

Introductory Logic

TEACHER

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Introductory Logic: The Fundamentals of Thinking Well, Teacher

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INTRODUCTORY LOGIC

The Fundamentals of Thinking Well

TEACHER: FIFTH EDITION

Canon Logic Series



A NOTE to the TEACHER for the FIFTH EDITION

Logic is the science and art of reasoning well. We reason as we draw conclusions from other information by means of logical arguments. Arguments are made up of premises and conclusions, which are types of statements. Statements are sentences that are true or false. Categorical statements predicate something of a subject, and thus connect subject and predicate terms. A term is the verbal expression of a concept. Consequently, in order to follow logical arguments as we reason, we must know how to determine the truth of statements, and to understand statements, we need to be able to define the terms that make up those statements.

In this text we begin with terms. Your students will learn how to define terms and how to relate terms to other terms in genus and species charts. They will then study statements, discovering ways to determine the truth of a given statement, and will examine how statements relate to each other. Next, they will learn how to put statements together into arguments, and gather strategies for distinguishing valid arguments from invalid ones. They will do this first in the tightly controlled, artificial environment of categorical syllogisms. You will then lead them into the real world as they take the tools they have mastered and learn how to apply them to arguments in normal English. Once they have gained the skills of analyzing the arguments of others, they will take a brief foray into constructing arguments to establish conclusions of their own. They will then finish this course by learning to detect the fallacies that litter arguments in daily life.

This logic course thus follows the program outlined by Dorothy Sayers in “The Lost Tools of Learning.” In that seminal essay, she outlined for us the course of study for the medieval logic student, who learned “how to use language: how to define his terms and make accurate statements; how to construct an argument and how to detect fallacies in argument.” Terms, statements, arguments, fallacies—these are concepts that will become familiar to your students in this study of *Introductory Logic: The Fundamentals of Thinking Well*.

April 2014

PUBLISHER'S NOTE from CANON PRESS

SCHEDULES

It's up to you to choose the pace for working through *Introductory Logic*. If you're comfortable with moving at a quick pace, and can schedule three to five classes per week, you can work through the course in one semester. Those who prefer a more leisurely pace can plan to complete the course in a year with one to three class meetings per week. On the following two pages, we have provided two sample schedules. The first option is based on meeting daily for one semester. The second option fits a schedule of three weekly classes for a whole year. Use these as a guideline, and adapt as needed to meet the needs of your class or homeschool. Just cover the material listed for each week in as many days as you have per week, and you'll finish on time. Or alter either schedule to suit your students' pace and the time you have allotted for the course: add or subtract weeks and adjust the pacing of the material accordingly to fit your needs.

PAGE NUMBERS

This Teacher text contains the entire Student version as well, with the same page numbers. The Arabic numerals (on single-columned pages) are the same in both texts. Your teacher notes (double-columned pages) are numbered with Roman numerals.

DAILY LESSON PLANS

Each student lesson in the Teacher edition is accompanied by double-columned teaching notes: objectives, step-by-step teaching instructions,

assignments, and more. You can decide whether you want to read through the lesson with the students out loud, have the students read through it alone and then teach through it, teach through it without reading it...whatever suits your personal teaching style best.

GRADING

This Teacher Edition contains all the answers you need for all exercises, quizzes, and tests. For many lessons, answers may vary depending on the imagination and creativity of your students. Expect this; you'll still be able to grade the differing answers fairly if you, as teacher, thoroughly understand the principles involved. We've included point values for each quiz or exercise question to help with this. Consider giving partial credit for incorrect answers that have a piece of the final answer right. If you mark an answer wrong, but a student thinks it is *not* wrong, consider allowing them to try to argue the point back, in writing. This gives them practice arguing, and they just might be right.

DVD COURSE

If you can take advantage of the fantastic DVD course companion, we'd suggest that you watch the day's lesson first (let our teacher's years of classroom experience do the hard work), and then you can answer any questions as your students work on the exercises. The DVD works through every "Form B" Test, so that can be especially helpful for practice tests.

**As always, if you've got questions, ideas, or just want to get in touch,
call 208-892-8074 or find us online at www.canonpress.com.
We'd love to help you as you teach the fundamentals of thinking well.**

SCHEDULE OPTION 1: ONE SEMESTER

This schedule will allow you to cover the contents of *Introductory Logic* meeting daily over the course of a sixteen-week semester. Adjust daily or weekly assignments as needed.

Week	Day	Text	Assignment	Week	Day	Text	Assignment
1	Mon	Introduction		9	Mon	Lesson 24	Exercise 22
	Tues	Lesson 1	Exercise 1		Tues	Challenge Project	Exercise 22
	Wed	Lesson 2	Exercise 2		Wed	Challenge Project	Exercise 22
	Thur	Lesson 3	Exercise 3		Thur	Quiz Day	<i>Quiz Nine</i>
	Fri	Quiz Day	<i>Quiz One</i>		Fri	Lesson 25	Exercise 23
2	Mon	Lesson 4	Exercise 4	10	Mon	Lesson 26	Exercise 24
	Tues	Lesson 5	Exercise 5		Tues	Lesson 26	Exercise 25
	Wed	Quiz Day	<i>Quiz Two</i>		Wed	Quiz Day	<i>Quiz Ten</i>
	Thur	Review for Test	Review Questions		Thur	Review for Test	Review Questions
	Fri	Test Day	<i>Test One</i>		Fri	Test Day	<i>Test Five</i>
3	Mon	Lesson 6	Exercise 6	11	Mon	Lesson 27	Exercise 26
	Tues	Lesson 7	Exercise 7		Tues	Lesson 27	Exercise 27:1-3
	Wed	Lesson 8	Exercise 8		Wed	Lesson 27	Exercise 27:4-6
	Thur	Quiz Day	<i>Quiz Three</i>		Thur	Quiz Day	<i>Quiz Eleven</i>
	Fri	Lesson 9	Exercise 9		Fri	Lesson 28	Exercise 28
4	Mon	Lesson 10	Exercise 10	12	Mon	Lesson 29	Exercise 29
	Tues	Lesson 11	Exercise 11		Tues	Lesson 29	Exercise 30
	Wed	Quiz Day	<i>Quiz Four</i>		Wed	Quiz Day	<i>Quiz Twelve</i>
	Thur	Review for Test	Review Questions		Thur	Review for Test	Review Questions
	Fri	Test Day	<i>Test Two</i>		Fri	Test Day	<i>Test Six</i>
5	Mon	Lesson 12	Exercise 12	13	Mon	Lesson 30	Exercise 31
	Tues	Lesson 13	Exercise 13		Tues	Lesson 30	Exercise 32
	Wed	Lesson 14	Exercise 14		Wed	Quiz Day	<i>Quiz Thirteen</i>
	Thur	Quiz Day	<i>Quiz Five</i>		Thur	Lesson 31	Exercise 33
	Fri	Lessons 15 & 16	Exercise 15		Fri	Lesson 31	Exercise 34
6	Mon	Lesson 17	Exercise 16	14	Mon	Lesson 32	Exercise 35:1-5
	Tues	Lesson 18	Exercise 17		Tues	Lesson 32	Exercise 35:6-10
	Wed	Quiz Day	<i>Quiz Six</i>		Wed	Quiz Day	<i>Quiz Fourteen</i>
	Thur	Review for Test	Review Questions		Thur	Review for Test	Review Questions
	Fri	Test Day	<i>Test Three</i>		Fri	Test Day	<i>Test Seven</i>
7	Mon	Lesson 19	Exercise 18	15	Mon	Lesson 33	Exercise 36
	Tues	Lesson 20	Exercise 19:1-5		Tues	Lesson 34	Exercise 37
	Wed	Lesson 20	Exercise 19:6-10		Wed	Lesson 35	Exercise 38
	Thur	Quiz Day	<i>Quiz Seven</i>		Thur	Quiz Day	<i>Quiz Fifteen</i>
	Fri	Lesson 21			Fri	Lesson 36	Exercise 39
8	Mon	Lesson 22	Exercise 20	16	Mon	Review for Test	Review Questions
	Tues	Lesson 23	Exercise 21		Tues	Test Day	<i>Test Eight</i>
	Wed	Quiz Day	<i>Quiz Eight</i>		Wed	Review for Comprehensive Exam	
	Thur	Review for Test	Review Questions		Thur	Review for Comprehensive Exam	
	Fri	Test Day	<i>Test Four</i>		Fri	Exam	<i>Comprehensive Exam</i>

