and ideas, essays, novels, and articles—just to name a few. Yet how many students can explain what analysis requires? How many have a clear conception of how to think it through? Which of our graduates could complete the sentence: “Whenever I am asked to analyze something, I use the following framework: . . .”

The painful fact is that few students have been taught how to analyze. Hence, when they are asked to analyze something scientific, historical, literary, or mathematical—let alone something ethical, political, or personal—they lack a framework to empower them in the task. They muddle through their assignment with only the vaguest sense of what analysis requires. They have no idea how sound analysis can lead the way to sound evaluation and assessment. Of course, students are not alone. Many adults are similarly confused about analysis and assessment as intellectual processes.

Yet what would we think of an auto mechanic who said, “I’ll do my best to fix your car, but frankly I’ve never understood the parts of the engine,” or of a grammarian who said, “Sorry, but I have always been confused about how to identify the parts of speech.” Clearly, students should not be asked to do analysis if they do not have a clear model, and the requisite foundations, for the doing of it. Similarly, we should not ask students to engage in assessment if they have no standards upon which to base their assessment. Subjective reaction should not be confused with objective evaluation.

To the extent that students internalize this framework through practice, they put themselves in a much better position to begin to think historically (in their history classes), mathematically (in their math classes), scientifically (in their science classes), and therefore more skillfully (in all of their classes). When this model is internalized, students become better students because they acquire a powerful “system-analyzing-system.”

This thinker’s guide is a companion to *The Miniature Guide to Critical Thinking Concepts and Tools*. It supports, and is supported by, all of the other miniature guides in the series. It exemplifies why thinking is best understood and improved when we are able to analyze and assess it **EXPLICITLY**. The intellectual skills it emphasizes are the same skills needed to reason through the decisions and problems inherent in any and every dimension of human life.

## Why the Analysis of Thinking is Important

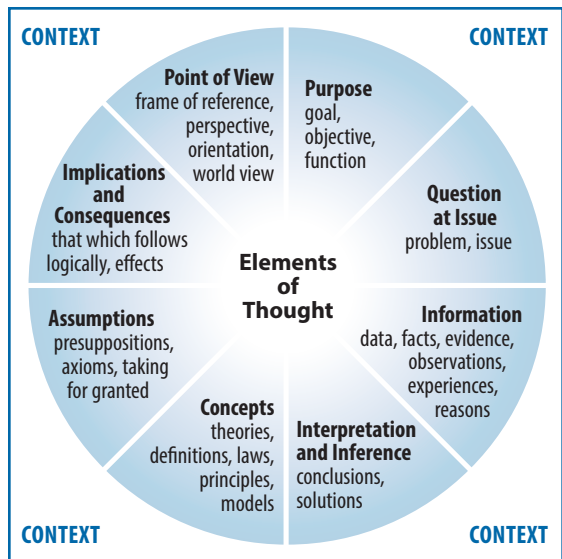
Everyone thinks; it is our nature to do so. But much of our thinking, left to itself, is biased, distorted, partial, uninformed, or downright prejudiced. Yet the quality of our life and of what we produce, make, or build depends precisely on the quality of our thought. Shoddy thinking is costly, both in money and in quality of life. If we want to think well, we must understand at least the rudiments of thought, the most basic structures out of which all thinking is made. We must learn how to take thinking apart.

### All Thinking Is Defined by the Eight Elements That Make It Up

**Eight basic structures are present in all thinking:** Whenever we think, we think for a purpose within a point of view based on assumptions leading to implications and consequences. We use concepts, ideas and theories to interpret data, facts, and experiences in order to answer questions, solve problems, and resolve issues.

Thinking, then:

- generates purposes
- raises questions
- uses information
- utilizes concepts
- makes inferences
- makes assumptions
- generates implications
- embodies a point of view



Each of these structures has implications for the others. If you change your purpose or agenda, you change your questions and problems. If you change your questions and problems, you are forced to seek new information and data. If you collect new information and data...

**Essential Idea:** There are eight structures that define thinking. Learning to analyze thinking requires practice in identifying these structures in use.

## All Humans Use Their Thinking To Make Sense of the World

The words *thinking* and *reasoning* are used in everyday life as virtual synonyms. Reasoning, however, has a more formal flavor. This is because it highlights the inference-drawing capacity of the mind.

Reasoning occurs whenever the mind draws conclusions on the basis of reasons. We draw conclusions whenever we make sense of things. The result is that whenever we think, we reason. Usually we are not aware of the full scope of reasoning implicit in our minds.

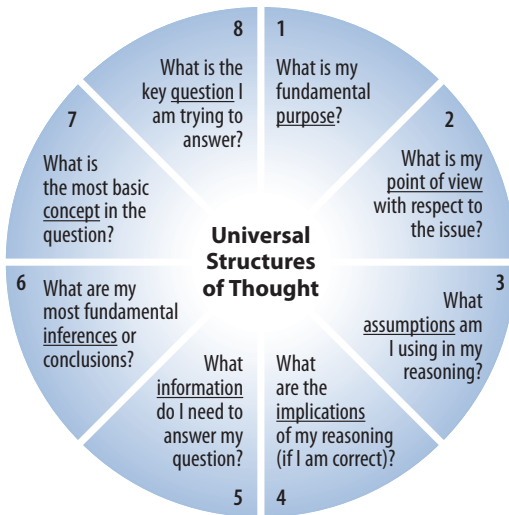
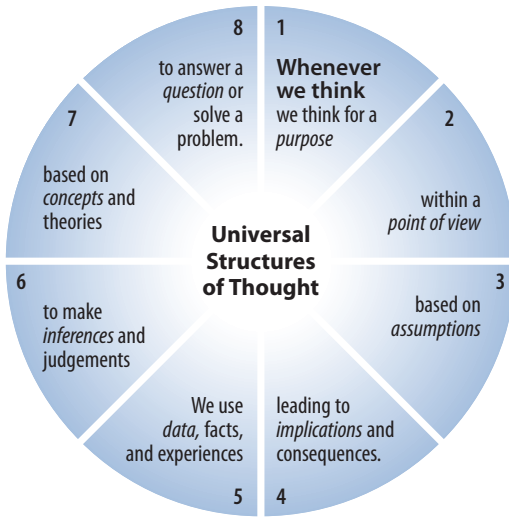
We begin to reason from the moment we wake up in the morning. We reason when we figure out what to eat for breakfast, what to wear, whether to make certain purchases, whether to go with this or that friend to lunch. We reason as we interpret the oncoming flow of traffic, when we react to the decisions of other drivers, when we speed up or slow down. One can draw conclusions, then, about everyday events or, really, about anything at all: about poems, microbes, people, numbers, historical events, social settings, psychological states, character traits, the past, the present, the future.

