



Social Studies



Plato and Socrates

Logic and Reasoning

Schroon Lake Central School

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Purpose:

1. Learn to think logically
2. Learn to be analytical in essays and discussions

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As a preparation for writing persuasive essays and conducting themselves strongly in debates, students need to know the fundamentals of logic and reasoning.

Incorporated in the curriculum as a means of discussing content, persuasion and debate are strong methods to promote long-term retention of the multitude of facts that the Social Studies course demands.

Rational thinking is a prerequisite to success of the democratic republic and the citizen's positive contribution to it.

1.0 Propositions

A proposition is a sentence that **says something is true or false**.

Propositions that claim something is true are called **affirmative**.

Propositions that claim something is false are called **negative**.

Exercise 1.0: Identify each proposition as affirmative or negative.

1. [affirmative negative] All dogs are smart.
2. [affirmative negative] Some birds sing well.
3. [affirmative negative] Some men like football.
4. [affirmative negative] Most young people do not like school.
5. [affirmative negative] No students here speak Russian.
6. [affirmative negative] The audience cannot hear the speaker.
7. [affirmative negative] No books by this author are good.

1.1 Parts of a Proposition

Subject	Copula	Predicate
<i>James</i>	<i>is</i>	<i>tall.</i>
<i>Edna</i>	<i>is not</i>	<i>tall.</i>

Subject is what you are affirming or denying about.

Copula is always a form of “to be” (is, am, are).

Predicate is what can be affirmed or denied about the subject.

Exercise 1.1: Identify the bold-faced part of each proposition.

1. [subject copula predicate] All dogs **are** smart.
2. [subject copula predicate] Some **birds** are those that sing well.
3. [subject copula predicate] Some men are **those who like football**.
4. [subject copula predicate] Most **young people** are those who do not like school.
5. [subject copula predicate] No students are here **who speak Russian**.
6. [subject copula predicate] The **audience** cannot hear the speaker.
7. [subject copula predicate] No **books by this author** are good.

1.2 Kinds of Propositions

- affirmative or negative – “it is or it isn’t”
- universal or particular – “all/none or some”

The predicate of an affirmative proposition is always taken **particularly**.
The predicate of an negative proposition is always taken **universally**.

Exercise 1.2.1: Identify whether the term in bold-face in each proposition is universal or particular.

1. [universal particular] All **dogs** are smart.
2. [universal particular] Some **birds** are those that sing well.
3. [universal particular] Some **men** are those who like football.
4. [universal particular] Most young people are **those who like school**.
5. [universal particular] No students are here **who speak Russian**.
6. [universal particular] Some seventh grade boys are **tall**.
7. [universal particular] Books by this author are not **good**.

Exercise 1.2.2: Practice converting regular statements into propositions.¹

1. "Only good students will succeed" is equivalent to

- Everyone who succeeds is a good student.
- Any good student will succeed.
- Anyone not succeeding is not a good student.
- All the good students will succeed.

2. "There are happy students who have passed the test" is equivalent to

- Unhappy students have not passed the test.
- Some who have passed the test are happy students.
- Somebody who has passed the test is a happy student.

¹ *Working with Syllogisms*. 14 Nov. 2004. <http://www.internetlogic.org/fall02/syllogisms.html>

- Anybody who is a happy student has passed the test.
-

3. "No one who is rich is unhappy" is equivalent to

- Everyone happy is rich.
 No one unhappy is poor.
 Only those who are rich are happy.
 All who are rich are happy.
-

4. "Those who do not study will not do well" is equivalent to

- Only those who did not study did not do well.
 Everyone who studied was someone who did well.
 Anyone who did not do well was someone who did not study.
 Everyone who did well was someone who studied.
-

5. "No old cars in this lot are expensive" is equivalent to

- Any new car in this lot is expensive.
 Every old car in this lot is inexpensive.
 Any inexpensive car in this lot is old.
 There are no inexpensive new cars in this lot.
-

6. "Honest politicians cannot get elected for a second term" is equivalent to

- Anyone not elected for a second term was an honest politician.
 Only honest politicians do not get reelected.
 Dishonest politicians do get elected for a second term.
 Anyone reelected is a dishonest politician.