SCHEDULE OPTION 2: FULL YEAR

This schedule will allow you to cover the contents of *Introductory Logic* meeting three days per week over the course of a thirty-two-week school year. Adjust as needed if you meet fewer days per week.

Week	Day	Text	Assignment	Week	Day	Text	Assignment
1	1	Introduction		17	49	Lesson 24	Exercise 22
	2	Lesson 1	Exercise 1		50	Challenge Project	Exercise 22
	3	Lesson 2	Exercise 2		51	Challenge Project	Exercise 22
2	4	Lesson 3	Exercise 3	18	52	Finish Project and Review	
	5	Finish Exercises and Review			53	Quiz Day	<i>Quiz Nine</i>
	6	Quiz Day	<i>Quiz One</i>		54	Lesson 25	Exercise 23
3	7	Lesson 4	Exercise 4	19	55	Lesson 26	Exercise 24
	8	Lesson 5	Exercise 5		56	Lesson 26	Exercise 25
	9	Quiz Day	<i>Quiz Two</i>		57	Quiz Day	<i>Quiz Ten</i>
4	10	Review for Test	Review Questions	20	58	Review for Test	Review Questions
	11	Practice Test	<i>Test 1a</i>		59	Practice Test	<i>Test 5a</i>
	12	Test	<i>Test 1b</i>		60	Test Day	<i>Test 5b</i>
5	13	Lesson 6	Exercise 6	21	61	Lesson 27	Exercise 26
	14	Lesson 7	Exercise 7		62	Lesson 27	Exercise 27:1-3
	15	Lesson 8	Exercise 8		63	Lesson 27	Exercise 27:4-6
6	16	Finish Exercises and Review		22	64	Finish Exercises and Review	
	17	Quiz Day	<i>Quiz Three</i>		65	Quiz Day	<i>Quiz Eleven</i>
	18	Lesson 9	Exercise 9		66	Lesson 28	Exercise 28
7	19	Lesson 10	Exercise 10	23	67	Lesson 29	Exercise 29
	20	Lesson 11	Exercise 11		68	Lesson 29	Exercise 30
	21	Quiz Day	<i>Quiz Four</i>		69	Quiz Day	<i>Quiz Twelve</i>
8	22	Review for Test	Review Questions	24	70	Review for Test	Review Questions
	23	Practice Test	<i>Test 2a</i>		71	Practice Test	<i>Test 6a</i>
	24	Test Day	<i>Test 2b</i>		72	Test Day	<i>Test 6b</i>
9	25	Lesson 12	Exercise 12	25	73	Lesson 30	Exercise 31
	26	Lesson 13	Exercise 13		74	Lesson 30	Exercise 32
	27	Lesson 14	Exercise 14		75	Quiz Day	<i>Quiz Thirteen</i>
10	28	Finish Exercises and Review		26	76	Lesson 31	Exercise 33
	29	Quiz Day	<i>Quiz Five</i>		77	Lesson 31	Exercise 34
	30	Lesson 15, 16	Exercise 15		78	Finish exercises	
11	31	Lesson 17	Exercise 16	27	79	Lesson 32	Exercise 35:1-5
	32	Lesson 18	Exercise 17		80	Lesson 32	Exercise 35:6-10
	33	Quiz Day	<i>Quiz Six</i>		81	Quiz Day	<i>Quiz Fourteen</i>
12	34	Review for Test	Review Questions	28	82	Review for Test	Review Questions
	35	Practice Test	<i>Test 3a</i>		83	Practice Test	<i>Test 7a</i>
	36	Test Day	<i>Test 3b</i>		84	Test Day	<i>Test 7b</i>
13	37	Lesson 19	Exercise 18	29	85	Lesson 33	Exercise 36
	38	Lesson 20	Exercise 19:1-5		86	Lesson 34	Exercise 37
	39	Lesson 20	Exercise 19:6-10		87	Lesson 35	Exercise 38
14	40	Finish Exercises and Review		30	88	Lesson 35	Exercise 38
	41	Quiz Day	<i>Quiz Seven</i>		89	Quiz Day	<i>Quiz Fifteen</i>
	42	Lesson 21			90	Lesson 36	Exercise 39
15	43	Lesson 22	Exercise 20	31	91	Review for Test	Review Questions
	44	Lesson 23	Exercise 21		92	Practice Test	<i>Test 8a</i>
	45	Quiz Day	<i>Quiz Eight</i>		93	Test Day	<i>Test 8b</i>
16	46	Review for Test	Review Questions	32	94	Review for Comprehensive Exam	
	47	Practice Test	<i>Test 4a</i>		95	Review for Comprehensive Exam	
	48	Test Day	<i>Test 4b</i>		96	Exam	<i>Comprehensive Exam</i>

INTRODUCTORY LOGIC

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LOGIC: ITS NATURE AND PURPOSE

Introductory Logic, pp. 1–6

STUDENT OBJECTIVES

1. Define *logic*.
2. Define *reasoning*.
3. Identify the three laws of thought.
4. Construct the logic chart, explain it, and answer questions about it.

TEACHING INSTRUCTIONS

1. Read the Introduction, “Logic: Its Nature and Purpose” (*Introductory Logic* pp. 1–6) aloud to the students (or have them take turns reading it). You can either read it in its entirety and then continue into the following steps, or stop and discuss the following as you go.
2. Ask students how they would define *reasoning*. After fielding weird answers and blank stares, explain that **reasoning means drawing proper conclusions from information we already have**. Give an example or two (“You smell smoke and decide something is burning. That’s reasoning. Your friend is unnaturally quiet and you decide she’s upset. That’s reasoning.”) Make sure students understand that reasoning is one of God’s gifts to us so that we can get at truth; it is *not* what constitutes our being made in the image of God.
3. Write the definition of formal logic on the board: **Formal logic is the science and art of reasoning well**. Ask the students why they

think that logic is a *science*. (Because it is about discovering the *rules* by which we reason.) Ask why they think logic is also an *art*. (Because the rules can be applied skillfully to discourse, we can't follow the rules woodenly; we have to practice logic skillfully. Have them think about what that might mean.) Make sure that students understand that logic was not created by man or God, but is an *attribute* of God that we see all over his creation.