By reasoning, then, we mean making sense of something by giving it some meaning in our mind. Virtually all thinking is part of our sense-making activities. We hear scratching at the door and think, "It's the dog." We see dark clouds in the sky and think, "It looks like rain." Some of this activity operates at a subconscious level. For example, all of the sights and sounds about us have meaning for us without our explicitly noticing that they do. Most of our reasoning is unspectacular. Our reasoning tends to become explicit only when someone challenges it and we have to defend it ("Why do you say that Jack is obnoxious? I think he is quite funny"). Throughout life, we form goals or purposes and then figure out how to pursue them. Reasoning is what enables us to come to these decisions using ideas and meanings.

On the surface, reasoning often looks simple, as if it had no component structures. Looked at more closely, however, it implies the ability to engage in a set of interrelated intellectual processes. This thinker's guide is largely focused on making these intellectual processes explicit. It will enable you to better understand what is going on beneath the surface of your thought.

**Essential Idea:** Reasoning occurs when we draw conclusions based on reasons. We can upgrade the quality of our reasoning when we understand the intellectual processes that underlie reasoning.

# To Analyze Thinking We Must Learn to Identify and Question its Elemental Structures



**Be aware:** When we understand the structures of thought, we ask important questions implied by these structures.

# Think About Purpose

**Your purpose is your goal, your objective, what you are trying to accomplish. We also use the term to include functions, motives, and intentions.**

You should be clear about your purpose, and your purpose should be justifiable.

## Questions which target purpose:

- What is your, my, their purpose in doing \_\_\_\_\_?
- What is the objective of this assignment (task, job, experiment, policy, strategy, etc.)?
- Should we question, refine, modify our purpose (goal, objective, etc.)?
- Why did you say...?
- What is your central aim in this line of thought?
- What is the purpose of this meeting (chapter, relationship, action)?
- What is the purpose of education?
- What is the function of this \_\_\_\_\_  
(bodily system, machine, tool, economic policy, plant, ecosystem)?

**Be aware:** All of what we do is guided by our purposes or goals. We are aware of only some of our goals. When our goals reflect our greed or possessiveness, or such, we deny them as goals. We then describe our actions in such a way as to hide purposes to which we cannot admit.

## State the Question

**The question lays out the problem or issue and guides our thinking. When the question is vague, our thinking will lack clarity and distinctness.**

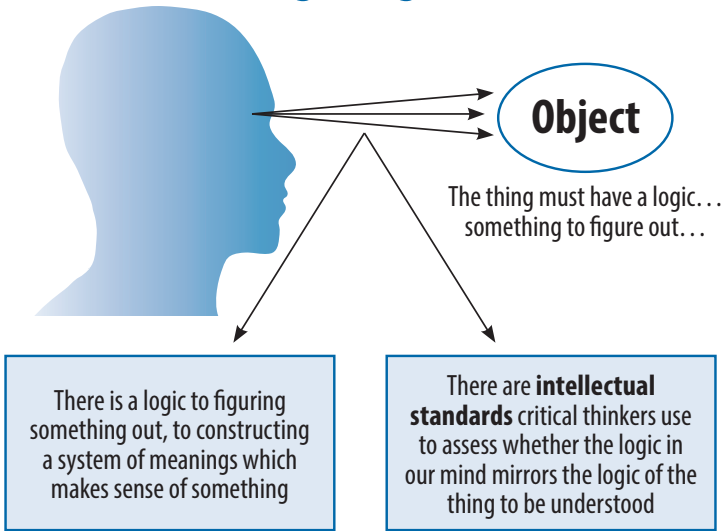
The question should be clear and precise enough to productively guide our thinking.

### **Questions which target the question:**

- What is the question I am trying to answer?
- What important questions are embedded in the issue?
- Is there a better way to put the question?
- Is this question clear? Is it complex?
- I am not sure exactly what question you are asking. Could you explain it?
- The question in my mind is this: How do you see the question?
- What kind of question is this? Historical? Scientific? Ethical? Political? Economic? Or...?
- What important questions does this discipline address?
- What would we have to do to settle this question?

**Be aware:** Often the real question or problem is hidden or obscure. People resist admitting problems that cast them in a negative light. We need intellectual courage to bring the real problems and issues to the surface.