7. "Only the old are wise" is equivalent to

- Each wise person is old.
 - Each old person is wise.
 - Anyone not wise is not old.
 - Anyone old is wise.
-

8. "Everyone who studies will do well" is equivalent to

- There are no people doing well who did not study.
 - There are no people who studied who did not do well.
 - Only someone who studied did do well.
 - Someone who did not study did not do well.
-

9. "We do have examples of hard-working people who are not successful" is equivalent to

- No one successful is not someone working hard.
 - Anyone unsuccessful did not work hard.
 - Some people who work hard do not succeed.
 - Some people who succeed did not work hard.
-

10. "Hard questions are not always confusing" is equivalent to

- Some hard questions are confusing.
- No hard questions are confusing.
- Some hard questions are not confusing.
- Each hard question is not confusing.

11. "There are lucky students who did pass the test even though they never studied" is equivalent to

- Some students who did study are unlucky and did not pass the test.
 - No students who studied are unlucky and did not pass the test.
 - Each lucky student who didn't study did pass the test.
 - Some students who passed the test are lucky and did not study.
-

12. "Anyone famous is also rich" is equivalent to

- Everyone rich is famous.
 - No one poor is famous.
 - Anyone poor is not famous.
 - No one rich is not famous.
-

13. "Only those who work hard and save their money will be rich" is equivalent to

- All who are rich worked hard and saved their money.
 - All who work hard and save their money are not poor.
 - No one who is poor worked hard and saved his money.
 - Everyone poor worked hard but did not save his money.
-

14. "Each right answer is marked in blue" is an example of

- an A statement
- an E statement
- an I statement

an O statement

15. "Some wrong answers are marked in red" is an example of

- an A statement
- an E statement
- an I statement
- an O statement

2.0 Syllogisms

The traditional syllogism comes down to us from Aristotle and was the standard for formal logic down to this century. To work with syllogisms you will need to be able to restate information in the simplest way possible in order to show whether you have--

- an A statement (universal positive), such as "All students are ambitious"
- an E statement (universal negative), such as "No students are lazy"
- an I statement (particular positive), such as "Some tests are easy"
- an O statement (particular negative), such as "Some students are not ready"

A **syllogism** is a logical argument. It contains **three propositions**: two **premises** and a **conclusion**.

Example Syllogism:

All men are mortal.

John is a man.

Therefore, John is mortal.

If you accept the first two propositions (premises) as true, you must accept the third proposition (the conclusion) as true.

If the conclusion does not follow from the premises, we say it "does not follow"; it is illogical. The fancy Latin name for this is **non sequitor**.

2.1 Propositions in a Syllogism

To work with syllogisms you will need to be able to organize your statements in standard form so that you have the middle (connecting) term as the first part of the top premise but the second part of the bottom premise, as in this example: We want to prove that "Some tests are hard" by showing the linkage between the idea that anything long is hard and the idea that some tests are long.

Anything that takes a long time is hard. ("being long" is the middle term)
Some tests are things that take a long time.
∴Some tests are hard.

The first proposition is the **major proposition**.

The second proposition is the **minor proposition**.

The term that appears in both the major and minor premise is the **middle term**.

Exercise 2.1.1: Identify the major proposition, minor proposition, and middle term of each argument.

1. All men are mortal. John is a man. Therefore, John is mortal.	1. Major: _____ Minor: _____ Middle: _____
2. All cats love milk. My pet is a cat. Therefore, my pet loves milk.	2. Major: _____ Minor: _____ Middle: _____
3. All women like football. Henrietta is a woman. Therefore, Henrietta likes football.	2. Major: _____ Minor: _____ Middle: _____

Exercise 2.1.2: In each of the following problems you are asked to see whether you could construct a valid syllogism using the three statements provided. If so, circle the conclusion. Otherwise circle "not possible."

Z

1.
Logic is fun.
Anything interesting is fun.
not possible
Logic is interesting.

2.
Anyone who is ambitious will succeed.
not possible
Anyone who works hard will succeed.
Anyone who is ambitious will work hard.

3.
Some athletes are honor students.
Some athletes get scholarships.
All honor students get scholarships.
not possible

4.
All honor students get scholarships
Some math majors are honor students.
Some math majors get scholarships.
not possible

5.
Some honor students get scholarships.
Some chess players get scholarships.
not possible
Some chess players are honor students.

6.
Anyone who is always on vacation is lazy.
No logic students are always on vacation.
not possible
No logic students are lazy.

7.

not possible

Some athletes are lazy.

No one who is lazy will be successful.

Some athletes will not be successful.

