A Guide to Essential Thinking,

with Pictures that are Usually Irrelevant to Anything Except on Days When the Author is Feeling Particularly Creative about Making Connections, which Connections might be of Questionable Value, even though the Many Pictures Themselves are Interesting and, it is Hoped, the Content is also Interesting

A picture of a frog climbing a wall in Kruger National Park, South Africa

In the more introductory material, we covered several reasons why we might not want to engage in essential thinking. This page provides a reason why we might want to (from *John Brown's Body*, by Steven Vincent Benét): "Some men wish evil and accomplish it/ But most men, when they work in that machine,/ Just let it happen somewhere in the wheels./ The fault is not decisive, villainous knife/ But the dull saw that is the routine mind." Essential thinking protects people from developing routine minds. (If essential thinking becomes routine, I'll have to change the quote, but I'm not optimistic that essential thinking will ever become routine.)

A picture of a dragonfly in Lake Superior Provincial Park, Ontario

Essential thinking provides a set of tools for evaluating information (there are some hints about finding and organizing information, but those can be considered different projects). We need a distinction at the

outset between truth and facts. Truth, and lies, are statements or beliefs or opinions about facts. Facts exist as they are. There are many theories of truth. Facts as such do not require a theory. There are many layers of truths or lies: a scientist will collect and analyze some facts, but not others, based on beliefs and opinions, and then that scientist will present those facts and analyses in certain ways depending on beliefs and opinions. Another scientist will critique that collection and analysis and presentation based on other beliefs and opinions and will collect and analyze and present different facts based on different beliefs and opinions. People believe that they are speaking truly when they believe what they are saying. People believe that they are lying when they do not believe what they are saying.

People who talk about The Truth—sometimes capitalized, usually with a definite article, believe that their opinions about facts (or about anything) are the only valid/useful/accurate/whatever opinions. Note that what people believe are facts is a belief, not a fact, except insofar as there is the fact that they hold a belief, and what people are willing to collect and analyze is a result of an opinion or belief, not a fact. Note also that people can have layers of beliefs, including beliefs about beliefs: They can believe that something is a fact, whether it is or not. They can believe that some facts are better/worse/more-factual/less-factual than other facts. They can believe that their beliefs are the best/only beliefs. Etc.

This is a picture of the author holding a kinkajou in Peru.

The cheat page: the quick version of essential thinking is to first and always be honest and direct about what is right in front of us. People get into habits of thinking for various reasons: convenience, lack of time, lack of energy, inadequate information, general laziness, wishful thinking, etc. But the place to

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start, and the place to go back to when thinking becomes complicated, is always: what is happening right in front of me? What is here? What is not here?

A picture of water, some logs, a few leaves, a frog, and an amphibian with the body of a frog and the tail of a tadpole. The surface of the water has many colors, depending on reflections and depth and what's in it, near it, or under it. That's some of what's right in front of me when I'm looking at this picture.

Someone told me once that it wasn't polite or socially acceptable to disagree with anyone's beliefs or opinions. For better or worse, it is only possible to disagree with opinions or beliefs. The thing that is there is the thing that is there, regardless of what anyone thinks of it. A rose by any other name would smell as sweet, because the name, categorization, or label, is a way of thinking about or presenting the fact. The fact is that there are chemical compounds that can be detected by functioning olfactory nerves, which is then interpreted as scent. There can also be layers of facts: The molecular mix is a fact. The measurement of the amount of a molecular fix is a fact about the fact of the molecular mix. Essential thinkers will make a distinction between a bare fact of reality and the fact of measurement, because these are not the same things. The experience is a fact for the person having the experience. The person's opinion of the experience is true for that person. It is a fact that the person has an opinion. The person's expression of the experience to others might be true or false, accurate or inaccurate, depending on how well the person's understanding, or lack thereof, of truth and fact is working. Sorting between and among facts, opinions, and truths can be complicated, but it is essential to make the distinctions, and it is essential to think carefully about the cases that seem to cross categories.

One can be right/accurate or wrong/inaccurate about facts, and one can be honest or dishonest about truth.

A picture of a howler monkey lounging in Peru. The fact is that this is a picture of a howler monkey. The truth is that I believe this howler monkey was lounging. Actually and factually, this is a picture of a red-faced uakari (*Cacajao calvus*), in Peru. Truly, I do think this uakari was lounging at the time that the picture was taken. My opinion about the uakari makes not a lick of difference to the uakari or his activities that day, but you might think that the uakari was doing something other than lounging: what else might the uakari be doing?

There are some basic principles that help people to get started in essential thinking. In this section, the information will be kept as general and basic as possible in order to move toward more specific information later.

When does an elephant cross the road? Whenever he darn well pleases. This one was in Kruger National Park, South Africa.

There's another word that has come into this text that hasn't yet been covered: information. For the purposes of this project, information is a meaningful presentation of a conceptualization (an idea). Information can be provided about conceptualizations of facts, about beliefs, about beliefs about knowledge, etc., and it can be provided in many different forms: language (my personal favorite), behaviors, music, etc. That there is information is a fact, and there can be information about information (meta-information) in many layers.

A picture of a bee on a flower along the Weatherford Trail on Mt. Humphreys, Arizona

Asking good questions is the first and most important step. Good questions usually share some common characteristics. Some questions that don't follow these patterns might be good questions, but I'm focusing on the most usual ways to ask good questions.

Good questions are usually open-ended, starting with content interrogatives like 'what'/'why'/'when'/ 'how much'/'how many' (questions that ask for facts), 'how' (questions that ask for procedures or process), or 'why' (questions about causes).

Good questions are usually seeking clarification, more specific information, or possible outcomes.

Good questions are worded and structured as clearly and specifically as possible in order to elicit the most relevant answers possible.

It might not always be possible to ask a question that elicits the desired information on the first attempt, but the great thing about good questions is that they can result in good information that teaches us enough to ask better questions, questions that are still more specific, or more precise, or deeper.

Most good questions have more than one good answer. It is often productive to ask the same or similar questions of different people or to keep good questions in mind when looking at a variety of different sources. Keep asking and asking and asking.