4. Ask the students, “What is the first thing you need to build when you're building a house?” (A foundation. Something to build on.) Explain that reasoning is a lot like house-building: you always need something to build it on. Tell them that in logic we build on three rules, or laws. Remind students that impersonal laws don't have authority in themselves: somebody in authority has to give them. Emphasize that the three Laws of Thought are grounded in the Lawgiver, in the triune God.
5. Introduce the first law using the phrase “Jesus is Lord.” Point out that there are only two responses to this statement, faith or unbelief, so the statement must be either true or false; you can't say, in a dreamy voice, “That statement is beyond truth and falsity.” Write on the board the **Law of Excluded Middle: any statement is either true or false**. Insist that there is nothing in between. (Students may try to play devil's advocate and bring up “maybe” sentences or nonsense sentences. Be ready to explain that

a “maybe” sentence is still true or false, and a nonsense sentence is just that—nonsense.)

6. Introduce the second law with the same phrase “Jesus is Lord”: if Jesus is Lord then Jesus is Lord. Explain that this might be kind of obvious, but a lot of people try to say things like “Well, ‘Jesus is Lord’ is true for you, but not for me.” If something is true, it’s true everywhere, for everyone. Write on the board the **Law of Identity: If a statement is true, then it is true.**
7. Explain, thirdly, that you can’t agree that “Jesus is Lord” and disagree with it at the same time without having a split personality. Write on the board the **Law of Non-Contradiction: A statement cannot be both true and false.**
8. Explain that these laws might seem obvious, but that if we didn’t assume them, we wouldn’t be able to say anything for sure. But also point out that even though the world follows these laws, the world is nevertheless full of mystery, because God is full of mystery. He is Three in One. Ask the students for other examples of things we can’t understand through logic alone. Emphasize that **logic must always give way to mystery.**
9. Draw the chart on page 6 of *Introductory Logic* on the board as you explain it. (Reassure anyone worried that while they need to be able

to reproduce this chart, they do not need to understand all the concepts yet.) Explain that **formal logic deals directly with proper and improper modes of reasoning**, while **informal logic deals with operations of thinking that are indirectly related to reasoning**, such as defining terms, relating terms, and determining relationships between statements. Explain that formal logic also divides into two main branches: **Induction is reasoning to probable conclusions from examples or experience** (e.g., “Every cat I’ve ever had has purred when I petted it. Probably all cats purr when petted.”), while **deduction is reasoning with certainty from premises to conclusions** (“All dogs bark. This is a dog. Therefore it barks.”). Inductive arguments are either **strong** or **weak**; deductive arguments are either **valid** or **invalid**. The two branches of deductive reasoning are categorical and propositional logic. Tell students that in this book you will be studying both informal and categorical logic.

ASSIGNMENT

1. Have students review the three laws and practice drawing the logic chart.

LOGIC: ITS NATURE AND PURPOSE

God created man with the ability to reason: “Come now, and let us reason together, saith the Lord” (Is. 1:18). He did this so that we could communicate with Him and with one another. This enables us to love and obey Him. Reasoning means drawing proper conclusions from other information. A proper use of reason allows us to form rational statements, and to understand the statements that are made by others. It allows us, for example, to take universal statements such as “God has commanded all men everywhere to repent” and to apply them, first to ourselves and then to our neighbor: “We are men, therefore we must repent.” Without the ability to reason, we would be unable to discuss, preach, read, hear the gospel, or follow God’s commands. In other words, proper reasoning opens the mind so that it can close upon truth.

Some have assumed that this ability to reason is what constitutes man being created in the image of God. But there are several problems with this assumption. First, there are other creatures (like angels and cherubim) who have an ability to reason, but who do not bear the image of God the same way that man does. Another problem is that it implies that humans who are very young (e.g., a fertilized human ovum) or who are severely retarded cannot bear God’s image, or that they do so imperfectly. Rather than treating reason as the image of God in man, it would be far better to treat reason as a gift that God gives (out of His own nature and character) to all intelligent creatures. The more He gives, the greater our responsibility to love Him, as Scripture says, “with all our minds.”

Formal logic is the science and art of reasoning well. As a science, logic includes discovering and identifying the patterns or rules by which we reason. As an art, logic teaches how to follow those rules, without abusing them in a wooden (and unreasonable) way. About sixteen centuries ago, Augustine said this about the science of logic:



KEY POINT

Reason opens our minds so that they can close upon truth. Reason is a gift from God; it is *not* the single, essential aspect of bearing God’s image.



DEFINITION

Logic is the science and art of reasoning well.

And yet the validity of logical sequences is not a thing devised by men, but is observed and noted by them that they may be able to learn and teach it; for it exists eternally in the reason of things, and has its origin with God. For as the man who narrates the order of events does not himself create that order; and as he who describes the situations of places, or the natures of animals, or roots, or minerals, does not describe arrangements of man; and as he who points out the stars and their movements does not point out anything that he himself or any other man has ordained; in the same way, he who says, “When the consequent is false, the antecedent must also be false,” says what is most true; but he does not himself make it so, he only points out that it is so. (*On Christian Doctrine*, book II, chapter 32)



KEY POINT

Logic is not created by God or man; rather, it is an attribute of God. It is not over God or independent of Him.

Logic is not devised by man, but neither is it created by God, like maple trees and dwarf stars are. Rather, it is an “attribute” of God which is reflected in creation. We need to be careful here, because it is not an attribute of God that is stated directly in Scripture, as His holiness, love, and righteousness are. But it is a characteristic of God that we see assumed everywhere in Scripture. We do not believe that logic is independent of God and over Him, which would mean that the triune God is not the sovereign God of the Bible. But neither do we believe that God could have created a nonsensical world where He was both the creator of it and not the creator of it. This leaves us with the assumption that all things are ultimately defined by God Himself, rather than by “rules.” Since we want to learn how to reason as faithful Christians, we begin by assuming that all faithful thinking and reasoning is somehow sharing in this characteristic of God. So when we study logic faithfully, we are studying some of the divine reflection in the world around us.

The Laws of Thought

Keeping all of this in mind, we must be careful when dealing with “rules” and “laws” of logic. In order to reason well, we have to assume

certain very basic things that never show up as particular items in our argument. They are simply (and quietly) assumed. For example, if you were putting together an argument about light bulbs or tricycles, it is very important that they not turn into something else (like toaster ovens or catcher's mitts) halfway through the argument. If they did, the argument would just have to lie down in the corner and sob quietly. It could never get anything done.

Traditionally, these assumptions have been called the "laws of thought." There is nothing wrong with the *contents* of these assumptions, but there is a significant problem with *another* deeper assumption lying beneath them. That assumption is that you can have laws without a lawgiver, and that ultimately, you can have reason apart from the triune God of Scripture. All you need to do, it is thought, is postulate some laws of thought and off you go.

Because this is the case, we want to begin by showing how the laws of thought are actually grounded in the nature of the triune God, revealed in Jesus Christ. After we have done that, we will be able to discuss the traditional terminology. The reason for doing this is that many modernists have been guilty of thinking that impersonal "laws" have authority in themselves, which of course they do not.