8.

not possible

No smokers are rich.

No vegetarians are smokers.

No vegetarians are rich.

9.

not possible

Every blik is a grimble.

Each grimble will wannow.

Any blik will wannow.

10.

Any H is F.

not possible

Any H is G.

Any G is F.

11.

Some G is H.

Every H is F

not possible

There is a G that is F.

12.

not possible

No H is G.

Some F is H.

Some F is not G.

13.

not possible

There is no F that is G.

Any H is G.

Any F is H.

14.

Some F is not H.

Each F is G.

not possible

Some G is not H.

15.

Whatever is interesting is rewarding.

not possible

Logic is interesting.

Logic is rewarding.

2.2 Rules of the Syllogism

Validity versus Truth: An argument is valid if it follows all of the rules of logic. That is, if the two true premises could not give you a false conclusion. Arguments can be valid, but false.

There are several ways to recognize whether what you have is a valid form (meaning, one in which true premises could not give you a false conclusion).

- (1) For an invalid form it is possible to set up a parallel example with different terms so that you definitely have true premises but there is an obviously false conclusion.
- (2) For an invalid form you can imagine a counterexample--a story in which the premises stay the same but the conclusion is the opposite, and you supply some explanation for how this is possible.
- (3) You can work with Venn diagrams.
- (4) You can do what are called Euler circles--diagrams in which again you keep the premises the same but try to show a false conclusion.
- (5) You can apply a mechanical list, such as the "BARBARA CELARENT" type of thing from the Middle Ages.
- (6) You can run through the following checklist.

Rule 1: A syllogism works with only three terms used with exactly the same meaning throughout.

Example: "Anything light can be lifted up, but the sun is light, so the sun can be lifted up." We are not using "light" the same way (the fallacy of ambiguity). Rule 2: Nothing follows from two negative premises.

Rule 3: Nothing follows from two particular premises.

Rule 4: Any negative premise calls for a negative conclusion.

Rule 5: Any particular premise calls for a particular conclusion.

Rule 6: The middle term must be distributed (meaning, it is used universally at least once in the premises).

Example: "All mathematicians are smart, and all geniuses are smart, so all mathematicians are geniuses." In both premises we talk only about some of those who are smart (the fallacy of an undistributed middle).

Rule 7: There cannot be a universal subject or predicate in a conclusion if the term was not used universally in the premises.

Example: "No woman has been President, but all Presidents have lived in the White House, so no woman has lived in the White House."
We know the conclusion is wrong even though the premises are correct (if we don't count the Presidents before the White House was built), so we know the pattern is invalid. To see why, we look at the way in which we move from the idea of being some of the people living in the White House (particular) to being none of the people living in the White House.

Exercise 2.2.1: Rewrite these arguments in syllogistic form.

1. All parrots can think, because parrots can talk, and all talking things can think.
2. Rats are vermin, so they spread diseases.
3. No valuable thing comes free of charge, and plastic surgery operations are valuable things.
4. No freight carriers are ocean-going vessels. Some ships sail on the sea. Therefore, some boats do not carry cargo.
5. Some Europeans are Moslems, since some Cypriots are.
6. Computers that can run OSX must have at least 64 megabytes of internal memory, and my computer doesn't have that much memory. So I can't run OSX.
7. Only N.Z. citizens can vote in N.Z. elections. Since you're a citizen, you can vote.
8. Photosynthesis must occur as far down as 250 metres below the surface of the ocean, for there are algae that live at those depths.

Exercise 2.2.2: Test the following syllogisms to determine which are valid and which are invalid. Translate them into standard form categorical claims, putting brackets around the terms, then apply each test, telling which ones it passes.

1. All halyards are lines that attach to sails. Painters do not attach to sails, so they must not be halyards.
2. No blank disks contain any data, although some blank disks are formatted. Therefore, some formatted disks do not contain any data.
3. All tobacco products are damaging to people's health, but some of them are addictive substances. Some addictive substances, therefore, are damaging to people's health.
4. No argument with false premises is sound, but some of them are valid. So, some valid arguments are not sound.
5. All clothes made from cotton are clothes that shrink. All clothes that shrink are clothes that are too big in the store. So, no clothes that are too big in the store are clothes made from cotton.
6. Every time Louis is tired, he's edgy. He's edgy today, so he must be tired today.
7. All citizens are residents, and all voters are citizens. So no residents must be voters.
8. Only people who hold stock in the company may vote, so Mr. Hansen must not hold any stock in the company, because I know he was not allowed to vote.