A picture of a giraffe in Kruger National Park, South Africa. I want to be a giraffe if I grow up. People have told me that I can do anything I put my mind to. Either I'm not putting enough of my mind to the task of becoming a giraffe, or I'm already a giraffe (maybe this is a picture of me), or people have told me nonsense. Which do you think is mostly likely, and why?
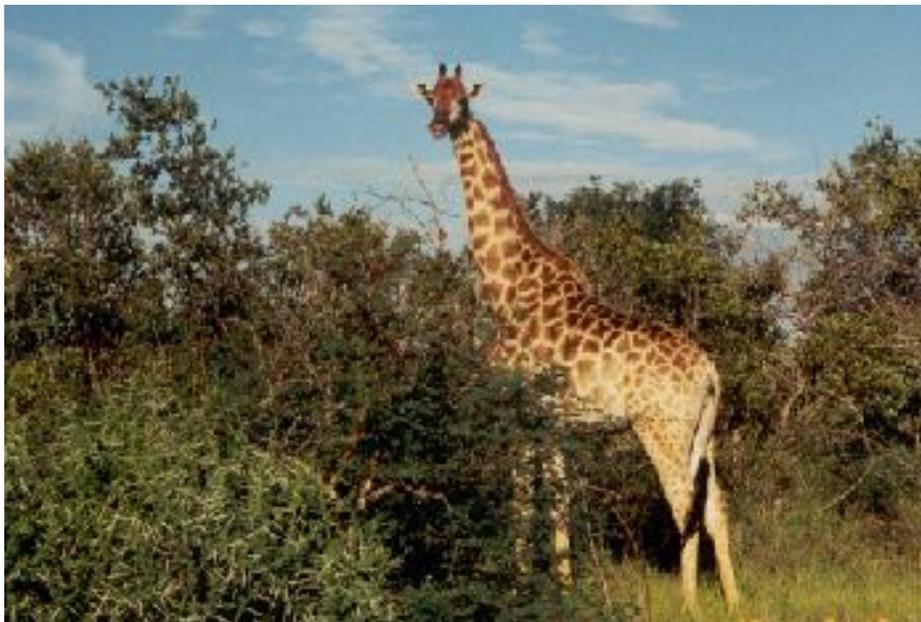
A skill, and second step, that is almost as important as the ability to ask good questions is to be a good listener. The best question in the world is useless if we don't listen carefully and closely to answers.

When listening, we need to remember that there are multiple good answers, and be ready to take in as much of the variety we can possibly find and take in. I call this open listening. This kind of listening leaves in the background any kind of attempt to answer, or evaluate, or critique. Many people don't really listen because they're more concerned about what they think or about what they want to say than they are about learning about something they don't already think. Listen first. Only listen first.

Eventually, answers tend to coagulate into groups or patterns of answers, and it's important to pay attention to that process, too, as well as to the patterns in asking questions.

When listening, we need to keep the question in mind so that we know if answers are actually answering the question. If the answers are not answering the question, maybe we need to ask the question again or figure out a way to reword or restructure the question, or maybe think about whether we have asked the wrong question, or maybe we need a different source for answers. For example, when I asked someone why salt wasn't being used to melt snow on roads in Anchorage, Alaska, one answer I received was "salmon." This did not really answer the question: it assumed that I would make up the same story that the someone expected me to, but I probably won't do that, because I don't know what story she intended. Her mostly uninformative, one-word answer did give me some good information, and that was that I needed to ask someone else, which I did—several someone elses.

When listening, we need to make sure that we take the time for listening. Answers aren't always simple or fast, but if we really want to learn what we need to know to engage in essential thinking, we have to be willing to put in the time and energy.

A picture of a lion strolling past a large herd of several different kinds of animals

It might also happen that we are asked to answer some questions. When we answer questions, we also need to be good listeners and make sure that we understand the questions. This might mean that we need to ask some secondary questions, while remembering the original question so that we don't change the subject accidentally (or intentionally) but do get back to the main inquiry.

A good answer answers the question as accurately and honestly as possible.

A good answer includes all of the relevant information and does not oversimplify the information.

A good answer might need to correct an inadequate question. If a question asks for information that, according to our best information at the moment, is inaccurate or dishonest, we have to make a note of that inaccuracy or dishonesty in order to answer to the best of our current ability.

A good answer does not assume that the person asking the questions thinks all of the same things that we think, in the same ways that we think them, for the same reasons that we think them. It can take some time to answer well. "Salmon" is probably not going to be our best answer to most questions. A person who is answering well takes the time necessary to answer well.

A picture of a moose amidst the trees of a small apple orchard in New Hampshire.

Maybe questions aren't always given in the form of a simple content-question, and sometimes answers don't always take the same form. Sometimes, we ask our own questions and need to write down our answers, such as for research papers, or maybe a question is assigned, or maybe a question results in multiple answers that we want to discuss. In such cases, we might need to describe answers in more detail. Sometimes, we are required to pick an answer and provide evidence for and against it. This is called making an argument. The basics of constructing a good argument will be included later.

A picture of a crayfish found in Tremen State Park, Enfield, New York

So far, the information about how to think essentially has all been about information. Information is crucial. One cannot think essentially without information, and it is often better to have more information than less information, but quality of information is even more important. Sometimes, more information isn't helpful because it's not improving the quality of the information available or it's redundant with high-quality information that's already available, in which case, the search for more information might be more of a waste of time and energy than necessary. And sometimes, when there doesn't seem to be higher quality information available, it's better just to hold the possibility of better information open until it becomes available or can be made available. The best information is the best information, even if there isn't much of it. So we need to do some thinking about what makes some information better (or worse) than other information.

A picture of a goose friend of the author at a hotel in Monterrey, Mexico

So the third main skill for essential thinking, in addition to asking good questions and listening well to answers, is to evaluate information. We'll get into more details on this in the second and third parts of this ever-expanding tome, but meanwhile, we can cover some general principles, which is what this first part is about, if I can keep from wandering off into details.

A picture of a most handsome peacock at the hotel in Monterrey, Mexico

When evaluating information, a good place to start is to recognize the fact that there are different types or levels of information. There are basic facts, there are descriptions of basic facts, there are analyses of descriptions, there are categorizations, there are labels of categories, there are measurements of categories, there are interpretations of any of these, and there are analyses of any of these beyond basic facts. These are probably not the only options, or the only interactions between and among the layers, but they are some of the more common types of information and interactions that I encounter. It's a fun commuting game to try to think of more kinds of information and more interactions of information. I think it's a fun game.

A picture of dolphins off the coast of Kaikoura, New Zealand

When evaluating information, it is beneficial to consider the ways in which words are used. I don't mean profanity or politeness here. Profanity can be used precisely and beautifully, and politeness can be used to do harm. When words are defined so that everyone knows what is meant by key terms, that's a good sign. When words are used precisely, that is a good sign. When words are used to make relevant distinctions rather than blurring different concepts or phenomena together, that's a good sign.

A picture of a seagull walking along the beach in Rhode Island; it's 'the' beach because I think the coastline of Rhode Island is too short to bother making distinctions between different sections of beach. This bird is almost to Connecticut—and Massachusetts.

