Critical Thinking Skills Tutorial:

Logical Method:
Induction and Deduction

Writing Center

English 800 Center

YOU DO NOT NEED TO

PRINT THIS TUTORIAL!

All notes and exercises should be done on separate sheets of paper, which you will bring to an Instructional Aide in the Writing Center.

As you work through the tutorial, make sure to see an instructor in the Writing Center or English 800 Center if you have any questions or difficulties.

Logical Method: Induction & Deduction

Imagine yourself as a primitive human, wandering around the plains of Africa millions of years ago. You come across a new tree with rich, red fruit. You pick a piece of fruit; you eat it. An hour later, you become violently sick. You make a mental note that this tree's fruit is poisonous.

A month later, you come across a tree of the same species. This time, you know to avoid the fruit. "It's poisonous," you explain to the rest of your group.

This is an example of how **inductive** and **deductive** reasoning combine to help us learn about the world. We all use both methods of drawing conclusions from the evidence around us, and from what we've already learned. Induction and deduction represent the natural turn of human intellect.

Reasoning consists of drawing a conclusion from previously established premises. We can outline rational arguments in a formula called "standard form," a logical outline consisting of a main idea (conclusion, bolded) and its supporting ideas (premises, listed above):

The walls are unpainted.
The roof needs replacing.
The carpet is worn.
Therefore, the building is in bad shape.

The building is in bad shape.
Buildings that are in bad shape are not worth buying.
Therefore, this building is not worth buying.

Of course, we can't join just any old statements together; the statements must combine to support the conclusion--they can't be irrelevant, they can't be repetitive, and every necessary logical step must be stated aloud. Standard form reveals incoherent or incomplete arguments:

Marie has red hair.
Therefore, she has a hot temper.
[What is implied about red-heads? Is it a reasonable statement?]

Marie has a hot temper.
Marie tends to get angry over small things.
Therefore, we should be careful not to annoy her .
[Are these two premises really different?]

Marie has a hot temper.
Marie has no respect for human life.
Marie enjoys hiking.
Therefore, we should be careful not to annoy her.
[Do these premises all relate to the conclusion?]

So: What are the different ways that we can combine premises to make conclusions?

The answer lies in the way our minds work. Human reason puts ideas together in two ways:

- By inferring general statements or principles from observation. We put evidence together, usually based on our observations, and see if we can make any general conclusions.

  This raven is black.
  This other raven is black too.
  All ravens I've ever seen or heard about have been black.
  Therefore, ravens are black.

- By applying these principles to new information. Now we have inferred a pattern or general statement about ravens, we apply this information to any new ravens we see.

  All ravens are black.
  This bird is a raven.
  Therefore, this bird must be black.

Look again at the opening example, in which you were a prehistoric human eating bad fruit.

- First, you ate some fruit and got sick. From this concrete and specific experience, you drew a conclusion not just about the fruit you ate, but about all fruit of that kind. That was one kind of reasoning: "This piece of fruit made me sick, therefore fruit of this kind will always make me sick."
- Next, you applied this information to other fruit. Even though you didn't even taste the fruit from the second tree, you already felt you knew something about it based on your past experience.

These two methods of drawing conclusions are called **induction** and **deduction**. You may not be aware of doing these mental operations, any more than you are aware of all the nerve endings relaying electric messages from your brain when you walk. But you do both mental operations all the time; together, they form the essence of human learning.

IN YOUR NOTES: (keep these to submit with exit quiz):

1. Name the two steps involved in putting ideas together.
2. How does each step work?

Induction

True story: A mother explained to her little girl that Daddy had a mild heart attack, and was going to be in the hospital for a few days. After absorbing the news, the girl replied, "Mum, when are you *going to have your heart attack then?"*

Everyone knows dozens of these "kids-say-the-darndest-things" stories. In truth, children are simply exercising the first natural mode of thinking**: induction**. This little girl had learned to see her parents as a group; what is true for one is true for the other. So when Dad has a heart attack, it follows that Mom will have one too.

Thus do we generate conclusions from our experience of the world? For instance, we see that every day of our lives the sun has risen. Experience suggests that the sun will rise tomorrow too. That is how we arrive at predictions or generalizations, such as: "the sun rises every day." **Induction** is the name we give to this kind of thinking: the tentative formulation of statements from what we have experienced.

The key word is "tentative." As we can see from the girl's example, even the most reasonable inductive inferences can never be 100% certain, because we don't know what we don't know. There may be information around the corner which will change everything.

Inductive reasoning is characterized by the following:

- **It is usually based on observation.** The premises of inductive arguments are usually bits of evidence that we've gathered by observation, direct or indirect.