Exercise 2.2.3: Using the various ways you have learned to test categorical reasoning, decide whether the arguments are valid. Test the argument and circle "valid" if it's valid or "invalid" if it's invalid.

Anything interesting is fun. Logic is interesting. Therefore, logic is fun.

Valid or Invalid?

Anything interesting is fun. Logic is fun. Therefore, logic is interesting.

Valid or Invalid?

Some interesting things are fun. Anything easy is fun. Therefore, anything easy is interesting.

Valid or Invalid?

Some interesting things are easy. Anything easy is fun. Therefore, some interesting things are fun.

Valid or Invalid?

Nothing important is easy. Logic is not easy. Therefore, logic is important.

Valid or Invalid?

Some politicians are dishonest. Anyone honest tells the truth. Therefore, some politicians do not tell the truth.

Valid or Invalid?

Logic must be fun, because whatever is interesting is fun, and logic is interesting.

Valid or Invalid?

These classes cannot be hard. A lot of students would not be enrolled in classes that are hard, but there are a lot of students enrolled in these classes.

Valid or Invalid?

Some teenagers are poor drivers, and some teenagers get into accidents. That proves some poor drivers get into accidents.

Valid or Invalid?

Republicans hate liberals, and Senator Snort hates liberals, so he must be a Republican.

Valid or Invalid?

Republicans hate liberals, and Senator Snort is a Republican, so he must hate liberals.

Valid or Invalid?

Nothing confusing is easy. A test like this is confusing, so this test must not be easy.

Valid or Invalid?

Some things that are confusing are not easy. This test is confusing, so it must not be easy.

Valid or Invalid?

Nothing confusing is easy. This test is not easy, so it must be confusing.

Valid or Invalid?

Nothing confusing is easy. These questions are easy, so they must not be confusing.

Valid or Invalid?

Some questions are easy. Anything that is not easy is confusing. Therefore, some questions are confusing.

Valid or Invalid?

Whoever gets everything right is a good student. Jack will not get everything right, which will prove he is not a good student.

Valid or Invalid?

Whoever gets everything right is a good student. Jill is a good student, so that proves she will get everything right.

Valid or Invalid?

Whoever gets everything right is a good student, and all good students work hard. Therefore, anyone not working hard will not get everything right.

Valid or Invalid?

Only those who are ambitious will be successful. Anyone ambitious does work hard. Therefore, only those who work hard will be successful.

Valid or Invalid?

Only those who are ambitious will be successful, and no one is successful who does not work hard. That proves anyone who works hard is ambitious.

Valid or Invalid?

Only those who are ambitious will be successful, and no one is successful who does not work hard. That proves anyone who is ambitious works hard.

Valid or Invalid?

Some of those who are unsuccessful have worked hard, and anyone working hard is ambitious. It follows that there are ambitious people who are unsuccessful.

Valid or Invalid?

Anything confusing is hard. This piece of paper is not hard, so it must not be confusing.

Valid or Invalid?

This is the last question. The last question is always difficult, so this question must be difficult.

Valid or Invalid?

3.0 Logical Fallacies²

Logical fallacies are errors in thinking. The following briefly describes some of the most common fallacies:

ad hominem: Latin for "to the man." An arguer who uses ad hominem attacks the person instead of the argument. Whenever an arguer cannot defend his position with evidence, facts or reason, he or she may resort to attacking an opponent either through: labeling, straw man arguments, name calling, offensive remarks and anger.

appeal to ignorance (argumentum ex silentio) appealing to ignorance as evidence for something. (e.g., We have no evidence that the Tooth Fairy doesn't exist, therefore, she must exist. Or: Because we have no knowledge of alien visitors, that means they do not exist). Ignorance about something says nothing about its existence or non-existence.

proving non-existence: when an arguer cannot provide the evidence for his claims, he may challenge his opponent to prove it doesn't exist (e.g., prove the Tooth fairy doesn't exist; prove UFO's haven't visited earth, etc.). Although one may prove non-existence in special limitations, such as showing that a box does not contain certain items, one cannot prove universal or absolute non-existence, or non-existence out of ignorance. One cannot prove something that does not exist. The proof of existence must come from those who make the claims.