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It is also beneficial to consider how much information is given, and whether the person providing the information is honest and thorough about how the information was gained and about all of the information. Good information includes as much information as possible, whether it lines up with the conclusions reached or not. Good information does not eliminate oddities because they don't fit. Good information makes clear where the information came from and how it was collected and the limitations on what could be collected or included. It's probably impossible to have all of the information, or to include even all that is available, so choices have to be made, but good information comes with good information about how decisions about information were made.

In the forests of oyamel firs in Mexico, millions and millions of monarch butterflies gather to spend the winter, breed, and die. Their descendants migrate back north. There are so many butterflies that enormous trees bend and sometimes break under the weight of the butterflies. Have you ever considered the damage that the weight of a butterfly can do, if one happens to be an oyamel fir?

Information that is good does not include information of a type that is different from the information that is being analyzed. If a description is undertaken, information is descriptive. If an analysis is undertaken, information is analytical. Those presenting the information might make hypotheses about how an analysis might go, after completing a description, but until the analysis is conducted, those hypotheses are conjectures (guesses) and need to be treated as such. It's not essential thinking when one kind of information is presented as conclusive in another domain of information.

A picture of a bird on the North Kaibab Trail in the Grand Canyon, Arizona

Another, usually useful, consideration is to examine how the information is organized. Information that is well organized has usually been handled carefully throughout its process of collection and presentation. There are many ways to organize information, and there are some culturally constrained patterns on how information is organized, so flexible thinking is important to essential thinking. Organized information provides a main idea and various supporting information for that idea, and disorganized information provides any number of ideas without adequately supporting some or any of them. There can be sub-ideas on the way to a main idea, but they're also moving toward the main idea. Organized information has a purpose and moves toward that purpose. But the purpose needs to be evaluated, too. Organized crime is still crime, and organized propaganda is more effective than disorganized propaganda.

A picture of another monarch butterfly in Mexico, this time on a plant that is not an oyamel fir

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It is also important to look at which kinds of facts underlie the information provided. Layers of information are possible, so we keep in mind that there is what there is, and then there are observations/descriptions and categorizations and labels and measurements and interpretations. Each of these kinds of information can be useful in the right domains, but the careful essential thinker will make these distinctions and evaluate the information accordingly. The careful essential thinker will also think about whether there are facts relevantly involved at all, or whether there are so many layers of information beyond basic facts—interpretations of interpretations of interpretations, for example—that any of the basic facts have been lost in the mists of, in some cases, millennia of interpretations.

A picture of a spider who has built a trap-style web, and wow—what a web.

Which brings us to the last general idea for evaluating information that will be included here: the ways in which it is indicated that the information be used. When a source of information suggests or states that interpretation-level information should be used to work with the most basic types of reality, there is a problem. When descriptions are presented as interpretations or analyses of some kind, there is a problem. When interpretations are presented as basic facts or descriptions, there is a problem.

A picture of a black squirrel who aggressively insisted on sharing my snack with me while I was taking a break from hiking up Yangmingshan in the Yangmingshan National Park, Taiwan.

It will be noted that I have not suggested that one look at the source or sources behind information. This might be useful in some cases, but anyone can be in error or unreliable or deceptive or needlessly biased. Government sources of information, which people often think are reliable, are routinely changed to fit the preferences of whichever group or person currently holds the highest position in the hierarchy. Academic sources and experts can be wrong. Majorities are often wrong or, as Ibsen notes, the "majority is always wrong until it does right" (A Doll's House). Review processes are only as good as the reviewers, and that process can be corrupted by a variety of processes. Etc. Nevertheless, the 'who' matters, but it's not the first consideration.

A picture of a spider on a box in Flagstaff, Arizona

In addition, a terrible source can still provide excellent information. For example, I've already been misleading about the picture of the uakari, and yet, here we still are, learning about essential thinking from someone who's demonstrably imperfect or at least giving reason to believe that I'm willing to mess with people. Good luck with that.

Monarch butterflies are not the only butterflies in Mexico. This is a picture of another kind of butterfly on a columnar flower stalk in an oyamel fir forest.

I also have not suggested that more recent information is better than older information, which is another common mistake that people make when evaluating information. Good information is good information, no matter how old or new it is. In some fields of inquiry, recency might be important, but closeness to basic facts matters more: Aristotle's idea that men have more teeth than women was well replaced, once someone finally backed up the information truck enough to count some people's teeth—counting is closer to the basic facts than is pronouncing upon a subject without recourse to facts.

A picture of an insect on a bench where I stopped for lunch outside a national park in the Bohemian Switzerland National Park in the Czech Republic

And I have not suggested that information is better if it is more well-known or presented in well-known publications or other media. Terrific information often languishes in the hinterlands of the world of information, and terrible information is often widely distributed and widely believed. Good information is good information no matter how readily available it is, or not readily available, and poor information is poor information, no matter how readily available it is, or not readily available.

A picture of a frog in Prague. Not really—the frog was in the Bohemian Switzerland National Park, too, but that doesn't rhyme, and I wanted to rhyme. A frog not too far from Prague by train would be relatively accurate.

And I most definitely am not suggesting that numbers speak for themselves. Information does not speak for itself. In the ways in which most scientists and statisticians use them, numbers are labels for categories of quantities that have been decided on in advance. So it's a fact that there are numbers used to label quantities and that those quantities can be relevantly compared to other quantities, if the quantities are applied in the same ways to the same categories of the same things. But the quantities of categories being labeled with numbers do not speak for themselves, and slapping numbers on anything doesn't cancel the need to make a case for the interpretations being constructed. Assuming or believing that numbers speak for themselves is the start of many problems in thinking.

A picture of a frog in Acadia National Park, Maine

When essential thinking is used to reach an outcome, it can be understood as a type of problem-solving. But not a problem, because situations that need essential thinking are more like puzzles, and not solving, because most good thinking doesn't reach a single, once-for-all-time solution but opens up options and helps us find ways to think about the options. Essential thinking is valuable because it helps us to ask better questions, in other words. It's complicated because, ideally, there will be multiple possibilities at each step along the way, as well as when we get to the end of the puzzle by having worked on each part of the puzzle. So there needs to be a way to make decisions, and it's important to keep track of the decisions made so that different decisions can be tried. Most people think that making a decision and playing a puzzle are pretty much the same sort of process, but I like to assume each of the possible decisions and run thought experiments to think about what options might be better or worse. The main trick is to think about both positive and negative outcomes if various possible decisions are made. Sometimes, people think only of what they want to have as an outcome, but that's not enough essential thinking. Keep going.