# The Figuring Mind



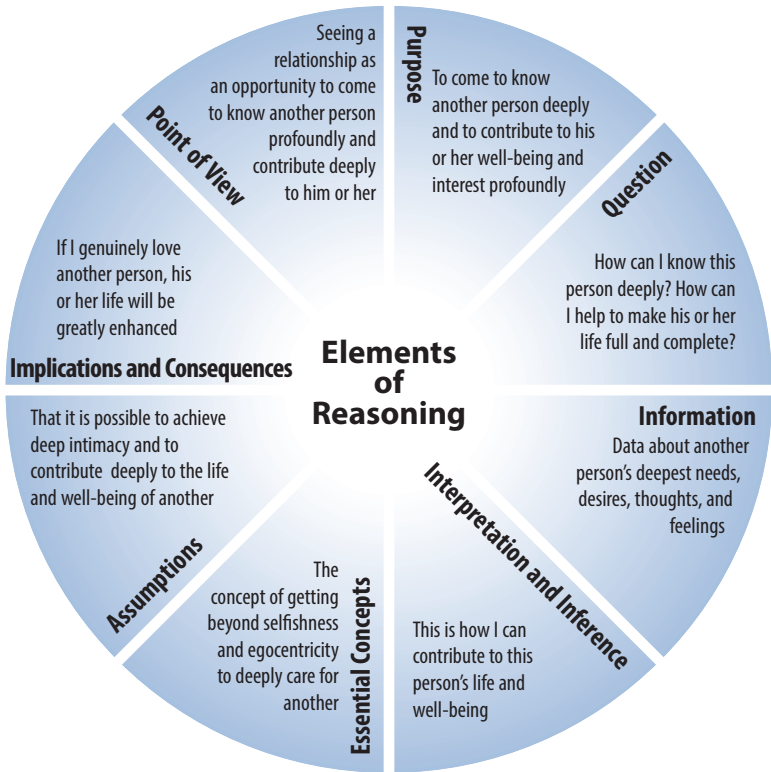
The Elements of Thought reveal the logic:			Intellectual Standards include:
1	An object to be figured out	some data or information, some experience of it (the <b>Empirical Dimension</b> )	
2	Some reason for wanting to figure it out	our <b>Purpose</b> or <b>Goal</b>	
3	Some question or problem we want solved	our <b>Question at Issue</b>	
4	Some initial sense of the object (whatever we take for granted)	our <b>Assumptions</b>	
5	Some ideas by which we are making sense of the object	the <b>Conceptual Dimension</b>	
6	Some drawing of conclusions about the object	our <b>Inferences</b> or interpretations	
7	What follows from our interpretation of the object	the <b>Implications</b> and <b>Consequences</b>	
8	Some viewpoint from which we conceptualize the object	our <b>Point of View</b> or <b>Frame of Reference</b>	



# Figuring Out the Logic Of Things

Critical thinkers have confidence in their ability to figure out the logic of anything they choose. They continually look for order, system and interrelationships. They say “there is a logic to this, and I can figure it out!” For example, consider the logic of love, fear and anger on this and the next two pages:

## The Logic of Love



**Be aware:** Even emotionally powerful states of mind have a logic to them. All emotions have a cognitive content.

## Analyzing Problems

**Identify some problem you need to reason through. Then complete the following:**

**What exactly is the problem?** (Study the problem to make clear the kind of problem you are dealing with. Figure out, for example, what sorts of things you are going to have to do to solve it. Distinguish problems over which you have some control from problems over which you have no control. Pay special attention to controversial issues in which it is essential to consider multiple points of view.)

**The key question that emerges from the problem is...** (State the question as clearly and precisely as you can. Details are very important.)

**My purpose in addressing the problem is...** (Know exactly what you are after. Make sure you are not operating with a hidden agenda and that your announced and real purposes are the same.)

**Actively seek the information most relevant to the question.** (Include in that information options for action, both short-term and long-term. Recognize limitations in terms of money, time, and power.)

**Some important assumptions I am using in my thinking are...** (Figure out what you are taking for granted. Watch out for self-serving or unjustified assumptions.)

**If we solve this problem, some important implications are... If we fail to solve this problem, some important implications are...** (Evaluate options, taking into account the advantages and disadvantages of possible decisions before acting. What consequences are likely to follow from this or that decision?)

**The most important concepts, theories, or ideas I need to use in my thinking are...** (Figure out all significant ideas needed to understand and solve the problem. You may need to analyze these concepts. Use a good dictionary.)

**The point(s) of view is/are as follows:** (Know the point of view from which your thinking begins. Be especially careful to determine whether multiple points of view are relevant.)

**After reasoning through the parts of thinking above, the best solution (conclusion) to the problem is...** (If the problem involves multiple conflicting points of view, you will have to assess which solution is the best. If the problem is one-dimensional, there may be just one "correct" solution.)

## Analyzing Problems

### The Problem of Pollution as an Example<sup>1</sup>

**What is the problem?** The problem is pollution and the fact that because people are not doing enough to reduce it, a host of negative consequences are occurring (e.g. increased medical problems, loss of animal and plant life, increased contamination of the earth's water sources).

**Questions that emerge from the problem are...** What can I personally do to reduce pollution? A related question is: What can we collectively do to reduce pollution?

**My purpose in addressing the problem is** to increase the things I do to contribute to a more healthy biosphere.

**The important information relevant to the question is** information about what I am currently doing to increase pollution (such as generating trash that could be recycled, driving a car, etc.), information about what I could do to reduce the amount of pollution I contribute to (such as locating recycling centers, pursuing alternative forms of transportation, etc.), information about environmental groups I might support, etc.

**Some important assumptions I am using in my thinking are** that pollution is causing significant damage to the biosphere, that everyone can help reduce pollution, that I, and everyone else, have an obligation to make a significant effort to help reduce pollution.

**If many people were to reason well through this issue, some implications are** that there would be a longer and higher quality of life for millions of people. Additionally, plant and animal species and ecosystems would be protected. A host of other positive implications would follow as well, implications for the atmosphere, the waterways, the forests, etc.