argument from omniscience: (e.g., All people believe in something. Everyone knows that.) An arguer would need omniscience to know about everyone's beliefs or disbeliefs or about their knowledge. Beware of words like "all," "everyone," "everything," "absolute."

appeal to tradition (similar to the bandwagon fallacy): (e.g., astrology, religion, slavery) just because people practice a tradition, says nothing about its viability.

argument from authority (argumentum ad verecundiam): using the words of an "expert" or authority as the bases of the argument instead of using the logic or

² Walker, Jim. *List of Common Fallacies*. 14 Nov. 2004. <http://www.nobeliefs.com/fallacies.htm>

evidence that supports an argument. Simply because an authority makes a claim does not necessarily mean he got it right. If an arguer presents the testimony from an expert, look to see if it accompanies reason and sources of evidence behind it.

argument from adverse consequences: (e.g., We should judge the accused as guilty, otherwise others will commit similar crimes) Just because a repugnant crime or act occurred, does not necessarily mean that a defendant committed the crime or that we should judge him guilty.

argumentum ad baculum: An argument based on an appeal to fear or a threat. (e.g., If you don't believe my religion, you'll be punished)

argumentum ad ignorantiam: A misleading argument used in reliance on people's ignorance.

argumentum ad populum: An argument aimed to sway popular support by appealing to sentimental weakness rather than facts and reasons.

bandwagon fallacy: concluding that an idea has merit simply because many people believe it or practice it. Simply because many people may believe something says nothing about the fact of that something. For example many people during the Black plague believed that demons caused disease. The number of believers says nothing at all about the cause of disease.

begging the question (or assuming the answer):

circular reasoning: stating in one's proposition that which one aims to prove. (e.g. Allah exists because the Koran says so; the Koran exists because Allah influenced it.)

confirmation bias (similar to observational selection): This refers to a form of selective thinking that focuses on evidence that supports what believers already believe while ignoring evidence that refutes their beliefs. Confirmation bias plays a stronger role when people base their beliefs upon faith, tradition and prejudice. For example, if someone believes in the power of fortune telling, the believer will notice the few false predictions while ignoring the majority of false predictions (which would indicate that fortune telling has no more value than random chance at worst or a placebo effect, when applied to health effects, at best).

observational selection (similar to confirmation bias): pointing out favorable circumstances while ignoring the unfavorable. Anyone who goes to Las Vegas gambling casinos will see people winning at the tables and slots. The casino managers make sure to install bells and whistles to announce the victors, while the losers never get mentioned. This may lead one to conclude that the chances of winning appear good while in actually just the reverse holds true.

confusion of correlation and causation: (e.g., More men play chess than women, therefore, men make better chess players than women. Or: Children

who watch violence on TV tend to act violently when they grow up.) But does television programming cause violence or do violence oriented children prefer to watch violent programs? Perhaps an entirely different reason creates violence not related to television at all.

half truths (suppressed evidence): An statement usually intended to deceive that omits some of the facts necessary for an accurate description.

loaded questions: embodies an assumption that, if answered, indicates an implied agreement. (e.g., Have you stopped beating your wife yet?)

misunderstanding the nature of statistics: (e.g., the majority of people in the United States die in hospitals, therefore, stay out of them.) "Statistics show that of those who contract the habit of eating, very few survive." -- Wallace Irwin

non sequitur: Latin for "It does not follow." An inference or conclusion that does not follow from established premises or evidence. (e.g., there occurred an increase of births during the full moon. Conclusion: full moons cause birth rates to rise.) But does a full moon actually cause more births, or did it occur for other reasons, perhaps from expected statistical variations?

post hoc, ergo propter hoc: Latin for "It happened after, so it was caused by." Similar to a non sequitur, but time dependent. (e.g. She got sick after she visited China, so something in China caused her sickness.) Perhaps her sickness derived from something entirely independent from China.

red herring: when the arguer diverts the attention by changing the subject.

slippery slope: a change in procedure, law, or action, will result in adverse consequences. (e.g., If we allow doctor-assisted suicide, then eventually the government will control how we die.) It does not necessarily follow that just because we make changes that a slippery slope will occur.

statistics of small numbers: similar to observational selection (e.g., My parents smoked all their lives and they never got cancer. Or: I don't care what others say about Yugos, my Yugo has never had a problem.) Simply because someone can point to a few favorable numbers says nothing about the overall chances.

straw man: creating a false scenario and then attacking it. (e.g., some say "Evolutionists think that everything came about by random chance.") Most evolutionists think in terms of natural selection which may involve incidental elements, but does not depend entirely on random chance. Painting your opponent with false colors only deflects the purpose of the argument.

two wrongs make a right: trying to justify what we did by accusing someone else of doing the same. (e.g. how can you judge my actions when you do exactly the same thing?) The guilt of the accuser has no relevance to the discussion.