A picture of a butterfly on some gravel along the Kapuas River, West Kalimantan, Indonesia

The main reason that I like to think of essential thinking as puzzle-solving is that I like to have something of an algorithm that I can use, a process that I can follow, in broad outlines. More than one algorithm, preferably: options at every step. It's important not to get stuck following a process, or stuck anywhere doing anything, because that kind of stickiness isn't essential thinking. It's robotic and/or lazy and/or a sign of inability. But it's helpful to have a way to start, and then, because we're also thinking essentially even about essential thinking, we can make adjustments as necessary as we go along. So here's a quick version of a few commonly useful options.

A picture of an enormous spider in the process of eating a moth in West Kalimantan, Indonesia

Conscience: I haven't done anything with ethics or morality yet in this study, and I'm trying to keep that to a minimum, but it doesn't hurt to consult one's conscience when making decisions about how to proceed. If a decision is likely to lead to the suffering or deaths of people or other valuable (and valuable in the sense of important, not in the sense of being financially rewarding—a lot of terrible decisions are made because a lot of people think that money is the only or primary thing that matters) creatures, then maybe we need to consider other options. It's important to recognize that a lot of what people prefer is not about morality: whether to eat meat, or to eat monkeys, horses, dogs, cats, insects, other people. It's about money or convenience or tradition or or or… Most decisions are about personal or cultural preference, and when those preferences are accepted by most people, most people then confuse those issues with morality. I'm not in favor of eating millipedes, for example, but for all I know, these could be delicious and nutritious, and my health benefit might outweigh the deaths of the millipedes. But that's a tricky decision.

A picture of some millipedes that used to be under leaf litter in West Kalimantan, Indonesia, until someone kicked over the leaf litter so that I could see them

Real moral or ethical issues (ethics and morality are different, but I'm going to skip over that for now, but the general idea is that ethics is the study of morality, and morality is people's decisions about what's right or wrong) are surprisingly consistent across individuals and cultures. Immanuel Kant called the consistent idea the moral imperative, and I had an English professor who called it reciprocity. More commonly, we might think of this idea as fairness. All over the world, in people of all kinds, we have a sense of what's fair and what's not fair. It's fair if what's okay for you is also okay for me. It's not okay for you to come to my house and steal my piano because it wouldn't be okay for me to go to your house and steal your piano. It's not okay for me to kill and eat you because I would object to your killing and eating me. A lot of interpersonal and international problems arise because of unfairness.

A picture of an insect on my backpacking tent

When fairness doesn't resolve the difficulty, there's the cost-benefit analysis approach. Is my health and well-being more important than the health and well-being of some millipedes? Or than a cow? Or than a carrot? Life requires a lot of death. Is it better for me to take a nap today or to finish reading a library book that's due tomorrow? If I take the nap, I feel better. If I don't return the book on time, I pay a fine. Or I can be tired and save some money. Should I eat the cookies or the carrots? And this leads us to another set of possibilities.

A picture of a toad along the Finger Lakes Trail in NY

And those are time, place, substance, and contextual considerations. Maybe I should eat the carrots now, and see if I'm still hungry before I eat all of the cookies. Or limit myself to one cookie. Maybe I should eat a cookie today, and save the carrots for tomorrow. Maybe I should make a hamburger. Maybe the jeans are fine for schlepping through the undergrowth, but the orange fish pants are more comfortable for the plane, and the black pants are more appropriate for the job interview. Maybe if I cut out cooking and just have the cookies and carrots for supper, I will have time to nap and finish the book. There is rarely only one answer because there are multiple approaches to any given problem.

A picture of a bat napping in a shelter along the Finger Lakes Trail, NY

Moderation: extreme options are rarely the best options. All spiders are bad and should be squished. Well, no—spiders are essential creatures on the planet. All sugar is bad and should not be eaten. Well, no—an occasional cookie is a pleasant treat, and most foods are digested into sugars, anyway, so even if we don't eat sugars, we still have sugars that we're living on. All [insert target minority-du-jour here] are dirty, poor, murderous, parasitical, whatever. Well, no—it's rarely the case that everyone in any group has all of the same characteristics.

A picture of a caterpillar on a shelter along the Finger Lakes Trail, NY

Getting to the source: dealing with symptoms can take us a long way, but it's even better if we can stop the problem from arising. An ounce of prevention is worth a pound of cure or a lifetime of treatment. So if we need to make a decision, if one option works toward dealing with the source of the problem, and one option covers up the problem temporarily, it's usually preferable to take care of the source. Heal the wound. Don't just cover it with a bandage. But sometimes, the bandage helps toward healing. The available options and processes need to be considered.

A picture of a ladybug on my tent

All of the problem-solving patterns rely on honesty. Honesty is more difficult and more complex than most of us imagine. Not-lying is a good start, but it's not nearly enough. We need to be honest about what's right in front of us: not an insect and a tent and a house and a car and some trees and a lawn, but a picture of those things. We need to be honest about why we do what we do. We might agree with someone in order to avoid an unpleasant discussion, but the ideas with which we agreed might not be our ideas. We might agree with an idea because we aren't familiar with other ideas, but the honest assessment is that we are ignorant in that case, not in agreement.

Another picture of my yard tent, but with a praying mantis

Then we need to make a decision about how to proceed. Maybe no decision is required. Maybe we just learned a variety of strategies we can try for a certain kind of puzzle, and we keep those strategies in mind for the next time we do that kind of puzzle, as well as our preferences about those strategies. But if we need to make a decision, we can, and we can also provide evidence for why we made that decision because we were explicit about and organized the evidence all the way along until we made the decision.

A picture of a moth with blurry wings, somewhere.

(A thought experiment is an experiment that is only carried out by imagination; they're not perfect, but they're useful, especially when one can't try out everything for real. The important part of a thought experiment is to be honest and not to avoid possible outcomes because we don't like them.)

A picture of a beaver in the water at Voyageurs National Park

When we keep going, we eventually reach some kind of outcome, even if only an imaginary outcome. There might be multiple outcomes; that's the funnest. Then we can evaluate possible outcomes. This is where it's important to remember the context in which the puzzle exists, because different kinds of benefit might be preferred in different contexts. Maybe we choose an outcome as better than others because it is new (maybe I want to go somewhere different for a vacation, so a new country would be preferable to a place I've already been); or because it's the best resolution to the puzzle (the picture on the puzzle is clear, rather than, say, a tower of pieces); or because costs are minimized and benefits are maximized; or because it meets the constraints (it could be possible to make a better flight experience, but regulations on the entire aviation industry limit the amount of creativity people can apply to the problems that currently exist); or because it's the most understandable option (it's the outcome that will make the most sense to the people who need the outcome); or because it's the most beautiful outcome (why have a dumpster when one could have an igloo?); or because… And then we can make decisions, or at least be honest, about which betterness is the better betterness in any given situation.