- **Its conclusions are tentative generalizations about groups or relationships, or predictions.** Eating one bad fruit yields the conclusion that what is true for one fruit must be true for the whole group of fruit. If one little green apple gives you stomachaches, you will conclude that little green apples always give stomachaches. Often, these conclusions seem to be proven facts. But because we're drawing conclusions based on what we do observe, we don't necessarily know that we're getting the whole picture. You will see a good example of this below (the turkey before Thanksgiving!) So inductive conclusions, however solid they seem, do not necessarily follow the premises. Other conclusions are always possible (maybe not reasonable, but possible).

Here are some inductive arguments. As you read them over, note:

- The conclusion is usually a prediction, guess or generalization.
- There are always other *possible* inferences (not reasonable ones, perhaps, but possible ones).

> The lights in my friend's house are out.
> The curtains are drawn.
> No one is answering the phone.
> **Therefore, my friend must be away.**

[This is an example of an inductive argument that is reasonable, but not necessarily correct. The friend may indeed be away, but other inferences are possible: he may be sick, or just hiding.]

I went to North Beach this week and parking was terrible.
I went to North Beach last year and parking was terrible.
Therefore, I will have trouble parking at North Beach.

House prices are very high here.
Gas prices are very high here.
Food prices are very high here.
Therefore, it is very expensive to live here.

Sean, an Irishman, drinks a lot.
Kevin, another Irishman, drinks a lot.
Frankie, yet another Irishman, drinks a lot.
Therefore, all Irishmen must drink a lot.

Fewer adult Americans smoke today than 30 years ago.
More laws restrict smoking in public than ever before.
Therefore, smoking is on the wane in the U.S.

[In the mind of a turkey, two days before Thanksgiving:]
The farmer fed me today.
The farmer fed me yesterday.
The farmer fed me the day before.
Therefore, the farmer will feed me forever!
[Here is an example of an argument that is quite reasonable, but unfortunately, quite wrong, because the turkey doesn't know what he doesn't know. The turkey has made a reasonable inference from the information at his disposal. But he doesn't see the big picture.]

IN YOUR NOTES: (keep these to submit with exit quiz):

3. What is inductive reasoning?
4. What are the two main characteristics of inductive reasoning?
5. What do you note about the pattern of inductive arguments, when you see them written down?

Where Induction Goes Wrong

We can't prove that an inductive conclusion is 100% right or wrong. But we can tell if it is sound or unsound.

Here are some classic mis-steps one can make when putting together inductive arguments that can lead to an unsound conclusion.

1. **Inferring an unreasonable generalization.**

   A reasonable inference covers the available information, and doesn't require us to invent a lot of new hypothetical information to make it stick. An unreasonable conclusion may fit the existing evidence, but it also requires us to accept a lot of other ideas!

   The lights in my friend's house are out.
   The curtains are drawn.
   No one is answering the phone.
   Therefore, my friend has joined a cult that worships darkness.

   I went to North Beach this week and parking was terrible.
   I went to North Beach last year and parking was terrible.
   Therefore, North Beach drivers enjoy tormenting me.

   House prices are very high here.
   Gas prices are very high here.
   Food prices are very high here.
   Therefore, all Bay Area residents must rob banks to survive.

   So: good induction relies on reasonable inferences.

2. **Generalizing from insufficient evidence.**

   All of the following generalizations are drawn from one or two examples. You would be surprised to find out how many of your opinions are based on one observation. Indeed, many of our opinions are not even based on observation at all--we merely say what everyone else around us is saying, or repeat what we heard on television last night. Sad, but true.

   I spent five minutes looking for a restaurant in San Mateo that was open at 2 p.m. but didn't find one.
   Therefore, there are NO restaurants open past 2 p.m. in San Mateo, ever.

   I tasted an Entenmann's cake and it was dry.
   Therefore, all Entenmann's cakes are rubbish.

   An Irishman got drunk at my house.
   Therefore, Irishmen are all drunks.

So: good induction relies on wide observation, including several examples, and preferably examples from other people's experience as well as your own.

3. Generalizing from a biased sample.

Look at the following arguments:

> Last Thanksgiving Thursday, Safeway was shut.
> The Thanksgiving before that, it was shut.
> The Thanksgiving before that, it was shut.
> The Thanksgiving before that, it was shut. [etc.]
> **Therefore, Safeway is always shut on a Thursday.**
>
> I have twenty-five Irish friends from my local Alcoholics Anonymous group, and all are recovering drunks.
> **Therefore, all Irishmen are recovering drunks.**
>
> 100% of students in the ENGL 165 online class use their computers to study.
> **Therefore, all CSM students use computers to study.**
>
> When I lived in San Francisco, no one I met through work was in trouble with the law. Since I moved to Eureka, everyone I've met through work has been in trouble with the law.
> **Therefore, there is a lot more lawbreaking in Eureka than in San Francisco.**

You can see the problem. In each case, the speaker has generalized from a sample--for instance, made a generalization about all Irishmen based on a sample of Irishmen. But even though the observation may be quite wide, the speaker has not taken into account the fact that the sample itself is biased.