Let's start with the basic Christian confession that *Jesus is Lord*. When God reveals Himself in Christ, the decision that must be made is whether to believe it or not. These are the only two options: faith or unbelief. This means that the statement *Jesus is Lord* must either be true or false. A faithful person confesses that it is true. An unfaithful person denies it as false. God does not leave open the option of saying something like, "I believe that the higher reality of the lordship of Christ cannot be contained in our paltry categories of true and false, and so I cannot say whether I believe in Him or not." Such a response is simple dishonesty masquerading as humility.

The fact that *any statement is either true or false* is one of the three traditional laws of thought, upon which much of the science of logic is based. This law of thought is called the **Law of Excluded Middle**, because it excludes the possibility of a truth value falling somewhere in the middle between true and false. Statements are either one or the other. If a statement is not true, then it is false, and vice versa.



DEFINITION

The *Law of Excluded Middle*: Any statement is either true or false.



DEFINITION

The ***Law of Identity***: If a statement is true, then it is true.



DEFINITION

The ***Law of Noncontradiction***: A statement cannot be both true and false.

As Christians we confess that God is triune. If asked, we would say, “Yes, that is true. God is triune.” Now if it is true that God is triune, *then it must be true that God is triune*. This is an application of **The Law of Identity**, which simply states that *if a statement is true then it is true*. For ordinary people in ordinary conversation, such rules are not thought to be necessary. But when people are fleeing from God, they will often take refuge in any folly, arguing that the truth of a statement can change in the middle of an argument. This law may be employed to answer the unbeliever who says, “Christianity may be true for you, but not for me.” No. If the Christian faith is true, then it is true.

The third law says that *a statement cannot be both true and false*. This is called the **Law of Noncontradiction**. Without this law, we could not argue for the exclusive truth of any statement that we hold. We could try to assert, for example, that “Jesus is Lord.” But our opponents could respond, “Oh, I agree that what you say is true. But it is also false.” We see that if we deny these laws, we lose the possibility of all rational discourse.

Think for a moment what would happen to our faith if we were to allow someone to deny these fundamental assumptions. If we confess “God in three Persons, blessed Trinity,” someone who denied the Law of Excluded Middle could say that this wonderful confession is not true, and it is not false. It is just wonderful, and perhaps even a little inspiring. One who denied the law of identity could say, “Yes, it is true that God is a Father for you, but it is *my* truth that She is a Mother.” And one who denied the Law of Noncontradiction could say that God is our Father, and also, in the same way and in the same respect, He is not our Father. In other words, denial of these bedrock assumptions would make a hash out of the simplest Christian confession like the Apostles’ Creed.

Having said all this, there is an important warning. The Bible does assume that the Father is the Father, and not the Son. The Spirit is the Spirit and not the Father. The Father is not “not the Father.” At the same time, the Bible *also* teaches that the Father perfectly indwells the Son, the Son indwells the Father, and both with the Spirit are one God. Statements about the Father are not independent from statements about

the Son. Jesus said, “Anyone who has seen me has seen the Father.” These truths do not deny the laws of thought but rather support them.

Through a wooden application of these laws, some logicians have gotten to the point where they cannot understand or appreciate poetry, metaphor, sacraments, or marriage. The world is full of “in-dwelling” and mutual partaking, because this is *also* what our God is like. In our study of logic, we must always leave room for mystery. We know that the Father is Father, and no one else. We know as well that the Father is not the Son. But we should also know that the Father reveals Himself perfectly in the Son.

The Scope of This Book

The subject of logic may be divided into two main branches: **formal** and **informal**. Formal logic deals directly with reasoning, by considering the means of distinguishing between proper and improper modes of reasoning. Informal logic deals with operations of thinking that are indirectly related to reasoning, such as defining terms, relating terms to each other, and determining relationships between statements. Because informal fallacies are not formal methods of reasoning, they are also included under the branch of informal logic.

Formal logic itself may be divided into two main branches, **induction** and **deduction**. Induction deals with arguments of likelihood and probability. By induction we draw conclusions from facts or experience, conclusions which go beyond those facts. Inductive conclusions are never certain, but only probable. As such, they can be considered strong or weak, depending on how well experience supports the conclusion. They may also be strengthened by further experience. You can see that induction is the logic of the experimental sciences.

Whereas induction deals with arguments that are strong or weak, deduction deals with arguments that are valid or invalid. If valid, the conclusion follows from the premises, and it does so with certainty. A valid conclusion is one that is contained within the premises: if the premises of a valid argument are true, then the conclusion must be true. There are many branches of deductive reasoning. Two main branches are **categorical logic** and **propositional logic**. To the best of our knowledge, categorical logic was first developed as a science by



KEY POINT

Logic must always give way to mystery. For example, we understand many things in terms of poetry, or sacraments, or the in-dwelling of the Trinity.



DEFINITIONS

Formal logic deals with the proper modes of reasoning. **Informal logic** deals with operations of thinking that are indirectly related to reasoning.

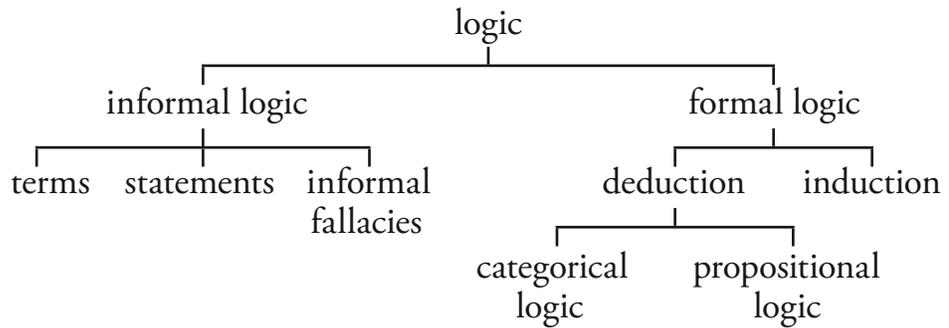


DEFINITIONS

Induction is reasoning with probability from examples or experience to general rules. **Deduction** is reasoning with certainty from premises to conclusions.

the Greek philosopher Aristotle (384–322 B.C.). Categorical logic deals with the **syllogism**, which is a type of deductive argument in which the conclusion connects one category (or term) with another, hence the name *categorical* logic. Propositional logic connects entire *propositions* together in arguments.

These branches of logic can be arranged as seen in the chart below:



This book is an introduction to the informal and categorical branches of logic. The next book in this series, *Intermediate Logic*, deals with the propositional branch of deduction. The point of all of this is to encourage students to begin the process of carefully “thinking God’s thoughts after Him.” The point of this book is *not* to teach us how to be quarrelsome with one another, nor to bring students to the false idea that the world is governed by some impersonal deity named Rules of Inference.