A picture of the ventral aspect of a gecko on a screen in West Kalimantan, Indonesia
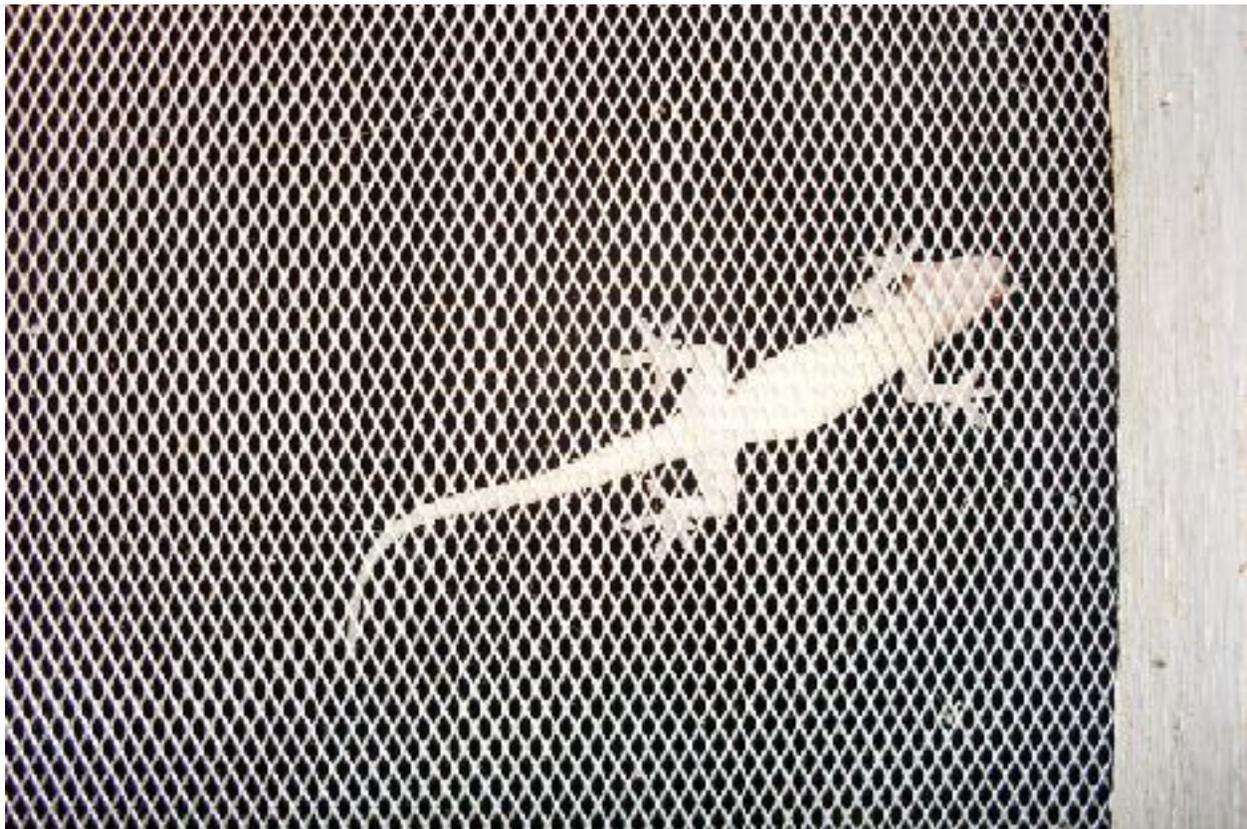
Peter Lipton wrote a good book that was published in 1991. His book was called *Inference to the Best Explanation,* and he has criteria that are more cleverly labeled and explained than the ones I just put on the previous page. If evaluating possible solutions in various ways is of interest, his book is definitely something to read.

A picture of a tree lizard on a rock

Maybe an example would help. I'll use an example from a book that is my currently favorite introduction to logic, *Introduction to Logic*, by Irving M. Copi. The title itself is a clear statement of fact. I have the 5th edition. One of the features that I appreciate most about this book is that there are puzzles at the ends of sections. One of the features that the book should include is a set of instruction for how to approach such puzzles, but in Copi's book on logic, problem-solving is assumed to be a skill that people already have. I don't think that's a reasonable assumption. But I can do differently here, based on a different assumption. The essential thinkers among us can decide which assumption is more beneficial in various ways.

A picture of a larva on pavement, somewhere.

Step one is to identify the problem or the puzzle. Here's the puzzle, from p. 48, given some light editing: "In a certain mythical community, politicians never tell the truth, and nonpoliticians always tell the truth. A stranger meets three citizens, and asks the first of them: 'Are you a politician?' The first citizen answers the question. The second citizen then reports that the first citizen denied being a politician. The third citizen says that the first citizen is a politician. How many of these three citizens are politicians?"

What do we need to figure out? This little puzzle makes the question explicit: how many of the three citizens are politicians. Information about what would count as an answer to a question or puzzle is not always readily available, but it's important to find that information, whether it's easy to find or not. And a clear statement, like "how many", is usually a good sign that the kind of information has been found.

A picture of a large grasshopper—note the comparison to the hand-sized hedge trimmers not far in the background.

Step two is to identify what information we have, and what information we don't have. We'll do those separately. We know that politicians lie. We know that politicians don't lie. We know who's lying or telling the truth because we know how the rules of these kinds of puzzles work. We know that Martin Luther was born in 1483 according to the available records and within the Gregorian calendar. We know that there are three citizens to work with. We know what two of the citizens said. We know that what those two citizens said could be lies or truths or some combination of lies and truths. We know that we can consider both of those options for both of the citizens from whom we have statements. We know what kind of an answer would be acceptable: how many asks for a number, so we're looking for a number.

A picture of a nocturnal toad on one of the support beams of the chicken coop in Borneo, Indonesia

What we don't know: what the first citizen said, how many citizens are in this community, what the citizens look like, how the citizens came to be so consistently truthful or untruthful, what color the water bottle is that I'm using today, whether the two citizens we have statements from were telling the truth or lying, whether the narrator of the question was a politician or not. Clearly, we know or don't know more than we need to know or don't know, so we need to decide what's relevant and what's not. My water bottle is completely irrelevant. How many citizens are in the community might be interesting, as might be the history of the community or the calendar, but those aren't relevant to our current question: how many of the three citizens are politicians?