- *Everyone* in an AA meeting is going to be a recovering alcoholic.
- Students in an *online class* are much more likely to use computers than the general school population.
- *Thanksgiving Thursday* is not a typical Thursday!
- The San Francisco/Eureka statements sounds impressive--until you find out that the speaker used to be a *Web designer*, and moved to Eureka to become a *cop*. It's not surprising, then, that he should encounter different kinds of people through his work.

So: a good generalization should be based on varied examples, to avoid getting a biased picture.

IN YOUR NOTES: (keep these to submit with exit quiz):

6. What are the three ways in which inductive reasoning can yield unsound conclusions?
7. What are the three characteristics of a good generalization?

Deduction

True story: A mother explained to her little girl that Daddy had a mild heart attack, and was going to be in the hospital for a few days. After absorbing the news, the girl replied, "Mum, when are you going to have your heart attack then?"

Look again at this story. We see **induction** at work in the child's unspoken generalization that everything that happens to Dad must happen to Mom as well. But note that she immediately uses this generalization to infer a piece of information about her mother: that her mother, too, will have a heart attack. This is **deduction**--the application of a general principle (my parents share all experiences) to a specific (my mom will have this experience too).

Induction gives us general statements, principles and predictions based on what we know so far. With **deduction**, we apply these principles to any new experiences. It helps us to make sense of them, and gives us some information about them.

For example: I eat some grilled liver; it tastes like boots. Later, I eat it again; it still tastes like boots. I conclude, through **induction**, that grilled liver *always* tastes like boots. The following week I am at a friend's house, and she serves me a plate of liver. I groan inside: "This is going to taste like boots," I think sadly.

Now, how can I know something about a meal that I haven't yet touched? Through **deduction**. I have drawn conclusions about liver in general, and now whenever I see liver on the menu, I assume that it must have all the qualities that I have discovered in liver.

The key word is "must." Inductive reasoning, you remember, is always tentative. The premises to an inductive argument may all be true, but your conclusion--however reasonable--may be wrong. However, deductive reasoning produces conclusions that are true *of necessity, IF the premises are true*. If it is indeed true that liver always tastes like boots, and if this quivering red mass before me is indeed liver, then it absolutely *must* be true that it, too, will taste like boots. If it does not, then the general statement that I got through induction must be false--or this isn't liver after all.

Deductive reasoning is characterized by the following:

- **It generates necessary conclusions**. If the premises of the arguments are true--and remember, they may not be--then the conclusion absolutely must be true. There is no room for other inferences.
- **It puts together a general statement about a group and a statement establishing a member of that group, and draws a conclusion about that member**. The premises to the liver argument are thus: Grilled liver always tastes like boots, and this is grilled liver. My conclusion: This, too, will taste like boots.
- **It puts together a general prediction and a statement about a given situation, and draws a conclusion from this**. The premises establish what we know about a particular cause-effect, and use these to draw conclusions about a situation. For example: If you drink milk, it will make you throw up. You are not throwing up. Therefore, you haven't drunk milk.

There are two patterns of deductive argument:

1. **Syllogisms:** This involves putting together a general statement about a group and a statement establishing something as a member of that group, and draws a conclusion about that member. See how this is reflected in the logical outline:

   a. the premises consist of a generalization about a group (the kind of statement that you would get through induction), and a statement that something belongs to that group;
   b. the conclusion connects the quality of the group to the thing or person that is part of that group;
   c. the conclusion *must* be true if the premises are true.

   Here are some examples.

   - All men are mortal.
     Socrates is a man.
     Therefore, Socrates is mortal.
     [See how the conclusion MUST follow here. If it's true that all men are mortal, and if it's true that Socrates is a man, then we know something for certain about Socrates.]

   - Parking at North Beach is always terrible
     Green Street is in North Beach.
     Therefore, parking in Green Street is terrible.

   - It is very expensive to live in the Bay Area
     San Francisco is part of the Bay Area.
     Therefore, it is very expensive to live in San Francisco.

   - All Irishmen drink a lot.
     Ardal is an Irishman.
     Therefore, Ardal drinks a lot.
     [This is an example of how a deductive argument can be wrong. Remember, the conclusion follows ONLY if the premises are true. If it turns out that Ardal never drinks, then one of the argument's premises MUST be wrong. Either not all Irishmen drink after all, or Ardal isn't really Irish!]

   - Smokers have yellow fingers.
     Janine is a smoker.
     Therefore, Janine has yellow fingers.

   - It is fine to perform natural bodily functions in public.
     Nursing babies is a natural bodily function.
     Therefore, it is fine to nurse babies in public.
     [Remember this? Here is the standard form of the argument.]