UNIT 1

TERMS AND DEFINITIONS

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THE PURPOSES AND TYPES OF DEFINITIONS

Introductory Logic, pp. 9–13

STUDENT OBJECTIVES

1. List and align the six purposes and five types of definitions and give examples.
2. Complete Exercise 1.

TEACHING INSTRUCTIONS

1. Read “Lesson 1: The Purposes and Types of Definitions” (*Introductory Logic* pp. 9–11) aloud with students. (Again, teach during or after the reading at your own discretion.)
2. Explain that **A term is a concept that is expressed precisely in one or more words.** A term is a verbal expression of an idea. Point to various objects around the room and make sure students understand that when you give these objects names they become terms, although the names are not themselves the terms. Explain that a single term can be expressed by many different words (e.g., *girl* and *puella* are two different words to describe the same term.) Also, one word can represent more than one term. Have students each write down their own definition of the word *mad*, and compare answers. Explain that the reason they all gave different definitions is that they are using the same word to describe different terms (e.g., *mad* can mean either “angry” or “crazy”).
3. Give the definition of *definition*: **A definition is a statement that gives the meaning of a term.** Tell students that what you are going to investigate today are the purposes of different

kinds of definitions, what they’re *for*. Explain that in this chapter you will be examining six purposes and five types of definitions.

4. Write **1) Definitions show relationships** on the board. Use the example in *Introductory Logic* of defining *man* as *a rational animal*. What relationships does this definition imply that the man has? Well, it implies that he is related to other rational creatures, like angels, demons, and God, but also to other animals, like walruses, kittens, and dung beetles. The definition ties a string between man and other stuff; it connects them.
5. Write **2) Definitions remove ambiguity** on the board. Ask students what it means that a word is “ambiguous,” and tell them that **Words are ambiguous when they have more than one possible meaning** (like the word “mad”). Explain that in lots of debates and arguments what the debaters get hung up on is definitions: they are using ambiguous words that mean something different to each person. When they finally define the ambiguous terms they have nothing left to argue about any more. Make sure students understand the book’s example about the definition of love: you don’t love your enemy the same way you love ice cream, or your baby sister. Explain that a definition that either shows relationships or removes ambiguity **by providing a single, established meaning of a term is called a lexical definition**, i.e., the kind you would find in a dictionary.

6. Write **3) Definitions reduce vagueness** on the board. Emphasize that ambiguity is similar to, but not the same as, vagueness: **A term is vague when its extent is unclear.** A term itself may have a straightforward meaning, but there may be situations in which it is uncertain whether the term applies. For example, we call a man *tall* if he is over six feet, but a tree would have to be much taller than six feet before we would call it tall; so the meaning of *tall* is vague. A precisifying definition seeks to make more precise what was previously vague or fuzzy. Clarify that precisifying definitions are not dictionary definitions; they apply only to the situation they are used in. If we use *tall* to describe 6'5" Harold, *tall* does not always and for everyone mean 6'5". Ask students whether nouns can also be vague. (They can. How old does a girl have to be before she is a *woman*?)
7. Write **4) Definitions increase vocabulary** on the board. Ask students for some vocabulary words they have recently learned in English class. Or grab a dictionary, open to a random page and choose a word no normal person would know (Even better, have a particularly good word picked out beforehand.) Read the word and definition to them and tell them that their vocabulary just grew. Explain that **a stipulative definition is a definition given to a brand-new-just-invented word, or to an existing word applied in a new way.** Look up some new words in a recent dictionary, such as *blog*, *to google*, and *woot*.
8. Write on the board **5) Definitions can explain concepts theoretically.** Explain that sometimes we give a definition for a word not because we don't know what the word means, but because we're trying to understand the term behind it better. Explain the book's example of H_2O . This is a theoretical definition: a definition given to a term that is not understood, usually scientific or philosophical. Explain that people give theoretic-

cal definitions to lots of concepts we don't fully understand, like *spirit*, *life*, even *God*. Explain that if you accept a theoretical definition, you accept the theory behind it; if you accept the definition of man as an evolved ape, you accept the theory of evolution.

9. Write on the board **6) Definitions can influence attitudes.** Go over the book's three definitions of *abortion* and have students explain how each definition is supposed to make them feel about the act of abortion. Explain that all definitions like this are **persuasive definitions: they aim at persuading the listener one way or another toward the term being defined.** Emphasize that persuasive definitions can be used for either good or bad. Have the students give some more persuasive definitions for *school*, *government*, and *cats* from different points of view.

ASSIGNMENT

Have students complete Exercise 1, and go over it with them.

OPTIONAL EXERCISE

Play the Dictionary Game (cf. Balderdash). Pick an unknown word from the dictionary, and read it aloud to everyone. Have each student make up a definition for the word and write it on a sheet of paper. Write the real dictionary definition of the word on another sheet of paper and mix it in with the made-up definitions. Read all the definitions aloud and have students vote on which they think is the true definition of the word. Remind students to be thinking as they play about what goes into writing a definition and what they are doing when they try to invent definitions for words or figure out what the definition of a strange word might be.

THE PURPOSES AND TYPES OF DEFINITIONS

A **term** is a concept with a precise meaning expressed by one or more words. A single term can be expressed by many different words. Words that are exact synonyms represent the same term. The English word *girl* and the Latin word *puella* represent the same term. Similarly, a single word can represent different terms. For example, the word *mad* can mean either “angry” or “insane.”

A **definition** is a statement that gives the meaning of a term. The ability to define terms accurately is a valuable skill. Lawyers must continually define their terms, and may use precise, technical language to do so. The same is true for teachers, scientists, philosophers, theologians, and most other professionals. To demonstrate the value of this skill, let us consider some of the purposes that definitions serve.

1. *Definitions show relationships.* When a term is defined properly, the definition often gives some idea of the **relationships** which that term has with other terms. For example, if you were to define man as “a rational animal,” your definition implies both that man has some relationship to other rational beings, such as angels and demons, and to other animals—bears, whales, and lizards. Or if bald is defined as “having no hair,” its contradictory relationship with the term hairy is immediately apparent.
2. *Definitions remove ambiguity.* Words are **ambiguous** when they have more than one possible meaning. Commonly, in a discussion or a debate, ambiguous words are used without the participants being aware of the ambiguity. The result is a verbal disagreement that may be cleared up by defining terms. For instance, some people believe that Jesus’ command to love your enemies is an absurd requirement because they are defining *love* to mean “believe the other to be a nice person,” when in fact they know



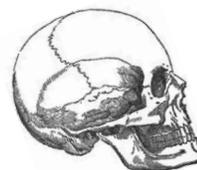
DEFINITIONS

A **term** is a concept that is expressed precisely in words. A **definition** is a statement that gives the meaning of a term.



KEY POINT

Note the difference between a term and a word: one word can carry the meaning of many terms; the same term can be expressed with different words.



CAUTION

It is extremely important to define your terms at the beginning of any debate. You want to argue about substance, not words.



DEFINITIONS

An *ambiguous* word has more than one definition. A *vague* word is one whose extent is unclear.



CAUTION

A precisifying definition is very dependent on the situation in which it is used.



KEY POINT

Defining terms is a key way of communicating knowledge.

their enemies to be quite wicked and depraved. But biblically, *love* means ‘to treat the other person lawfully from the heart,’ which is to be our behavior toward all men. If this definition is made clear, the people may still think that the command is impossible, but at least they no longer should see it as absurd.

A definition that shows relationships or reduces ambiguity by providing a single, established meaning of a term is called a **lexical definition**. This is the sort of definition one would find in a dictionary.