I'd like to start a photodocumentary project for portraits of mantids in Borneo.

Step three is to identify the options. We have statements from citizens two and three, and each of them is lying or telling the truth. Four logical options:

- 2 and 3 are both telling the truth;

- 2 is lying and 3 is telling the truth;

- 2 is telling the truth and 3 is lying;

- 2 and 3 are both lying.

Notice that I kept 2 and 3 in order consistently, and always called them 2 and 3. I could have said that 3 is telling the truth and 2 is lying, but that's an inconsistent presentation. I could have renamed them Blue and Green, but I didn't. The labels don't matter, but keeping track of the options does. Keeping the labels consistent helps me to see exactly what the options are and focus on the options.

A picture of a weird snake in rural Hungary

I could have held the truth/lying options consistent for each citizen. Here's how that would have looked:

- 2 could be telling the truth, and 3 could be telling the truth

- 2 could be telling the truth, and 3 could be lying

- 2 could be lying, and 3 could be telling the truth

- 2 could be lying, and 3 could be lying

Or:

- 3 could be lying, and 2 could be telling the truth

- 3 could be telling the truth, and 2 could be telling the truth

- 3 could be lying, and 2 could be lying

- 3 could be telling the truth, and 2 could lying

Or: …

The crucial factor at the moment is not a certain organization of the information, but holding as much consistent as possible in order to compare what is similar and contrast what is different, and being aware of how different presentations of information might affect approaches to that information. In this case, we need to check all of the possibilities, however we arrange those possibilities, but it's also a good idea to consider the ways in which these different presentations change, or don't change, how we think of the information. And here's a little exercise: come up with another way of organizing this information, while still including all of the options.

A picture of a monarch butterfly in Isle Royale National Park, in August: this was a member of the super-generation, the butterflies who fly all the way to the oyamel fir forest in Mexico.

Step four is to evaluate the options.

- 2 and 3 are both telling the truth: if so, the message is consistent, and the first citizen is a politician, and the two other citizens are not. So 1 of the 3 citizens is a politician, and it's the first guy. This is a good solution, and it's the target solution. We could quit here, but because we're looking at all of the options, and because many puzzles have more than one solution, we'll keep going.

- 2 is lying, and 3 is telling the truth: If 2 is lying, 2 is a politician, and 3 is not. This does not tell us about the first guy, because we have contradictory information about the first guy. Citizen 2 said that Citizen 1 denied being a politician. This is where double negation matters: if 2 is lying about what 1 said, then 1 said that he was a politician. But if 3 is telling the truth, the 1 is a politician, and 1 would lie about that, so we can't believe 2 because this sets up a contradiction about 1.

- 2 is telling the truth, and 3 is lying: This makes 3 a politician, and 1 not a politician (because 3 lied about 1 being a politician). But then 2 is telling the truth about 1 denying being a politician, which sets up 1 in a contradictory position again: a politician and a non-politician.

- 2 and three are both lying: so 2 and 3 are both politicians, but what about 1? We don't believe 2, so we believe that 1 said he was a politician, and we don't believe 3 when he said that 1 is a politician. But if 1 said he was a politician, he would be telling the truth, which is not what politicians do.

Another picture of another praying mantis in Borneo, Indonesia

Marla Perkins, Ph.D.: Essential Thinking, I

Step five is to answer the question. So we have 2 and 3 telling the truth, and 1 is the politician. We had that answer after the first option. And if we needed to, we could take the information from our examination of all of the options to explain why the answer is what it is. And there's a good answer, and a good backup/justification for an answer. Of course, this little exercise is fairly straightforward, but the pattern is useful in all kinds of domains, and even when the complications are much more complicated and numerous.

A picture of a toad emerging from hibernation along the shores of the Königssee in Berchtesgaden. That was timing—I went for a walk one day in April, heard a lot of strange shuffling in the underbrush, and stopped to investigate. There were hundreds and hundreds of these toads emerging from the hillside. To date, this was my favorite European thing ever—not the buildings, not the languages, not the museums, not the usual things that people go to Europe for. I go for the toads.

For more complex material, there might be multiple problems, in which case, we'd have to run the steps for each problem, and then combine the solutions to work on the problem as a whole. Or the situation might be even more complex, with even more layers of problems moving toward a solution. A lot of times, when people can't agree on a solution to a problem or puzzle, it's because there are sub-puzzles that haven't been solved, or even identified, and sub-sub-puzzles that haven't been solved, or even identified, etc. Or different beliefs and opinions about the puzzles and the information that contributes to the puzzles.

A picture of ducks on Lake Luzern (or Lucerne, depending on which language one prefers)

(On a side note: I had a paper critiqued recently, and apparently, I like informative information, complex complications, descriptive descriptions, and such like. The reviewer did not, feeling these to be redundant. Probably they could be, and maybe they should be, but in my experience, they are not. Just something to consider, maybe on a long commute.)

A picture of a bird in Bavaria

I've assumed for the purposes of this section one way of approaching ideas and information, but in all fairness, and to encourage essential thinking, it would be useful to look at several ways to work with ideas and information, so that people can make informed choices about what to do and informed evaluations of what other people are doing with ideas and information.

A picture of elk in Rocky Mountain National Park

Along with a puzzle-solving algorithm, it is also helpful to have some strategies to use to help with each of the steps in the algorithm. One strategy is to think in analogies, or comparisons. How is this puzzle like other puzzles I have solved? How is it different? Nothing is exactly like anything else, so it's important to remember both the similarities and the differences when thinking analogically, using both comparison and contrast.

A picture of fossilized dinosaur tracks in Arizona. We can't see the dinosaurs any more, nor the process of fossilization, but we can see their footprints and compare those footprints to the tracks of other animals that we can observe and begin, through analogical reasoning, to make some relevant guesses about what the dinosaurs might have been doing, while remembering that we still can't see the dinosaurs.

Backward reasoning starts with the solution and works its way toward the problem. This kind of approach works well when the process is the answer, as in working mazes or showing how one reached an answer in math or research. Mazes are a good example. We know where the start is, and we know where the finish is, but we don't know, at the outset, how to proceed from start to finish. And sometimes, it helps to try both directions, working forward and working backward. I often think that math students would be benefitted by being provided the answer and then being required to show the steps to get to the answer. This is sort of what happens when proving a theorem: we know what the theorem is, and we just have to show how to get there. But lots of us resist having to show the work, and find the answer. So maybe we should just provide the answers and asks for the steps, since many of us are too lazy to want to do both.