2. **Hypothetical chains:** This involves putting together a cause-effect statement (predictions arrived at through induction) and a statement about a specific event, to draw a conclusion about that event.

   a. the premises consist of a statement about a cause-effect relationship, another kind of generalization that you would get through induction, and a statement describing a specific situation;
   b. the conclusion is usually a statement about that specific situation;
   c. the conclusion must be true if the premises are true.

   Here are some examples:

   - If the window is open, the room will be cold.
     The room is warm.
     Therefore, the window is not open.
     [See how the conclusion MUST follow here. If it's true that an open window cools the room down, and if it's true that the room is warm, then there is no way the window can be open--unless one of these premises is wrong.]

   - If the team played well, we would certainly win.
     We played well.
     Therefore, we must have won.

   - If Chevron and Exxon merge, the price of gas will go up.
     Chevron and Exxon have merged.
     Therefore, the price of gas will go up.

   - If the ink contains nigrosine, a chemical introduced in 1940, it cannot be Victorian.
     The ink contains nigrosine.
     Therefore, the ink cannot be Victorian.
     [This is an example of how a hypothetical chain can be wrong. Remember, the conclusion follows ONLY if the premises are true. In this case, as you remember, another expert determined that nigrosine WAS used in the 19th century, and thus challenged the first premise.]

   - If Grace Foods caused the pollution that made the families in Woburn sick, they are responsible for that sickness.
     Grace Foods did cause the pollution that made the families sick.
     Therefore, Grace Foods is responsible for the sickness.

   - If the families started to get sick before the earliest date that Grace Foods could have contaminated the water, then Grace Foods is NOT responsible for their sickness.
     The families did start to get sick before this date.
     Therefore, Grace Foods is not responsible for their sickness.
     [These last two arguments reflect the arguments put forward by opposing sides in a famous court case, described in A Civil Action.]

IN YOUR NOTES: (keep these to submit with exit quiz):

8. What is deductive reasoning?
9. What are the three characteristics of deductive reasoning?
10. What is a syllogism?
11. What is a hypothetical chain?

Where Deduction Goes Wrong

While the standard for an inductive statement is whether or not it is *sound*, the standard for a deductive statement can be more rigorous. Deductive arguments give us conclusions that follow *of necessity* if the premises are true. Sometimes, however, we make mistakes about what is or is not necessarily true! We draw conclusions that may (coincidentally) be right, but which are not warranted by the premises. This kind of mistaken reasoning is called invalid. This is the standard for deductive arguments: they are valid or invalid.

Sometimes we think we are using good deductive reasoning, but we have mixed up our formulae. Looking again at both syllogisms and hypothetical chains, here are the two errors we can fall into.

a. "All" is not the same as "Only": How Syllogisms Can Go Wrong

Here is a perfectly good bit of deduction:

- All cats eat meat.
  Mister is a cat.
  Therefore, Mister eats meat.

If it's true that all cats eat meat, and if it's true that Mister is a cat, we know one thing about Mister for sure: we know he must eat meat. This argument makes sense.

But what about this?

- All cats eat meat.
  Mister eats meat.
  Therefore, Mister is a cat.

Not so good!

This sounds very similar. But the line of logic is quite different. It may be true that all cats eat meat, and it may be true that Mister also eats meat. But nowhere have we said that *only* cats eat meat. In fact, lots of creatures eat meat--cats, dogs, pigs, accountants, rock stars and certain kinds of plant. The logical mistake here is thinking that because two things share the same quality, they must belong to the same group. Unless this is the *only* group that has the quality you're talking about, this conclusion isn't warranted.

Here are some more of this kind of mistake. In each case, the speaker slips by thinking that because two things share the same quality, they must belong to the same group:

- Lions eat a huge meal at one sitting.
  My brother John eats a huge meal at one sitting.
  Therefore, my brother John is a lion.
  [Are lions the only creatures that eat huge meals at once?]

- People with shaved heads and swastika tattoos are racists.
  Ron does not have a shaved head or a swastika tattoo.
  Therefore, Ron is not a racist.
  [Is there only one kind of racist?]

- Hard workers do well in their studies.
  Frank does well in his studies.
  Therefore, Frank is a hard worker.
  [How do we know Frank isn't just lucky?]

- All the cool people will be at the Castro Halloween festival.
  Marco will be at the Castro Halloween festival.
  Therefore, Marco is one of the cool people.
  [Are the cool people the only ones who are going?]

- Teens who go on to commit violent acts often dye their hair, wear black clothes, play video games, argue with their parents and listen to depressing music.
  Joey dyes his hair, wears black clothes, plays video games, argues with his parents and listens to depressing rock music.
  Therefore, Joey is going to commit violent acts.
  [Paraphrased from the FBI guidelines, published in the wake of the Columbine massacre, on how to spot troubled teens. The problem is, it describes half the population of a normal high school!]