3. *Definitions reduce vagueness.* A problem similar to ambiguity is vagueness. A term is vague when its extent is unclear. The term itself may have a single, understood meaning, but there are “gray areas” where it is uncertain if the given term applies. This is a common problem in descriptive terms, such as *old*, *dark*, *tall*, *mature*. If a father tells his children it must be warm outside before they can swim in the lake, the children often immediately want vagueness reduced: “*How warm?*” If the father responds, “At least eighty degrees Fahrenheit,” the issue is made clear. Or if you are asked to give a small donation for a gift for the secretary, you may want a definition to reduce the vagueness of the term *small*, like, “By small I mean five dollars.” This type of definition is a **precising definition**, because it seeks to make more precise what was previously vague or fuzzy. Note that precisifying definitions would not be found in a dictionary; they apply only to the situation in which they are used.

4. *Definitions increase vocabulary.* One of the most important elements of education is learning the meaning of unfamiliar terms. An increase in vocabulary means an increase in knowledge, which is why in English class students are taught “vocabulary words” and their definitions. In this very lesson you may have learned the definitions of terms like ambiguity and vagueness. Knowing these definitions helps us to make subtle distinctions and otherwise use language properly.

When a new word is invented, or an existing word is applied in a new way, it is given a **stipulative definition**. Such definitions, if widely accepted, increase the vocabulary of the language to which they are added. New words are continually adopted into English, such as words resulting from new inventions (*laptop*, added in

1985), from sports (*screwball*, 1928), from other languages (*macho* from Spanish, also 1928), or coined out of someone’s imagination (*boondoggle*, from an American scoutmaster, 1957).

5. *Definitions can explain concepts theoretically.* Sometimes definitions are given for terms, not because the word itself is unfamiliar, but because the term is not understood. Such concepts require theoretical definitions, which are often scientific or philosophical in nature. For example, when your chemistry teacher defines water by its chemical formula H_2O , he is not trying to increase your vocabulary (you already knew the term *water*), but to explain its atomic structure.

Accepting a **theoretical definition** is like accepting a theory about the term being defined. If you define spirit as “the life-giving principle of physical organisms,” you are inviting others to accept the idea that life is somehow a spiritual product.

6. *Definitions can influence attitudes.* Often terms are defined, not necessarily for the purpose of clarifying their meaning, but in order to influence the attitudes and emotions of an audience. Abortion has been defined as “the slaughter of innocent children” on the one hand, “the right of a woman to control her own body” on the other, or even the non-emotional “termination of a pregnancy.” All these definitions aim at persuading the listener one way or another toward the term being defined, and as such are called **persuasive definitions**. Examples abound. Is democracy “mob rule” or “government by the people”? Is marriage “the institutionalized slavery of women by men” or “the blessed union of man and wife”? You can see the capacity of persuasive definitions for good or ill.

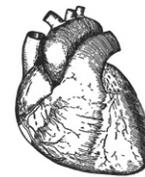


KEY POINT

Definitions may seem dry and logical, but they can be used persuasively. Knowing how to define terms well is a great advantage in debate.

SUMMARY

Definitions give meanings for terms. Definitions can show relationships between terms, remove ambiguity, reduce vagueness, increase vocabulary, explain concepts theoretically, and influence attitudes. Along with these purposes are the five types of definitions: lexical, precisising, stipulative, theoretical, and persuasive.



EXERCISE 1 (16 points)

1. Write lexical definitions of the words *child* and *adult* that show the relationship between them. (3)

Child: A person who has not yet gone through puberty
 Adult: A person who has gone through puberty

2. The word *grace* is an ambiguous word. Write two lexical definitions for the word *grace*, giving two of its different meanings. (2)

Grace: undeserved favor
 Grace: beauty of motion

3. Write a precisising definition of the word *soon* to clarify the vagueness in the sentence "I will be home soon." (2)

By soon I mean "before dinner."

4. Invent a stipulative definition for the word *ploff*. (1)

A crime that was nearly committed, but not quite.

5. Write a persuasive definition of the word *television* from the point of view of a mother who thinks her children watch too much of it. (4)

A television is a one-eyed brain sucker.

6. Write a short, imaginary dialogue between two people having a verbal dispute about the word *believe*. Then introduce a third person who settles the dispute by presenting lexical definitions for the word that eliminate the ambiguity. (Continue on the back if needed.) (4)

Smith: Satan certainly believes in God.
 Jones: No, if Satan believed in God he would be saved, for all who believe are saved.
 Johnson: By 'believe' I think Smith means 'takes as real' but Jones means 'puts his trust in.'

GENUS AND SPECIES

Introductory Logic, pp. 15–20

STUDENT OBJECTIVES

1. Define *genus* and *species*.
2. Construct genus and species charts.
3. Correct errors in genus and species charts.
4. Complete Exercise 2.

SPECIAL NOTE

Some of the students may have already dealt with the concepts of genus and species in a biology class. If so, make sure they understand that biology “hierarchies” are different from logic “hierarchies”: logic doesn’t have any levels other than genus and species (no family, order, class, phylum, or kingdom.)

TEACHING INSTRUCTIONS

1. Read “Lesson 2: Genus and Species” (*Introductory Logic* pp. 15–18) aloud.
2. Remind students that you are still discussing definitions, and that now you are narrowing in on a particular way of defining words and understanding the relationship between them. Explain that oftentimes we define terms by placing them inside a higher category or **genus: a term that is more general, broad, or abstract than the original term and includes it**. Give an example of a definition, such as “dime: a coin worth ten cents,” or “kitten: a young cat.” Ask students what the genera are that you’re putting

each of these words into (“coins” and “cats.”) Explain that “dime” and “kitten” are species of “coins” and “cats.” **A species of a term is a term that is more specific, narrow, or concrete than the original term and is included by it.**

3. Explain that terms can be placed in a genus and species hierarchy to show off the relationships between them. Have the students look at the hierarchy on p. 15. Explain that “food” is the overarching, Big Daddy genus over all these species. But point out that the *species* of “food” are also *genera* of other species. For example, “fruit” is a species of “food,” but it is the genus of “grapes,” “strawberries,” “tangerines,” and “pineapples.” Even “grapes” is a genus of all the different kinds of grapes there are (white and red for starters). Ask students for some species of “cheese.” Emphasize that the words genus and species are relative, because some terms can be both a genus and a species.
4. Have the students look at the first hierarchy on p. 16, and tell you (without looking ahead) what the genera and species are in this chart. Show that the species Informal logic and Formal logic are **mutually exclusive**: they don’t overlap. They are also **exhaustive**: no other species of logic exist. Explain that *theoretically* every genus can be divided like logic into species that are both mutually exclusive and exhaustive, but that while species must always be mutually exclusive, usually they’re not exhaustive. For example, it would be hard to come up with an exhaustive list of the species of “food.”