A picture of my birthday lizard among the Wupatki Ruins. Even though I'm doing essential thinking a lot of the time, I consider the appearance of fabulous reptiles good omens, especially on my birthday. But the rest of that year was rough. Clearly the facts are not backing up my preference that reptiles be good omens.

I had mentioned previously looking for patterns in information. That's conceptual reasoning. It can be useful, or not, depending on how it's used (a principle that applies to nearly everything). The search for patterns can be overblown to the extent that people being to believe in absurdities—this is how we get so many fun conspiracy theories about how the government is trying to benefit or harm its citizens, or about how the aliens live on a planet that's hiding behind another planet, which is why the aliens' planet cannot be detected. When people are making up more information than they have in order to plug holes in the information that they do have, that's a problem. The information and facts have to be more complete than the gaps in order for patterns to be meaningful and relevant.

A pronghorn antelope in the Horseshoe Canyon section of Canyonlands National Park

It's also useful to look for information that isn't available. It's hard to think about what's not available, but it's a useful skill to practice. Sometimes it helps to think about what could be available, but isn't. We do this when working on jigsaw puzzles, and we have most of the pieces of the kitten's blue collar in place, but we can see that a piece is missing, and we guess that the piece probably has some blue on it. Making guesses about missing information is called conjecturing. When using conjectures as a strategy, it's important to remember that the conjectures are just guesses about gaps in the information. Sometimes, those guesses can help us find the missing information, but it's easy to forget that the conjectures are guesses, and then proceeding as if the conjectures are the information we're looking for. We can use the tools, but we have to remember what we're building, and that the tools are not the building. As with the previous strategy, when the gaps are more than the information, the ratio of gaps to information becomes a problem.

A picture of a prairie dog in Theodore Roosevelt National Park. What isn't in this picture? There's no tiger in this picture, and no lake, and no couch. Lots of ways to fill in the gaps of what's not included in the picture.

Another way of using guesses as a tool is to use a heuristic. A heuristic is a procedure that will get us close enough for whatever we're trying to do, but isn't exactly right. Calculus is all about heuristics, but for those of us who haven't gone that far in applied mathematics yet, a more accessible heuristic is thinking of electricity like a fluid—the current flows, and the lights turn on. That analogy is a heuristic that helps us think about electricity, but that's not quite how electricity works. But it's close enough for most purposes, for those of us who aren't specialists.

A picture of a bison in Yellowstone National Park. We didn't even think of Yellowstone not being in the picture of Theodore Roosevelt, but it wasn't. Most things aren't there, wherever there is. The gaps are bigger than the substance.

Prediction is a tool that makes conjectures, or guesses, about the future. The future is a big gap. The only way to check predictions is to wait for whatever was expected to happen to happen. And that's the big problem with prediction. The deadline for when whatever is predicted to happen can be pushed farther and farther into the future without ever disproving the prediction. Predictions that come with timeframes are better, because at least we can tell if the predictions were accurate within the timeframes provided. But not realizing a prediction within a timeframe doesn't necessarily disprove the prediction. It might just disprove the timeframe. And we're back to the original weakness with prediction. Prediction works best as a tool when the timeframe is built into whatever we're making predictions about. If I predict that someone will win a game, then the timeframe is built into the game. Even cricket games eventually end, and most games have clearly defined end points. The clearly defined end points help make prediction a useful tool.

A picture of a butterfly in Grand Teton National Park

Marla Perkins, Ph.D.: Essential Thinking, I

Relational thinking is a kind of analogical thinking. It's a structured way to make comparisons or contrasts between selected items: things. Ideas, people, meanings of words, etc. Standardized tests have often evaluated relational thinking: a sapling is to a tree what a puppy is to a/an: A. elephant; B. dog; C. computer; or D. worm. If you said B, congratulations. You're relational thinking is intact, at least right now and at least for this language and culture. One of the problems with relational thinking is that it relies on shared assumptions about what matters and what's expected and what pieces of information might be the most relevant: these kinds of information are cultural and part of the information conveyed in a language. If we want to be creative essential thinkers, we could think of ways in which the relationship between a sapling and a tree is like the relationship between a puppy and a computer. Or between a puppy and anything else. Another difficulty with relational thinking is that we need to have a lot of information that we already know, and a pretty good idea about the information that is not in place yet. But the structure of relational thinking can be helpful, especially when we do have a lot of information available and we're trying to figure out the relationships that are relevant between and among pieces of information and kinds of information and topics of information.

A picture of fish in a lake in Glacier National Park

I mentioned thought experiments. Thought experiments are a way to consider a variety of options and possible outcomes without having to commit ourselves. It's easy to change our minds, if we want to, but it's not easy to move the bridge to another part of the river. As I sit here, I can think of how I might like to organize my library the next time I move. Alphabetical by author's last name, alphabetical by first substantial word of the title, by topic, by how often I use the various books, etc. I have a lot of books. I can spend a lot of time and energy shuffling books around, but if I think about the books ahead of time, I can imagine how I would use my library when organized in various ways, and think about which way I would prefer to use my library, and then set up my library in the way that I want it to be set up. I could avoid some shuffling and go straight to a useful library. One of the drawbacks of thought experiments is that they are just about thoughts. Maybe once I get my library set up, I find that I'm using it differently than I thought I would, and I end up needing to shuffle the books around again, anyway.

A picture of many, many ladybugs, somewhere

A friend of mine has a specific kind of thought experiment that he likes to conduct. He calls it polarizing. Instead of checking a lot of different possibilities when he's trying to make a decision, he thinks primarily about the worst possible outcome and the best possible outcome. According to him, doing this kind of thinking helps him to clarify the components of the decision that are most relevant to the outcome. I'm not convinced. The main problem with thought experiments, and with the polarization version of thought experiments, is the range of one's imagination. I can get to the end of the world (or utopia) from the color of pants that I chose this morning. The end of the world might be a worst-possible-outcome, but I also know that the color of pants that I wear probably matters only to me. So using thought experiments of whatever flavor needs to be only one part of the process. Another part of the process is thinking essentially about the thinking that one is doing when one uses the experiment. The end of the world from the color of my pants is too much, and I can think about that and back up the thinking truck and take a more reasonable route. In case you were wondering and in case the world comes to an end soon: I chose the multi-colored striped pants today.

A picture of a butterfly whose chrysalis was kept in a plastic jar at a butterfly research station in Peru. The adult butterflies are sometimes kept as breeding stock in the butterfly house, and sometimes they are released into the forest. How does that decision get made? Let's think of the best and worst outcomes of releasing the butterfly or breeding the butterfly (so four options: best and worst of releasing, and best and worst of breeding). Can you get to the end of the world or utopia from either releasing a butterfly or breeding a butterfly? If so, thought experiments might not be the best tool for you.