So keep your premises clear in your mind:

- If a group has a quality and something belongs to that group, it is valid to assume that it, too, shares the quality.
- BUT if a group has a quality and something else has that quality, it is not valid to assume that it too must belong to the group--unless we know that this group is the only one that possesses the quality. "All" does not equal "only."

b. "Always" is not the Same as "Only": How Hypothetical Chains Go Wrong

Consider the following reasonable inference:

- If you drink milk, you get sick.
  You aren't sick.
  Therefore, you didn't drink milk.

If both of these premises are true, then this argument makes perfect sense. If drinking milk must result in sickness, then the fact that the person is not sick must mean that she hasn't drunk any milk. If a cause must have a certain effect, then the absence of that effect must imply the absence of that cause. So far, so good.

You can generalize this pattern using A and B to stand for "cause" and "effect":

- If you drink milk [A,] then you will get sick [B] If *A, then B.*
  You aren't sick. *[Not B.]*
  Therefore, you didn't drink milk. *Therefore, not A.*

But what of this?

- If you drink milk [A], you will get sick [B]. *If A, then B.*
  You aren't drinking milk. *[Not A.]*
  Therefore, you won't get sick. *Therefore, not B.*

Here, you've switched around; you've inferred that because Cause A has the certain effect of Effect B, then the absence of Cause A must mean that Effect B can't happen either. This *isn't* logical.

What makes it illogical is clearer with a more concrete example:

- If I shoot my cat, he'll die.
  I didn't shoot my cat.
  Therefore, he must be alive.

You see the problem? The cat could have died for any number of reasons: he could have leaped from the window, fallen ill, or accidentally eaten a pound of tainted meat.

It's logical to infer that where the effect of a cause is certain, then the absence of the effect means the absence of the cause. If I shoot my cat, he'll certainly die; so if he's alive, I can't possibly have shot him.

However, it isn't logical to infer that where a cause-effect link is certain, it must also be exclusive. That is to say, just because Cause A must result in Effect B, it may be that many other causes would produce Effect B equally well--just as there are many ways to kill a cat!

If I shoot my cat, he'll die. But just because I didn't shoot him doesn't mean he's alive; this cause may have a sure effect, but it's not the only cause. It's certain, but not exclusive.

Here are some examples of illogical inferences that make this mistake.

- If you do no work, you'll fail this course.
  You failed the course!
  Therefore, you didn't work hard.
  [We've frequently been the victim of this piece of illogic! Everyone knows there are many reasons for not getting a passing grade in a course.]

- If you eat 900 calories a day, you'll be slim.
  Mark is slim.
  Therefore, Mark eats 900 calories a day.
  [And we all know someone who shows up this piece of illogic! While it's (arguably) true that rigorous dieting can help you get slim, it's also true that other causes contribute--a speedy metabolism, lots of exercise, etc.]

- If the burglar got in through the window, it would be broken.
  It is broken.
  Therefore, the burglar got in through the window.
  [Couldn't something else have broken the window?]

- If the Giants play well, they will win the Series.
  The Giants did play well.
  Therefore, they must have won the Series.
  [But it's possible that their opponent played a little better!]

- If you smoke, you greatly increase your risks of cancer.
  Frank doesn't smoke.
  Therefore, Frank does not risk cancer.
  [Unless he supervised nuclear testing in the 1950s.]

- If you get a 4.0 GPA, you will be eligible for a scholarship.
  You didn't get a 4.0 GPA.
  Therefore, you won't get a scholarship.
  [But scholarships are granted for many reasons.]

Did you note the pattern of these illogical arguments?

If A, then B.
B, therefore A.
OR
If A, then B
Not A, therefore not B.

12. What do we mean by a "valid" deductive argument?
13. Describe the most common logical error we make with syllogisms.
14. Describe the most common logical error we make with hypothetical chains.

Both patterns make the same mistake: both assume that because Cause A certainly leads to Effect B, it is also the *only* thing that leads to Effect B. Thus when Effect B does or doesn't happens, the speaker infers that Cause A must or must not have happened.

So keep your premises clear in your mind:

- If a cause always leads to an effect, we can reasonably conclude that if the cause is there, the effect must be there. If shooting my cat will kill him and I have shot him, it is valid to conclude that he will die.
- But one effect may have many causes. If shooting my cat will kill him and he is dead, it is not valid to conclude that I must have shot him. Many things might kill my poor cat. "Always" does not mean "only."

The Scientific Method

So: which generates better conclusions? Which is better--inductive or deductive reasoning? By now, you probably realize that this is a meaningless question. Neither method excludes the other. Indeed, it's clear from looking at arguments that neither method can exist in isolation.

Induction gives us general statements. It is the natural turn of human thought, the essence of learning, to make patterns and draw abstract principles. "All the grilled liver I've ever eaten has tasted like boots, so I guess that grilled liver generally tastes like boots."