**The most important concepts, or ideas, I need to use in my thinking are** the concepts of pollution, and that of a healthy biosphere. Each of these concepts leads to a host of further technical, ecological, and ethical concepts required to understand the multiple dimensions of pollution and the ethical responsibilities that knowledge of its many harmful effects entails.

**My point of view is as follows:** I am looking at pollution. I am seeing it as something I can help reduce through many means.

**After reasoning through the parts of thinking above, the best solution (conclusion) to the problem will be to** put into action the various options that my research has revealed.

<sup>1</sup> This problem is presented without details and is intended merely to exemplify how one might begin to reason through the logic of a complex question. When using this approach, the more details one includes, the deeper the analysis can be. Many layers of detail could then be specified based on research into all of these levels. For further background information on this particular problem, see the Logic of Ecology (p. 40).

## Analyzing the Logic of an Article, Essay or Chapter

One important way to understand an essay, article or chapter is through the analysis of the parts of the author's reasoning. Once you have done this, you can evaluate the author's reasoning using intellectual standards (see page 9). Here is a template to follow:

- 1) The main **PURPOSE** of this article is \_\_\_\_\_.  
(Here you are trying to state, as accurately as possible, the author's intent in writing the article. What was the author trying to accomplish?)
- 2) The key **QUESTION** that the author is addressing is \_\_\_\_\_  
\_\_\_\_\_.  
(Your goal is to figure out the key question that was in the mind of the author when he/she wrote the article. What was the key question addressed in the article?)
- 3) The most important **INFORMATION** in this article is \_\_\_\_\_  
\_\_\_\_\_.  
(You want to identify the key information the author used, or presupposed, in the article to support his/her main arguments. Here you are looking for facts, experiences, and/or data the author is using to support his/her conclusions.)
- 4) The main **INFERENCES** in this article are \_\_\_\_\_  
\_\_\_\_\_.  
(You want to identify the most important conclusions the author comes to and presents in the article).
- 5) The key **CONCEPT**(s) we need to understand in this article is (are) \_\_\_\_\_  
\_\_\_\_\_. By these concepts the author means \_\_\_\_\_  
\_\_\_\_\_.  
(To identify these ideas, ask yourself: What are the most important ideas that you would have to know to understand the author's line of reasoning? Then briefly elaborate what the author means by these ideas.)
- 6) The main **ASSUMPTION**(s) underlying the author's thinking is (are) \_\_\_\_\_  
\_\_\_\_\_.

(Ask yourself: What is the author taking for granted [that might be questioned]? The assumptions are generalizations that the author does not think he/she has to defend in the context of writing the article, and they are usually unstated. This is where the author's thinking logically begins.)

- 7a) If we accept this line of reasoning (completely or partially), the **IMPLICATIONS** are \_\_\_\_\_.  
(What consequences are likely to follow if people take the author's line of reasoning seriously? Here you are to pursue the logical implications of the author's position. You should include implications that the author states, and also those that the author does not state.)
- 7b) If we fail to accept this line of reasoning, the **IMPLICATIONS** are \_\_\_\_\_.  
(What consequences are likely to follow if people ignore the author's reasoning?)
- 8) The main **POINT(S) OF VIEW** presented in this article is (are) \_\_\_\_\_.  
(The main question you are trying to answer here is: What is the author looking at, and how is he/she seeing it? For example, in this mini-guide we are looking at "analysis" and seeing it "as requiring one to understand" and routinely apply the elements of reasoning when thinking through problems, issues, subjects, etc.).

If you truly understand these structures as they interrelate in an article, essay or chapter, you should be able to empathically role-play the thinking of the author. These are the eight basic structures that define all reasoning. They are the essential elements of thought.

**Be aware:** It is possible to use the basic structures of thinking to analyze articles, essays, and chapters. This analysis will deepen one's insight into the author's reasoning.

## Analyzing the Logic of an Article: An Example

On the next page you will find an analysis of the following brief article (see pages 28–29 for the analysis template).

### **Is it Possible for the News Media to Reform?<sup>2</sup>**

To provide their publics with non-biased writing, journalists around the world, would have to, first, enter empathically into world views to which they are not at present sympathetic. They would have to imagine writing for audiences that hold views antithetical to the ones they hold. They would have to develop insights into their own sociocentrism. They would have to do the things done by critical consumers of the news. The most significant problem is that, were they to do so, their readers would perceive their articles as “biased” and “slanted,” as “propaganda.” These reporters would be seen as irresponsible, as allowing their personal point of view to bias their journalistic writings. Imagine Israeli journalists writing articles that present the Palestinian point of view sympathetically. Imagine Pakistani journalists writing articles that present the Indian point of view sympathetically.

The most basic point is this: journalists do not determine the nature and demands of their job. They do not determine what their readers want or think or hate or fear. The nature and demands of their job are determined by the broader nature of societies themselves and the beliefs, values and world views of its members. It is human nature to see the world, in the first instance, in egocentric and sociocentric terms. Most people are not interested in having their minds broadened. They want their present beliefs and values extolled and confirmed. Like football fans, they want the home team to win, and when it wins to triumph gloriously. If they lose, they want to be told that the game wasn't important, or that the other side cheated, or that the officials were biased against them.

As long as the overwhelming mass of persons in the broader society are drawn to news articles that reinforce, and do not question, their fundamental views or passions, the economic imperatives will remain the same. The logic is parallel to that of reforming a nation's eating habits. As long as the mass of people want high fat processed foods, the market will sell high fat and processed foods to them. And as long as the mass of people want simplistic news articles that reinforce egocentric and sociocentric thinking, that present the world in sweeping terms of good and evil (with the reader's views and passions treated as good and those of the reader's conceived enemies as evil), the news media will generate such articles for them. The profit and ratings of news sources that routinely reinforce the passions and prejudices of their readers will continue to soar.