Marla Perkins, Ph.D.: Essential Thinking, I

One of my favorite tools is brainstorming. Favorite because I like the results, but not favorite because it usually generates far more material than I can possibly use. Brainstorming is generating as many possible ideas or options as we can, without cutting ourselves off because some ideas or options might be silly or impossible or ridiculous. Brainstorming is great because it allows us to get as many ideas and options as possible into consideration. Some of the ridiculous or impossible or silly ones might not be so ridiculous or impossible or silly once we have a chance to evaluate them rather than dismissing them.

A picture of a bison in Yellowstone National Park

If we're trying to figure something out, we can imitate something else that worked. Maybe I want to learn how to weave. I could read a book about weaving, or watch a documentary, or even take a course. Maybe the best way to learn to weave would be to sit next to someone who knows how to weave and imitate what that person does. This all sounds wonderful, but as with any tool, it's only good for what it's good for. Imitation can be difficult if there is too much of a gap in ability or knowledge between what we're currently able to do and what we're trying to be able to do. I can sit next to a concert pianist who's doing what she does best, but that doesn't mean that I'm going to become a concert pianist. If I wanted to move in that direction, I would be better off imitating the practice habits of the concert pianist.

A picture of birds in Yellowstone National Park

Marla Perkins, Ph.D.: Essential Thinking, I

Dialectical thinking involves taking two (or more) ideas that seem to be incompatible with each other and then thinking of ways in which those ideas can be compatible. This has been a fun game in theology and philosophy for millennia. How can three things be one thing, and one thing be three things? People have died disagreeing about answers to that question. Maybe 'fun game' was the wrong expression. This tool can result in a lot of creative solutions when used well, but it can also result in nonsense and violence, when people take their tools, and the results of their using their tools, too seriously. Taking things too seriously often ruins what could otherwise be a fun game.

Another picture of another prairie dog in Theodore Roosevelt National Park

Synectics is a great word, and a great tool. When one is using synectics, one flips around whatever one already thinks. If I prefer an idea X and disprefer idea Y, then for the sake of making some progress on whatever I'm thinking about, I flip those around: I prefer Y and disprefer X. This can be tricky to do, because sometimes, we have ideas that we really like for whatever reason. But our strong preferences also make synectics a good exercise. Maybe we find that our preferences are not as helpful or as useful as we might prefer. Maybe the whole thinking project can work better with different preferences. Synectics is a way to check out own thinking, and our own process of thinking, and as such, it is extremely valuable. I recommend this thinking tool highly.

A picture of goats on a driveway in Montana

Another good thinking tool is to try something and see how that something works. This is not the strategy when a decision cannot be reversed readily, but for example, if I'm having difficulty deciding which hiking shoes I should wear for a significant hike, sometimes it helps to try a pair out on a long hike, and a different pair on a comparable hike, and then see which one I think will be better for the expected conditions of the main hike. Maybe one pair of shoes gives me blisters, and another pair is comfortable mile after mile after mile. This tool is called trial and error, because some of the things that we try might not work out so well, like the shoes that gave me blisters. I can definitely try something else if the outcome, blisters, is not what I would prefer.

A picture of wild horses in Theodore Roosevelt National Park

When there are constraints on material so that there is a limited and relatively small number of possibilities, process of elimination can be helpful. When I do sudoku, when the numbers 3-9 are taken in a box, row, or column, I know that 1 and 2 are the only possibilities left in that box, row, or column. If there are A-D options on a test, and A, B, and D are obviously incorrect, I know that the answer is C, because of the rules for multiple-choice tests and because that's the only option left, even if I don't know anything about C. If I'm babysitting three children, and two of the children are in the room with me, I know that I need to go corral the third one.

A picture of a tick on my sock in Theodore Roosevelt National Park

Sensory input of various kinds can help with thinking. Some people think better with music or with chaos or with silence. I do well with classical music from the Baroque era and from the early 20th century. The Romantic period is too schmaltzy and gets in the way of my mental clarity. But I've met people who do well with music from the Romantic period. I have a hard time concentrating when the setting is chaotic, such as at a fast-food restaurant, but there are people who do their best thinking when they're in that kind of a place. Absolute silence is a tricky one. Sometimes, it works for me, and sometimes, it gives me too much room to distract myself. There are other senses. I don't think well when my clothes are scratchy or my shoes are too tight. I do think well when there is a nice breeze, up to and including a balmy wind. Each of us has to play around with conditions to see what works best for us, and then when we know, it's helpful for essential thinking when we can get as close as possible to the conditions that work for us.

A picture of a bison in Theodore Roosevelt National Park

Presenting information to ourselves in different ways can also be useful. Sometimes if I'm thinking about a topic that I learned about from a lecture, I can think more productively about the topic by drawing or writing: moving the auditory information into a visual or verbal form. Or maybe if I read about a topic, I can think more productively by talking about it: moving the verbal information into auditory form. Changing the presentation can change how I think, in good ways. Again, this is a strategy that each of us needs to play around with. Some people do far better with making information visual, for example, and some people can be more flexible about how they represent information, potentially benefitting in various ways from a wide variety of presentations. Changing the form of information is also a good exercise because it helps us to be aware that information is information, regardless of the presentation: if we can think of a way to represent information from a lecture as perfume, that's great. If information is spoken or written, both work. Preferring one kind of presentation is something we can learn about ourselves and use to our advantage as essential thinkers, but we also need to remember that other people might have other preferences for how they present or encounter information. Use the tools, but don't be a tool.

A picture of moose at Isle Royale National Park

My absolute favorite thinking tool is sleeping/daydreaming: giving my brain some time off to reset itself, without concentrating on an outcome that I need or want to reach. Thinking can be done without trying, as any of us know who have had a flash of insight at two in the morning after having a good sleep until two in the morning. Sometimes, I don't even have to sleep. Sometimes, I can get on with my day with a task that is not otherwise related to whatever thinking I'm trying to do. Maybe a solution comes to me, or another approach to whatever I need to think about, or several additional pieces of information that I hadn't been considering. That sort of thing. The downside of letting our minds work while doing something else is that outside observers who have not made it a point to become essential thinkers have no idea that work is still happening while non-work tasks are happening. But there's little to be done about that kind of ignorance, and so much for them. We have essential thinking to do.

A picture of a green beetle in Arizona

There are many other thinking tools and strategies, but these are enough for now. As usual, it's not the terms that matter (although synectics is a great word and a great strategy), or following a procedure exactly: the essential thing is doing the essential thinking, and thinking essentially about essential thinking.

A picture of an osprey on a nest in Idaho