Deduction lets us use those statements to make sense of the world. "Grilled liver? No thanks--it tastes like boots."

Without **induction**:

- there is no learning--every plate of liver is like the first.
- there is no deduction. You cannot make deductions about specifics unless you have some general principle to apply.

Without **deduction**:

- inductive generalizations are useless. What is the point of knowing that grilled liver tastes like boots, unless you apply this information to the next menu you read?
- inductive generalizations are never put to the test. Whenever reality contradicts our generalizations--when we meet a teetotal Irishman, or a red-head with a sunny temper, or

a purple raven--we know we have to go back and review our premises. Why? Because if our premises about Irishmen and drinking were both true, then every Irishman must be a drunk--the conclusion follows of necessity. So if we meet a sober Irishmen, one of our premises *must* be wrong--and it's probably the generalization!

Good critical thinking requires both inductive and deductive reasoning. Induction permits us to learn; deduction puts our learning to use, and also keeps it honest, by forcing us always to test what we think we've learned against reality. Neither method contradicts or is better than the other: as philosopher Alfred Whitehead wrote, "it would be just as sensible for the two ends of a work to quarrel."

This is the essence of the **scientific method**. Scientists observe facts and make a speculative inference (induction). Armed with this hypothesis, they get to work creating specific experiments that will help determine whether the hypothesis is true or not. They try to identify grounds, which can **disprove**, rather than **prove**, their ideas.

We do this all the time in our own lives. For instance, let's say you develop a rash and start sneezing, and your doctor tells you it's an allergic reaction. How do you know what you are reacting to?

- **Induction**. Is there something you've been eating a lot of recently? Something that commonly provokes allergies? You realize that you have: only last week you ate an entire crate of strawberries. This leads you to your tentative generalization:
  I ate lots of strawberries.
  Strawberries often provoke allergies.
  THEREFORE, I have developed an allergy to strawberries.

- **Deduction**. Now, you need to see if this is true. So you stop eating strawberries. But your rash and your sneezing don't go away. Deduction has now helped you test your inductive generalization, and indeed, reject it. It was reasonable; but deduction now shows that it was wrong.
  The only thing that gives me a rash is eating strawberries.
  I didn't eat strawberries.
  THEREFORE, I won't get a rash.
  [But you did. So since this is a valid deduction, this means that one of your premises must be untrue.]

If you only remember 3 things from your logic work a year from now, you should remember these:

- A lot of the things we think we "know," we don't really know at all--we have only guessed at.
- We must keep testing and re-testing our guesses, opinions and ideas against reality.
- If we are not able or ready to do this, our opinions are trivial.

15. Think of an example of how you've used induction and deduction in ordinary life. For example, perhaps you avoid a food you're allergic to: describe how this involves inductive and deductive reasoning. Or perhaps you refused to watch a movie because you believed you wouldn't like it. Describe the example, and how it shows your reasoning.

Exercise 1

Instructions: Decide whether the following represent inductive and deductive patterns of reasoning. Check your responses against the answer key. REMEMBER:

- just because an argument begins with a general statement doesn't mean that it's inductive; deductive arguments also contain general statements—
- just because an argument isn't necessarily true doesn't mean that it's inductive--many deductive arguments are guesses;
- you are looking at the train of thought, not just the words on the page;
- some of these may be open to interpretation, so read the explanation carefully to make sure you made the same choice for the right reasons!

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1. I know Joe is a terrible cook, because I've eaten at his house three times and each time the food has been awful.

2. Francois was French, so like all Frenchmen, we knew he would enjoy fine dining.

3. Having seen three of Jackie Chan's movies, I can testify that he's brilliant.

4. My cat must be angry with me for buying a kitten. He hisses every time I get near him, and he's started spraying around the living room.

5. The car's battery provides power to the engine, so if the battery is dead, the car won't start.

6. If you really loved me, you would have known what I wanted without having to ask me. And since you ask me, I guess you just don't love me.

7. Every time I've eaten oysters I've been sick--I must be allergic to oysters.

8. Sanjay is a mountaineer, and since mountaineers are very fit, Sanjay must be very fit too.

9. The bank won't be open tonight at nine o'clock, because all banks close by six.

10. Margery is a bad carpenter. She built some shelves that fell down, and then she built a bed that collapsed as soon as I sat on it.

Exercise 2

Instructions: What do you think of the following generalizations? Read the arguments, and decide if each seems sound or not sound.

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1. The carpet is ruined, the walls are unpainted and the building needs a new roof. The owners are not taking care of the building.

2. Well, Jenny hasn't answered my call and she didn't respond to my email. So it looks like she doesn't want to talk to me.