5. Explain that this chart is only one of the many different charts you could draw for the genus “logic.” You could have used a different “dividing principle” and come up with a different chart. When you divided the genus “logic” into “formal logic” and “informal logic” the dividing principle was “How directly related to reasoning is the term?” But say your dividing principle was “What is the goal of the term?” That would result in the second chart on p. 16. Same genus. Different species. Have the students each write their own species for “book,” and compare the different dividing principles they used.
6. Explain that there are a several errors to avoid when constructing these genus and species charts. Ask students to tell you what’s wrong with the first chart on p. 17 (without looking). Hopefully someone will say that there are women who are lawyers. Therefore the species are not mutually exclusive; they overlap. Make sure students understand that what caused this error was using two different dividing principles for the genus “people” at the same time: division by gender and division by profession. Write a few more examples of this error on the board, and have the students identify the conflicting dividing principles (genus: people / species: boys, paper-deliverers; genus: buildings / species: houses, palaces.)
7. Again, ask students to point out what’s wrong with second chart on p. 17. This is trickier, but maybe someone will notice that “induction” has sneaked up in the chart; it is itself a species of formal logic and goes underneath it, not next to it.
8. Ask for the error in the third chart on p. 17. It should be pretty obvious: the genus “ball” is ambiguous. There are two different definitions of that word: it could mean a round toy that bounces or the place Cinderella met her prince.
9. Again ask for the error in the fourth chart on p. 17. The students should see that species are not supposed to be *parts* of the genus, but rather *types* of the genus. The species of “flower” are not “petal” and “stem,” but “bluebell,” “daffodil,” and “morning glory” (among others). Ask the students how they could correct the bike chart.
10. Delve into the “Thinking Deeper” sidebar on p. 17 of *Introductory Logic*.

ASSIGNMENT

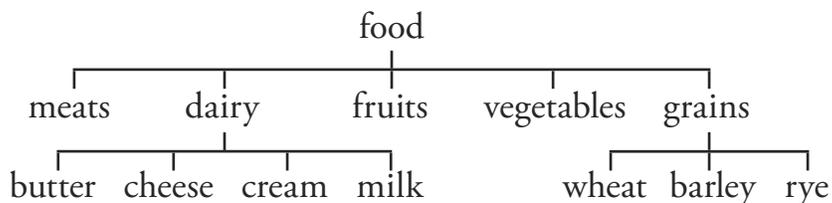
Have students complete Exercise 2, and go over it with them.

OPTIONAL EXERCISES

1. Write genus and species charts on the board and have students tell you if they are correct or incorrect, and if incorrect, why and how to correct them. Or have students do this for each other (and you.)
2. Start with a single term (ask for suggestions) and then expand it into a genus and species chart.

GENUS AND SPECIES

Terms are often defined by being placed among a higher category, or **genus**. The genus of a term is more general, broad, or abstract than the term itself. The term under a genus is called the **species**, which is a type, kind, or example of the term. The species is more specific, narrow, or concrete than the genus. Terms can be placed in a **genus and species hierarchy**, thus clearly showing the relationships between them. For example, consider the hierarchy below:



Here we see the genus *food*, and under it some of the species of the term food: meats, dairy products, fruits, vegetables, and grains. Of these, the terms *dairy products* and *grains* are shown to be genera (the plural of genus) for the species under them. The genus *dairy products* is broader than any of its species, such as butter, because dairy products includes not only butter but cheese, cream, milk, and any other species that could be placed under it. The chart also shows that the term *grains* is the genus of wheat, barley, and rye. Of course, many other terms could be included as species of grains. Can you think of any?

The words *genus* and *species* are relative terms. Each term can be both a genus and a species—a genus of the terms below it, and a species of the term above it. Thus *grains* is both a species of food and a genus of wheat. This process can continue (although not indefinitely) both downward and upward. *Cheese* could be the genus for different varieties of cheese, such as Swiss, Parmesan, and Cheddar.



DEFINITIONS

A **genus** of a term is a term that is more general, broad, or abstract than the original term and includes it.

A **species** of a term is a term that is more specific, narrow, or concrete than the original term and is included by it.



KEY POINT

Genus and **species** are relative terms. Each term can be both a genus and a species.



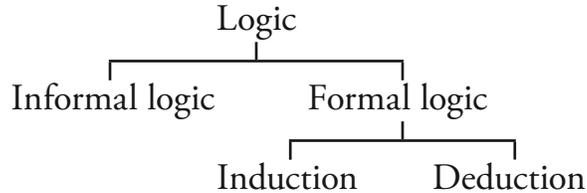
CAUTION

Even though *genus* and *species* are biological terms, logical hierarchies are very different from biological ones.

Food can be considered a species of *material* (if it is defined as “edible material”), and so on.

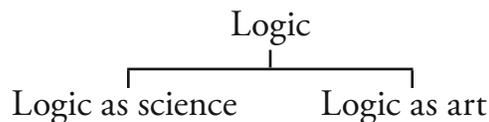
One caution: do not confuse the genus and species hierarchies of logic with the similar hierarchy you may have learned in biology. In logic, there are no levels other than genus and species—no family, order, class, phylum, or kingdom.

Now look at the genus and species hierarchy for the term *logic*.



Two types of logic are identified as species: informal and formal. These species are **mutually exclusive**—they do not overlap. No branch of logic is both formal and informal. They are also **exhaustive**—no other types of logic exist. Theoretically, every genus can be divided into species that are both mutually exclusive and exhaustive. And while the species must be mutually exclusive, in practice they are rarely exhaustive. Are induction and deduction an exhaustive list of the types of formal logic?

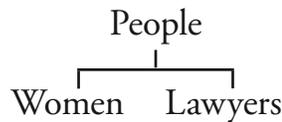
In the chart above, logic is divided into *formal* and *informal* logic. The dividing principle there is, “How directly related to reasoning is the term?” Logic that deals directly with reasoning is formal, while logic that is more indirectly related to reasoning is informal. Other dividing principles could have been used which would result in a different chart, such as “What is the product or goal of the term?” In one case, for logic, the goal might be to discover and classify the rules of reasoning. In this case we would be considering the *science* of logic. In another case, the goal might be to produce persuasive arguments, which would mean we are considering the *art* of logic. Thus the chart would be:



KEY POINT

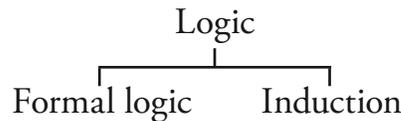
Genus and species charts can be drawn very differently depending on the principle used to divide and categorize terms.

There are several types of errors which we need to avoid while constructing genus and species charts. The first error was already mentioned: species which overlap, meaning that they are not mutually exclusive. Such an error exists in this chart:



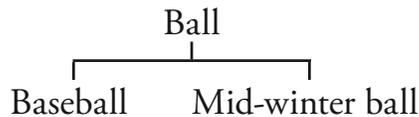
This is an error because the species overlap: some women are lawyers. The error was caused by using two different dividing principles for the term *people*: division by gender and division by profession.

A similar error would occur when a term appears at the wrong level in the chart, such as in this example:

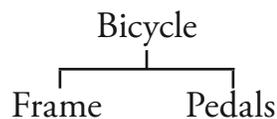


Here the species overlap because induction itself is a species of formal logic, and thus should appear beneath it.

Another error can occur if a chart is being produced for an ambiguous word, with two different definitions in mind for the same word. For example, consider the word *ball*. This word could be taken in two senses: as a round toy, or as a kind of formal dance. This ambiguity could result in the following faulty chart:



Finally, remember that a species is not a part of the genus, but rather a type or kind of that genus. The species of the genus *bicycle* may include *mountain bike*, but not *handlebars*. So when asked to make a genus and species chart, do not make a “whole to parts” chart like this:



THINKING DEEPER

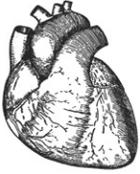
If the process of finding a further genus for any genus cannot continue indefinitely, it is reasonable to ask, What is the highest possible genus? If the genus of food is material, what is the genus of material? Possibilities include matter, substance, being, and so on. All of these are things created. But anything not created is God, since God alone is uncreated. Thus we are led to what theologians call the “Creator/creature distinction”: all things are either Creator, or something created by the Creator. These are the highest genera of things. More could be said about the highest genus of abstractions (like *logic*), verbs (like *to run*), and so on.