Card stacking:³ A one-sided case presents only evidence favoring its conclusion, and ignores or downplays the evidence against it. In inductive reasoning, it is important to consider *all* of the available evidence before coming to a conclusion.

Exercise 3.0.1: Identify the logical fallacy committed in each.⁴ Sometimes more than one answer is possible.

Studies show that abortion leads to breast cancer.

Fallacy: _____

There are only two kinds of politicians: those interested in their own welfare and those interested in the welfare of others.

Fallacy: _____

Women's just can't understand math.

Fallacy: _____

After the nuclear power plant began operations in our area, my dog started going bald. That plant contaminated my dog.

Fallacy: _____

Grades are irrelevant to learning. Students are in college to get an education, not good grades. The university should eliminate grades altogether.

Fallacy: _____

The best policy is to put juvenile offenders in jail so that they can get a taste of reality. Otherwise, they will repeat their crimes over and over.

Fallacy: _____

This country should research environmentally sound ways to use coal as an energy source. If we don't, we will become enslaved to the oil-rich Middle East nations.

Fallacy: _____

³ *Fallacy Files*. 14 Nov. 2004. <http://www.fallacyfiles.org/index.html>

⁴ Some from: *Logic in a Nutshell*. 14 Nov 2004.
<http://www.molloy.edu/academic/philosophy/sophia/logic/ex4.htm>

If we allow abortion, people will think it's acceptable to kill the homeless or pull the plug on sick people--two groups that are also weak and frail.

Fallacy: _____

The curfews that some towns impose on teenagers are as repressive as the curfews in totalitarian countries.

Fallacy: _____

Each day, Americans throw out tons and tons of edible food; it isn't true that some Americans suffer from hunger.

Fallacy: _____

Two members of the state legislature have introduced gun-control legislation. Both had led sheltered, pampered lives that prevent them from seeing how ordinary people need guns to protect themselves.

Fallacy: _____

Some say that auto insurance rates need to be more strictly regulated, but how strict are regulations on health insurance?

Fallacy: _____

Last year, a few students managed to avoid paying for their parking decals. This year's increased parking fees unfairly penalize everyone for the dishonesty of a few.

Fallacy: _____

Women are so sentimental! My mother and sister always cry at the movies. My father and I never do.

Fallacy: _____

No breath of scandal has ever touched the senator. Therefore he must be incorruptibly honest.

Fallacy: _____

How can you take Sartre's philosophical views seriously. The man, after all, led an abysmal life and was certainly no paragon of morality.

Fallacy: _____

After all, my views on gun control have been endorsed by some of Hollywood's most notable actors---Sylvester Stallone, Barbara Streisand, and Alec Baldwin,

among others. How could you not agree with me?

Fallacy: _____

Gentlemen, we can not let Honduras be ruled by a communist government. If we do then sooner or later Mexico will become communist along with the islands in the Caribbean and no doubt Canada

Fallacy: _____

The governor supports tax increases for middle-income earners. This doesn't surprise me. He has always been against unions and this is just another measure designed to undermine them. If we allow for these tax increases and the undermining of unions, democracy in this country will be threatened.

Fallacy: _____

It is necessary to confine criminals and to lock up dangerous lunatics. Therefore there is nothing intrinsically wrong with depriving people of their liberties.

Fallacy: _____

If you hold that nothing is self-evident, I will not argue with you for it is clear that you are a quibbler and not to be convinced.

Fallacy: _____

Narcotics are habit forming. Therefore if you allow your physician to ease your pain with an opiate you will become a hopeless drug addict.

Fallacy: _____

You can't park here. I don't care what the sign says. If you don't drive on, I'll give you a ticket.

Fallacy: _____

She says that she loves me and she must be telling the truth, because she certainly wouldn't lie to someone that she loves.

Fallacy: _____

There is no proof that the secretary "leaked" the news to the papers, so it couldn't have been the secretary who did it.