3. The diary found by Mike Barrett, and published by Shirley Harrison, is supposed to be the diary of James Maybrick, a Victorian cotton merchant. But it cannot possibly be his diary. The handwriting doesn't match any other samples of Maybrick's writing, and there hasn't been enough forensic testing to draw any strong conclusions. Its origins are also fishy.

4. Well, the mysterious diary that is supposed to be by James Maybrick, the Victorian cotton merchant, might well be real and certainly merits further investigation. After all, it has passed a number of forensic and historical tests.

5. We surveyed 5000 heroin addicts to ask what illegal drug they had tried first. Almost 95% replied that they had started with marijuana. We concluded that using marijuana leads to heroin addiction.

Exercise 3

Instructions: What do you think of the following deductive arguments? Read them, and decide if each is valid or invalid. Remember: you're not evaluating whether the argument is reasonable, or whether the premises are true. You are only trying to establish whether the conclusion does follow from the premises, if the premises are true.

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1. If you really cared about me, you'd buy me flowers. But since you haven't, I guess you just don't care about me.

2. People with shaved heads and swastika tattoos are racists; but Tony has a regular haircut and no tattoos, so he's obviously not a racist.

3. If BigCorp was responsible for polluting the well water, it is also responsible for the deaths and illness of the local families. The jury concluded that BigCorp was, indeed, responsible for polluting the well water. Thus, BigCorp was responsible for the deaths and illnesses in the local families.

4. Big corporations are always guilty of whatever they're accused of. BigCorp and HugeCorp are big corporations, so they must be guilty of what they're accused of here: namely, poisoning the village well.

5. Seeing as a family history of heart disease leads to an increased risk of heart attack, I can be comfortable knowing that I don't have an increased risk, since none of my family has such a history.

Answer Key

Exercise 1

1. Induction. The speaker assumes from your experience of his cooking.
2. Deduction. The speaker assumes that Francois will possess a quality because the group he belongs to does (according to the speaker!)
3. Induction. The speaker makes a generalization about Chan's movies based on three examples.
4. Either! It's induction if you see the argument as an accumulation of details leading to a tentative conclusion. But perhaps you see this argument implying the idea that any time a cat behaves like this, it must be angry. If so, you have reconfigured it as a deductive argument.
5. Deductive. It's a hypothetical chain: if A, then B.
6. Deductive. It's another hypothetical chain (if A, then B). You may have wanted to say it was inductive because it seems pretty silly. But remember than any kind of reasoning, deductive or inductive, can be sensible or silly. What matters here is the way the premises are put together to form a conclusion, not the value of the premises themselves.
7. Induction. The speaker has put together a number of oyster experiences, and drawn a general cause-effect conclusion.
8. Deductive. It's a syllogism: if the premises are true, the conclusion must be true.
9. Deductive. It's another syllogism; the speaker draws a conclusion about this specific bank based on a quality shared by all banks.
10. Induction. The speaker has drawn a general conclusion about Margery based on these two carpeting incidents.

Exercise 2

1. Sound. It may not be correct--perhaps the owners are simply away, or the building has been recently flooded--but the speaker produces a lot of detail and draws a reasonable conclusion.
2. Unsound. For all we know, Jenny may have left town, or her phone isn't working. Without any other information, it sounds like the speaker is leaping to conclusions.
3. Unsound. If you thought it was sound, you gave a reasonable answer; the speaker does provide lots of evidence. However, the conclusion seems too confident. The diary may well be a forgery, or probably a forgery. But it's not really possible to say for certain that it IS a forgery.
4. Sound. The speaker draws a reasonable conclusion from a spread of evidence.
5. Unsound. The speaker is generalizing from a biased sample. Everyone in the group he interviewed ended up as a heroin addict.

Exercise 3

1. Valid. Remember, even a silly argument can be valid. Here, the premises are silly--of course loving someone doesn't make you able to read their minds! But if they were true, the conclusion would be true. The method of reasoning is not mistaken.
2. Invalid. "All" isn't the same as "only." Even if it were true that every shaven-headed, tattooed person were a racist (which it isn't), that doesn't mean that ONLY shaven-headed tattooed people are racists. Hitler had no tattoos and a thick head of hair.
3. Valid. If A, then B. A; therefore, B. If A always causes B, then we know that the presence of A must mean eventually that we will see B.
4. Valid. If the statement about all corporations is true, then it must be true for one member of that group (namely BigCorp and HugeCorp).
5. Invalid. Perhaps A (genetics) always causes B (heart disease). But it's not the only thing to cause it. Perhaps this person smokes 100 cigarettes a day--more than enough to offset his or her genetic advantages.

You are now ready to take the exit quiz.

- You can get a printed version of the quiz at the Writing Center, OR
- You can print out the quiz at the end of this tutorial, and complete it at home.