<sup>2</sup> Paul, R. and Elder, L. (2002). *The Guide for Conscientious Citizens on How to Detect Media Bias and Propaganda*. Dillon Beach, CA: Foundation for Critical Thinking.

**The main purpose of this article is** to show why the news media are not likely to alter their traditional practices of slanting the news in keeping with audience preconceptions.

**The key question that the author is addressing is:** “Why is it not possible for the news media to reform?”

**The most important information in this article is:**

1. information about how and why the news media currently operates:
  - a. that the news media slant stories to fit the viewpoint of their audience. “Most people are not interested in having their views broadened. . . Like football fans they want the home team to win. . . The overwhelming mass of persons in the broader society are drawn to news articles that reinforce, and do not question, their fundamental views or passions.”
  - b. that the fundamental purpose of the mainstream news media is to make money. “As long as the mass of people want simplistic news articles. . . the news media will generate such articles for them. The profit and ratings of news sources that routinely reinforce the passions and prejudices of their readers will continue to soar.”
2. information about how the news media would have to change to be more intellectually responsible:
  - a. that the news media would have to actively enter differing world views “Imagine Israeli journalists writing articles that present the Palestinian point of view sympathetically. Imagine Pakistani journalists writing articles that present the Indian point of view sympathetically.”
  - b. That the news media would have to “develop insights into their own sociocentrism.”

**The main inferences in this article are:** “As long as the overwhelming mass of persons in the broader society are drawn to news articles that reinforce, and do not question, their fundamental views or passions,” the news will be presented in a biased way. Because the fundamental purpose of the media is to make money, and the only way people will buy papers is if their sociocentric views are reinforced and not questioned, the media will continue to distort events in accordance with audience views.

**The key concepts that guide the author’s reasoning in this article are:** biased and unbiased journalism, egocentrism and sociocentrism, propaganda. (Each of these concepts should be elaborated.)

**The main assumptions underlying the author’s thinking are:** The driving force behind the news media is vested interest – i.e. making money; that the news media therefore pander to their readers’ views so as to sell more papers; but that, at the same time, the news media must appear to function objectively and fairly.

**If this line of reasoning is justified, the implications are:** Citizens need to think critically about the news media and how they systematically distort stories in accordance with reader bias. They need to notice how their own sociocentric views are intensified by what they read.

**The main point of view presented in this article is:** The world news media function as profit-making enterprises that structure the news to pander to reader and society prejudices.

## Analyzing the Logic of a Textbook

- 1) The main **PURPOSE** of this textbook is \_\_\_\_\_.
- 2) The key **QUESTION**(s) that the author is addressing in the textbook is(are) \_\_\_\_\_.
- 3) The most important kinds of **INFORMATION** in this textbook are \_\_\_\_\_.
- 4) The main **INFERENCES** (and conclusions) in this textbook are \_\_\_\_\_.
- 5) The key **CONCEPT**(s) we need to understand in this textbook is(are) \_\_\_\_\_.  
By these concepts the author means \_\_\_\_\_.
- 6) The main **ASSUMPTION**(s) underlying the author's thinking is(are) \_\_\_\_\_.
- 7a) If people take the textbook seriously, the **IMPLICATIONS** are \_\_\_\_\_.
- 7b) If people fail to take the textbook seriously, the **IMPLICATIONS** are \_\_\_\_\_.
- 8) The main **POINT(S) OF VIEW** presented in this textbook is(are) \_\_\_\_\_.

**Be aware:** Students who take the time to figure out the logic of their textbooks develop central organizers into which they can integrate all of their learning from those textbooks. Fragmentation and short-term cramming are now fundamental barriers to deep and integrated learning.



## Evaluating an Author's Reasoning

1. Identify the author's **PURPOSE**: Is the purpose of the author well-stated or clearly implied? Is it justifiable?
2. Identify the key **QUESTION** which the written piece answers: Is the question at issue well-stated (or clearly implied)? Is it clear and unbiased? Does the expression of the question do justice to the complexity of the matter at issue? Are the question and purpose directly relevant to each other?
3. Identify the most important **INFORMATION** presented by the author: Does the writer cite relevant evidence, experiences, and/or information essential to the issue? Is the information accurate and directly relevant to the question at issue? Does the writer address the complexities of the issue?
4. Identify the most fundamental **CONCEPTS** which are at the heart of the author's reasoning: Does the writer clarify key ideas when necessary? Are the ideas used justifiably?
5. Identify the author's **ASSUMPTIONS**: Does the writer show a sensitivity to what he or she is taking for granted or assuming (insofar as those assumptions might reasonably be questioned)? Or does the writer use questionable assumptions without addressing problems inherent in those assumptions?
6. Identify the most important **INFERENCES** or conclusions in the written piece: Do the inferences and conclusions made by the author clearly follow from the information relevant to the issue, or does the author jump to unjustifiable conclusions? Does the author consider alternative conclusions where the issue is complex? In other words, does the author use a sound line of reasoning to come to logical conclusions, or can you identify flaws in the reasoning somewhere?
7. Identify the author's **POINT OF VIEW**: Does the author show a sensitivity to alternative relevant points of view or lines of reasoning? Does he or she consider and respond to objections framed from other relevant points of view?
8. Identify **IMPLICATIONS**: Does the writer display a sensitivity to the implications and consequences of the position he or she is taking?

**Be aware:** You can evaluate thinking by applying intellectual standards to its component parts.

## Analyzing the Logic of a Subject

When we understand the elements of reasoning, we realize that all subjects, all disciplines, have a fundamental logic defined by the structures of thought embedded in them.