Fallacy: _____

Gentlemen, I am sure that if you think it over you will see that my suggestion has real merit. It is only a suggestion of course, and not an order. As I mentioned at our last conference, I am planning to reorganize the whole business. I still hope, however, that it will not be necessary to curtail the operations of your department.

Fallacy: _____

The Rolls-Royce is a foreign made automobile and gets very few miles per gallon. Therefore all foreign made automobiles get very few miles per gallon.

Fallacy: _____

Two students were having a disagreement about cars. Student A said, "I can prove to you that Toyota Carolla's are faster than Honda Civic's. John owns a Carolla and he told me he beats very Civic he has ever raced." Student B asked, "How do you know John is telling the truth?" Student A replied by saying, "Someone who drives the fastest car wouldn't have to lie."

Fallacy: _____

4.0 Inductive versus Deductive Reasoning⁵

Inductive and deductive reasoning are two methods of logic used to arrive at a conclusion based on information assumed to be true.

Deductive reasoning arrives at a specific conclusion **based on generalizations**.

Inductive reasoning takes events and **makes generalizations**.

Deductive reasoning starts with a limited number of simple statements or assumptions, then builds more complex statements from the more basic ones.

In more formal logic terms deductive reasoning is reasoning from stated premises to conclusions formally or necessarily implied by such premises.

Deductive reasoning can be described as reasoning of the form if A then B.

If-then deductive reasoning is how scientists (and other people!) can test alternate hypotheses. Making deductions is important when we cannot directly observe a cause, and can only observe its consequences. This kind of reasoning can be modeled by the following:

If ...

⁵ Adapted from: *DEDUCTIVE VERSUS INDUCTIVE REASONING*. 29 Dec 04.
<http://www.nakedscience.org/skyline/Deductive%20and%20Inductive%20Reasoning.htm>

Then...

But...

Therefore...

For example, we might hypothesize that "The color of a mineral is determined by its crystal structure."

And so we could test this hypothesis using deductive reasoning:

If the color of a mineral is determined by its crystal structure; then all purple minerals should have the same crystal structure. But purple amethyst has a hexagonal structure and purple fluorite has an isometric structure (determined by observations). Therefore, the hypothesis is not supported or strengthened.

Inductive reasoning is basically the opposite of deductive reasoning. It involves trying to create general principles by starting with many specific instances.

Inductive reasoning, or induction, is the process by which a general conclusion is reached from evaluating specific observations or situations.

Many people distinguish between two basic kinds of argument: inductive and deductive.

Induction is usually described as moving from the specific to the general, while deduction begins with the general and ends with the specific; arguments based on experience or observation are best expressed inductively, while arguments based on laws, rules, or other widely accepted principles are best expressed deductively.

Deductive arguments:⁶

Arguments where the goal is to provide conclusive evidence for the conclusion; the nature of the inferential claim is such that it is impossible for the premises to be true and the conclusion false. (Valid or Invalid)

Inductive arguments:

Arguments where the goal is to provide the best available evidence for the conclusion; the nature of the inferential claim is such that it is unlikely that the premises are true and the conclusion false. (Strong or Weak)

Here are some examples:

⁶ Adapted from: Pine, Ronald C. *Essential Logic*. 29 Dec 04.
<http://www.hcc.hawaii.edu/~pine/Book2/chap3EL-2.html>

Deductive argument:

All U.S.-manufactured cars built after 2004 were equipped with tire pressure warning lights at the factory.

John has a 2005 U.S.-manufactured Ford.

Thus, John's car was equipped with tire pressure warning lights at the factory.

Inductive argument:

After careful observation we have not seen any hummingbirds all day in this forest.

Therefore, there probably are not any hummingbirds in this forest.

Exercise 4.0.1: Decide if the following arguments are either inductive or deductive arguments.

1. All Republican presidents have been in favor of a strong military.

President Bush was a Republican president.

It follows that President Bush was in favor of a strong military.

2. John is on the softball team and has short hair. Dan is on the softball team and has short hair. Kenji is on the softball team and has short hair. It seems likely that all the members of the softball team have short hair.

3. All members of the softball team must have short hair. Jay has short hair.

Therefore, Jay must be on the softball team.

4. If Hansen is the serial murderer, then his fingerprints would be on the gun. His fingerprints were on the gun. Therefore, it is clear that Hansen is the serial murderer.

5. Most presidents of the United States did not die in office. Therefore, it is doubtful that the twelfth president of the United States died in office.