YOUR NAME: _____ Date: _____

G# _____ Course# _____ Instructor _____

LOGICAL METHOD: Exit Quiz -- Directions

- Print this page, and your notes from the tutorial if you have kept them online. (If not, make sure you have your notes with you.) Complete this quiz on paper.
- Take the completed quiz, **and your notes with answers to all questions,** to the Writing Center to be checked. NO appointment is needed for this. However, if you do not pass the quiz, you must make a conference appointment for feedback and credit.
- **REMEMBER:**
  - However well you do on the quiz, the instructional aide **cannot** give you credit unless he or she can clearly see that you have responded to all questions.

1-10: Decide if the following arguments reflect deductive or inductive reasoning. Some may have more than one correct answer, depending on how you read the argument, but circle the one that you think most closely describes the logic.

1. Mark was distressed to hear that his daughter wanted to marry a policeman. Policemen, in his experience, were cynical and hard-bitten, and often difficult to live with. He was afraid the new son-in-law would share these qualities.

   DEDUCTIVE / INDUCTIVE

2. Ever since I started using shaved cedar chips in my cat's litter, she has sulked in the corner of the room, refusing to come out from behind the sofa. She won't even come when I call her. She must be pretty annoyed with me.

   DEDUCTIVE / INDUCTIVE

3. After eating three times at the new restaurant, I have decided that it's perhaps the worst restaurant in the neighborhood. The chicken was raw; the pancakes tasted like rubber; I was enjoying the salad until I discovered that it contained two worms and a cockroach.

   DEDUCTIVE / INDUCTIVE

4. I know I will get fined this year, because my tax returns are going to be late, and when you submit your returns late you get a fine.

   DEDUCTIVE / INDUCTIVE

5. After studying data on pulmonary, respiratory and cardiac conditions among smokers, doctors concluded that smoking represented a serious risk to health.

   DEDUCTIVE / INDUCTIVE

6. Writers have lively imaginations. So when our neighbor, a novelist, told us that she had seen a ghost, we just assumed she was making it up.

   DEDUCTIVE / INDUCTIVE

7. Boxing is a dangerous sport, and like all dangerous sports, it's a lot of fun to watch.

   DEDUCTIVE / INDUCTIVE

8. My car started yesterday; it started the day before. Indeed, it's never given me any problems. So I can conclude it will start tomorrow.

   DEDUCTIVE / INDUCTIVE

9. In the 1990s, both politicians and military officials in the United States were reluctant to become involved in the Bosnian wars. "We don't have a dog in that fight," argued many officials, meaning that the United States should only get involved in conflicts in which the country has some kind of direct interest.

   DEDUCTIVE / INDUCTIVE

10. In addition, many conditions suggested that U.S. intervention in Bosnia or Kosovo could end up badly. For instance, the terrain was difficult, mountainous and hard to penetrate; the military feared that a land force could be very badly hit; the population was divided by fierce hatreds which Americans were not sure they understood.

    DEDUCTIVE / INDUCTIVE

11. Americans love to fill out surveys, a recent survey discovered. According to the Association of Mad Scientists, 98% of Americans enjoy reading, filling out and returning random surveys. This conclusion was based on a survey mailed out to over 9,050 homes, of which approximately 9% were returned.

    DEDUCTIVE / INDUCTIVE

12. My husband had a severe sore throat. But the problem couldn't be strep throat; strep throat always causes a fever, and he didn't have a fever.

    DEDUCTIVE / INDUCTIVE

13. Having spent at least ten years touring the world, eating in homes, restaurants, villages and cities in every part of the globe, our gourmet correspondent has concluded that of all cuisines, Chinese cuisine is probably the most varied.

    DEDUCTIVE / INDUCTIVE

14. Ever since Artie started drinking wine every night about ten years ago, he has been suffering from insomnia. The wine must be causing him to sleep badly.

    DEDUCTIVE / INDUCTIVE

15. Every time I call Jo, he's at the store. I guess he loves shopping.

    DEDUCTIVE / INDUCTIVE

TO BE COMPLETED BY THE INSTRUCTIONAL AIDE:

_____ (initials) _____ (date)

1. Tutorial questions are COMPLETE / INCOMPLETE (____/15 questions)

2. Score on exit quiz: _____/15

3. Conference with instructor required for credit? YES / NO

ATTENTION!

STOP!

Now that you are at the end of this tutorial and have taken the Exit Quiz, please bring it, with your tutorial notes and exercise answers, to the Writing Center in 18-104 or the English 800 Center in 18-102 and ask the Instructional Aide to correct your quiz.

If you pass the quiz, the Instructional Aide will give you credit for this tutorial.

If you did not pass the quiz, you will need to make an appointment with a lab instructor. During this appointment, you will review your incorrect answers and ask any questions you may have about this tutorial. You will receive credit for the tutorial after this appointment.

Remember that you may go to the Writing Center or English 800 Center at any time in this process to ask questions and seek help.