Therefore, to lay bare a subject's most fundamental logic, we should begin with these questions:

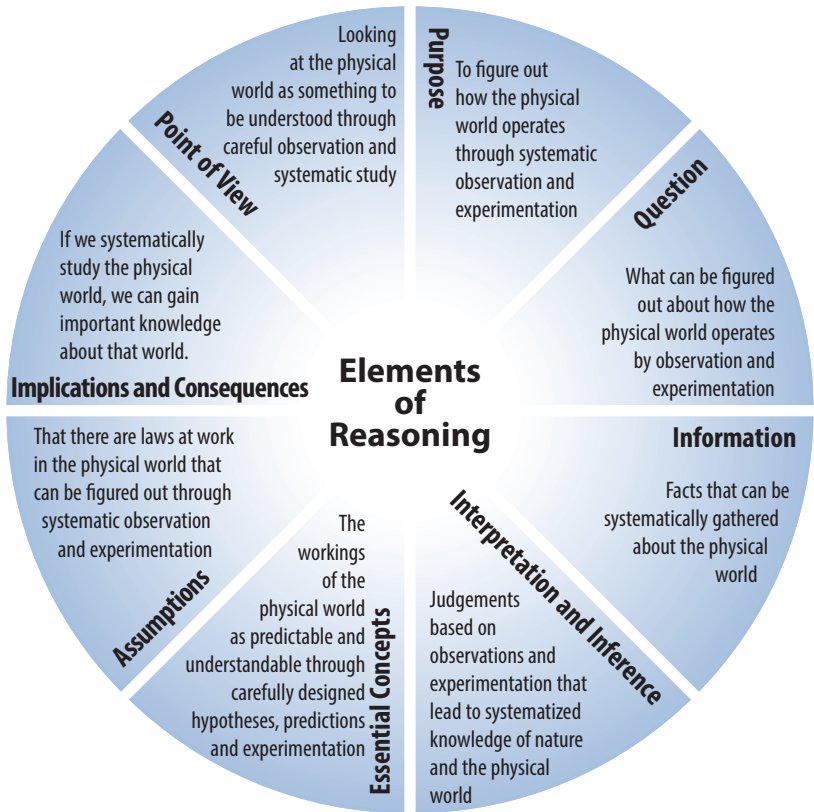
- What is the main **PURPOSE** or **GOAL** of studying this subject? What are people in this field trying to accomplish?
- What kinds of **QUESTIONS** do they ask? What kinds of problems do they try to solve?
- What sorts of **INFORMATION** or data do they gather?
- What types of **INFERENCES** or judgments do they typically make? (Judgments about...)
- How do they go about gathering information in ways that are distinctive to this field?
- What are the most basic ideas, **CONCEPTS** or theories in this field?
- What do professionals in this field take for granted or **ASSUME**?
- How should studying this field affect my view of the world?
- What **VIEWPOINT** is fostered in this field?
- What **IMPLICATIONS** follow from studying this discipline? How are the products of this field used in everyday life?

## Analyzing the Logic of Instruction

These questions can be contextualized for any given class day, chapter in the textbook and dimension of study. For example, on any given day you might ask one or more of the following questions:

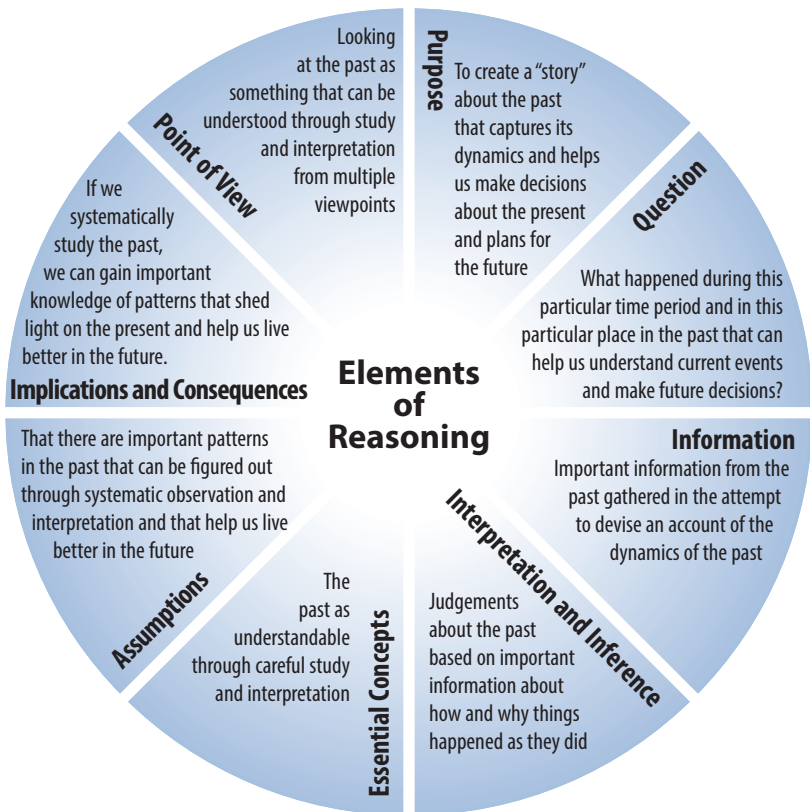
- What is our main **PURPOSE** or **GOAL** today? What are we trying to accomplish?
- What kinds of **QUESTIONS** are we asking? What kinds of problems are we trying to solve? How does this problem relate to everyday life?
- What sort of **INFORMATION** or data do we need? How can we get that information?
- What is the most basic idea, **CONCEPT** or theory we need to understand to solve the problem we are most immediately posing?
- From what **POINT OF VIEW** should we look at this problem?
- What can we safely **ASSUME** as we reason through this problem?
- Should we call into question any of the **INFERENCES** that have been made?
- What are the **IMPLICATIONS** of what we are studying?

# The Logic of Science



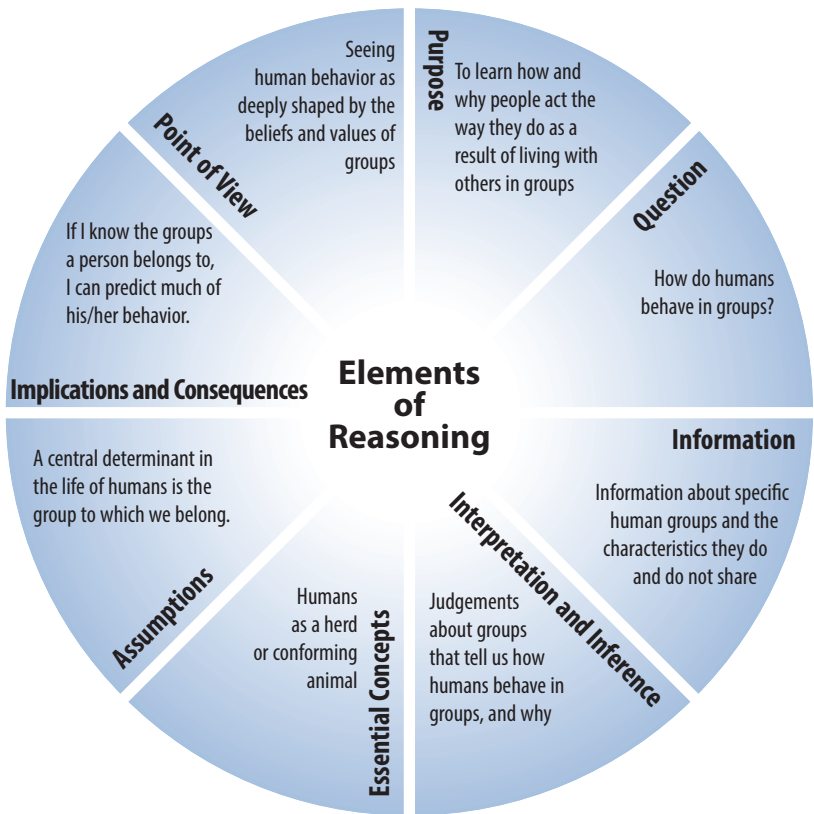
**Be aware:** Many people who have studied science in school fail to think scientifically in their professional and personal lives.

# The Logic of History



**Be aware:** Much human thinking is “historical.” We use our beliefs (formed in the past) to make thousands of decisions in the present and plans for the future. Much of this historical thinking is deeply flawed.

# The Logic of Sociology



**Be aware:** Much of our everyday decision-making is based on poor “sociological” thinking. For example, we often uncritically conform to peer groups when we should question them or note their contradictions and inconsistencies.

## The Logic of Ecology

**Goals of Ecologists:** Ecologists seek to understand plants and animals as they exist in nature, with emphasis on their interrelationships, interdependence, and interactions with the environment. They work to understand all the influences that combine to produce and modify an animal or given plant, and thus to account for its existence and peculiarities within its habitat.

**Questions that Ecologists Ask:** How do plants and animals interact? How do animals interact with each other? How do plants and animals depend on one another? How do the varying ecosystems function within themselves? How do they interact with other ecosystems? How are plants and animals affected by environmental influences? How do animals and plants grow, develop, die, and replace themselves? How do plants and animals create balances between each other? What happens when plants and animals become unbalanced?

**Information that Ecologists Use:** The primary information used by ecologists is gained through observing plants and animals themselves, their interactions, and how they live within their environments. Ecologists note how animals and plants are born, how they reproduce, how they die, how they evolve, and how they are affected by environmental changes. They also use information from other disciplines including chemistry, meteorology and geology.

**Judgments that Ecologists Make:** Ecologists make judgments about how ecosystems naturally function, about how animals and plants within them function, about why they function as they do. They make judgments about how ecosystems become out of balance and what can be done to bring them back into balance. They make judgments about how natural communities should be grouped and classified.

**Concepts that Guide Ecologists' Thinking:** One of the most fundamental concepts in ecology is ecosystem, defined as a group of living things that are dependent on one another and living in a particular habitat. Ecologists study how differing ecosystems function. Another key concept in ecology is ecological succession, the natural pattern of change occurring within every ecosystem when natural processes are undisturbed. This pattern includes the birth, development, death, and then replacement of natural communities. Ecologists have grouped communities into larger units called biomes, regions throughout the world classified according to physical features, including temperature, rainfall and type of vegetation. Another fundamental concept in ecology is balance of nature, the natural process of birth, reproduction, eating and being eaten, which keeps animal/plant communities fairly stable. Other key

concepts include imbalances, energy, nutrients, population growth, diversity, habitat, competition, predation, parasitism, adaptation, coevolution, succession and climax communities and conservation.

**Key Assumptions that Ecologists Make:** Patterns exist within animal/plant communities; these communities should be studied and classified; animals and plants often depend on one another and modify one another; and balances must be maintained within ecosystems.

**Implications of Ecology:** The study of ecology leads to numerous implications for life on Earth. By studying balance of nature, for example, we can see when nature is out of balance, as in the current population explosion. We can see how pesticides, designed to kill pests on farm crops, also lead to the harm of mammals and birds, either directly or indirectly through food webs. We can also learn how over-farming causes erosion and depletion of soil nutrients.

**Point of View of Ecologists:** Ecologists look at plants and animals and see them functioning in relationship with one another within their habitats, and needing to be in balance for the earth to be healthy and sustainable.

## Implications and Consequences

All reasoning leads somewhere. It has implications and, when acted upon, has consequences.

**Primary intellectual standards:** (1) significance, (2) logicality, (3) clarity, (4) completeness

**Common problems:** (1) unimportant, (2) unrealistic, (3) unclear, (4) incomplete

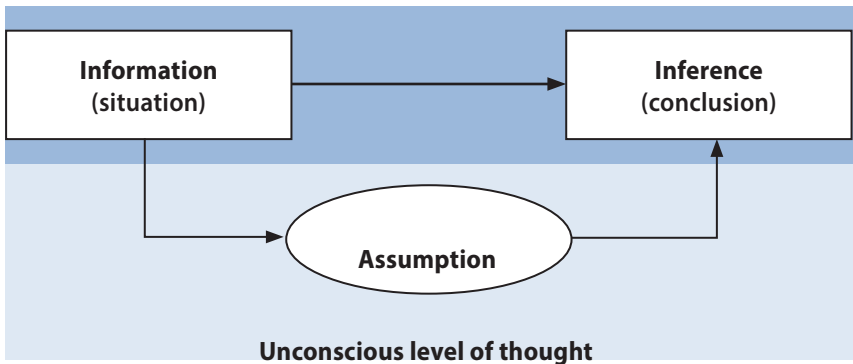
**Principle:** To reason well through an issue, you must think through the implications that follow from your reasoning. You must think through the consequences likely to follow from the decisions you make (before you make them).

Skilled Reasoners	Unskilled Reasoners	Critical Reflections
trace out the significant potential implications and consequences of their reasoning.	trace out few or none of the implications and consequences of holding a position or making a decision.	Did I spell out all the significant consequences of the action I am advocating? If I were to take this course of action, what other consequences might follow that I haven't considered?
clearly and precisely articulate the implications and possible consequences.	are unclear and imprecise in the possible consequences they articulate.	Have I delineated clearly and precisely the consequences likely to follow from my chosen action?
search for potentially negative as well as potentially positive consequences.	trace out only the consequences they had in mind at the beginning, either positive or negative, but usually not both.	I may have done a good job of spelling out some positive implications of the decision I am about to make, but what are some of the possible negative implications or consequences?
anticipate the likelihood of unexpected negative and positive implications.	are surprised when their decisions have unexpected consequences.	If I make this decision, what are some possible unexpected implications? What are some variables out of my control that might lead to negative consequences?



## Distinguishing Between Inferences and Assumptions

It is important to distinguish between an inference and an assumption. These two parts of thinking are easily confused with one another. An inference is a step of the mind, by which one concludes that something is true based on something else being true, or appearing true. Inferences can be justified or unjustified. All inferences are based on assumptions, beliefs we take for granted. Justifiable assumptions lead to reasonable inferences. Assumptions often operate at the unconscious level. When we uncover our assumptions, we often find the roots of prejudice, stereotyping, bias, and other forms of irrational thinking.



Consider these examples:

**Situation:** Your nation is in a conflict with another nation.

**Inference:** Your nation is justified in this conflict.

**Assumption:** Your nation is always justified in its conflicts with other nations.

**Situation:** I got an “A” in my composition class.

**Inference:** That proves I am a good writer.

**Assumption:** All students who get an “A” in composition class are good writers.

**Be aware:** Inferences follow from assumptions. If our assumptions are faulty, our inferences will be as well.

Consider the following method for identifying inferences and assumptions in one's thinking. We first determine what one might infer (either rationally or irrationally) in a situation. We then figure out the generalization that led to that inference. This is the assumption.

<b>Information (situation)</b>	<b>Possible Inference One Might Make</b>	<b>Assumption Leading to the Inference</b>
1. You have difficulty learning in class.	1. It is the teacher's fault	1. Whenever students have difficulty learning, it is the teacher's fault.
2. You notice a man reading a book by Karl Marx.	2. The man must be a communist.	2. All people who read books by Karl Marx are communists.
3. You see a child crying next to her mother in the grocery store.	3. The mother has refused to get the child something she wants.	3. Whenever a child is crying next to her mother in the grocery store, the mother has refused to give the child something she wants.
4. You see a man sitting on a curb with a paper bag in his hand.	4. The man must be a bum.	4. All men sitting on curbs with paper bags in their hands are bums.

Now think up your own situations. Formulate inferences that might follow from those situations. Then figure out the assumption that led to each inference.

<b>Situation</b>	<b>Possible Inference One Might Make</b>	<b>Assumption Leading to the Inference</b>
1.		
2.		
3.		
4.		

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## About the Authors



**Dr. Linda Elder** is an educational psychologist who has taught both psychology and critical thinking at the college level. She is the President of the Foundation for Critical Thinking and the Executive Director of the Center for Critical Thinking. Dr. Elder has a special interest in the relation of thought to emotion, and in the cognitive and affective. She has developed an original theory of the stages of critical thinking development. Dr. Elder has coauthored four books on critical thinking, as well as 24 Thinker's Guides. She has presented workshops to more than 50,000 educators.



**Dr. Richard Paul** was a leading proponent of critical thinking until his death in August of 2015, and in his work and legacy, Paul remains an international authority on critical thinking. He founded the Center for Critical Thinking at Sonoma State University in 1980, followed by the Foundation for Critical Thinking. In his lifetime, he developed concepts, principles, and theory essential to a robust and fairminded conception of critical thinking; he worked tenaciously to advance ethical, or strong-sense, critical thinking throughout education and society. In his lifetime, Paul authored more than 200 articles and seven books on critical thinking. He presented workshops to hundreds of thousands of educators over his 35-year history as a primary leader in the critical thinking movement.

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