CAUTION

Watch out for these basic errors when drawing genus/species charts: overlapping species, ambiguous terms, and confusing genus/species with part/whole.

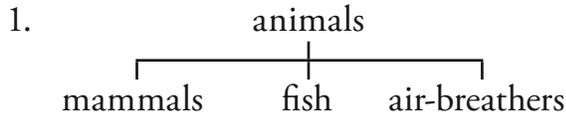
SUMMARY



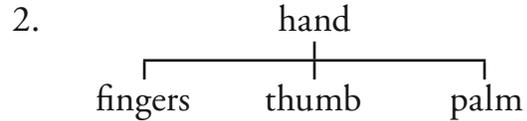
Terms can be organized into genus and species charts. A genus is a category into which a given term fits. A species is a type, kind, or example of a given term. Species should be mutually exclusive, and may be an exhaustive list.

Exercise 2 (20 points)

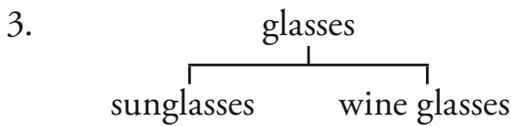
Explain the error or problem with each genus and species hierarchy shown. (2 each)



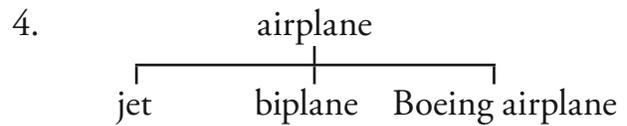
"Mammals" and "air breathers" are not mutually exclusive.



"Fingers," "thumb," and "palm" are parts of "hand," not species.

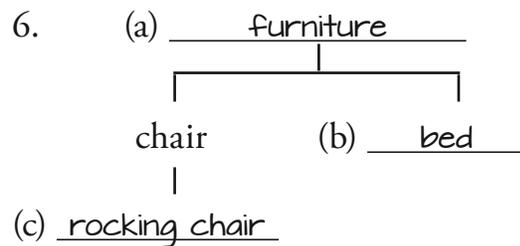
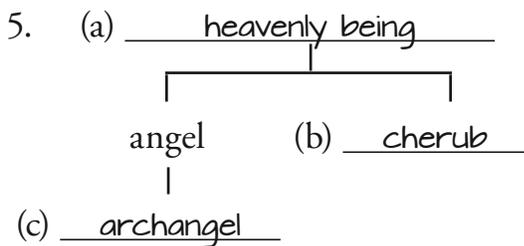


The word "glasses" is being taken ambiguously.

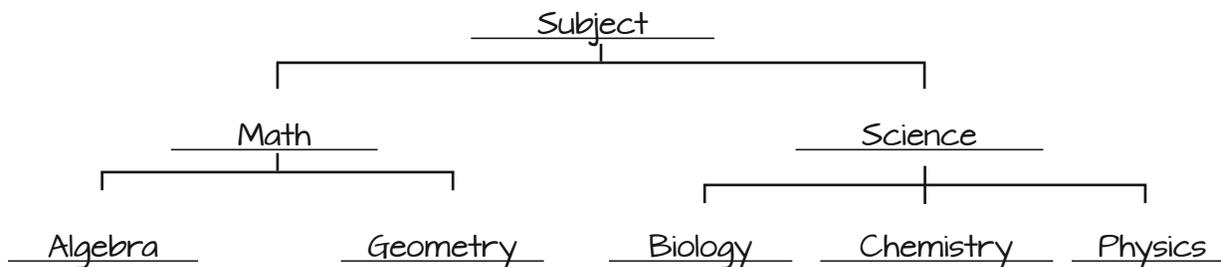


"Boeing airplane" and "jet" are not mutually exclusive.

Fill in the genus and species hierarchy for each term given, identifying a) a genus for the term, b) another species under that genus, and c) a species of the term. (3 each)



7. Draw a genus and species hierarchy that includes the following terms: ALGEBRA, BIOLOGY, CHEMISTRY, GEOMETRY, MATH, PHYSICS, SCIENCE, SUBJECT (6)



EXTENSION AND INTENSION

Introductory Logic, pp. 21–25

SPECIAL NOTE

1. Inform students that there will be a quiz tomorrow on the material you have covered so far. Encourage them to study particularly the definitions and key points in the margins of their *Introductory Logic*. Explain the quiz and test schedule to students: every week (after this week) they will have a quiz either on Wednesday or Thursday on the lessons covered since the last quiz. Every other week, on Friday, there will be a test on the material from the last two quizzes.

STUDENT OBJECTIVES

1. Define “extension” and “intension” and relate these to genus and species.
2. Arrange terms according to extension and intension.
3. Complete Exercise 3.

TEACHING INSTRUCTIONS

1. Read “Lesson 3: Extension and Intension” (*Introductory Logic* pp. 21–23) aloud.
2. Remind students (or have them remind you) that you have been discussing terms and definitions, and that you just went over genus and species charts. Extension and intension are concepts closely associated with genus and species.

3. Tell students that **the extension of a term is the sum of all the individual things to which the term applies**. For example (they’ll need examples) the extension of the term “book” is the set of all books: every novel, dictionary, *Introductory Logic*, and car manual ever written. The extension of “helmet” is every football, bicycle, and homemade spaceman helmet ever made. Give a term (something like “superhero,” or “board game” would work well) and have students give examples of particular objects included in its extension. Tell students that they can remember what “extension” is by remembering that when you *extend* something you make it bigger and bigger so it can include more and more stuff.
4. Explain that all of the particular objects in the extension of a term have some things in common with each other; if they didn’t, you couldn’t use the same term to identify them all. Have the students give you some common attributes of all the objects you wrote on the board (e.g., “they all have enemies,” “they all have rules,” etc.) Explain that **the intension of a term is the sum of the common attributes of a term**. The intension of “book” would include having pages, containing words or pictures, and being bound between two covers; the intension of “helmet” would include fitting on a head, being made of some protective material, and looking either very silly or very cool.
5. Tell students that extension and intension are inversely related (and have someone explain

what “inversely” means). Explain that in almost any genus and species chart, as you work your way up the chart the extension of each term is greater and the intension is smaller. Write the chart on p. 21 on the board.

6. Show that the word “clock” has a greater extension than “digital clock,” because there are more objects that the term “clock” applies to; just plain “clock” includes digital clocks *and* clocks with hands, called analog clocks. Moving up the chart, there are more timepieces than there are just plain clocks (sundials, for example), so the extension of timepiece is greater. And there are millions more wild and wacky devices in the world than timepieces. Illustrate this another way: if you had to have a drawer somewhere for all the different kinds of clocks in the world and another drawer for all the different kinds of devices, the drawer for the devices would need to be *much* bigger. So extension increases as you go up the chart.
7. Show that intension decreases as you go up the chart (and increases as you go down it): all the clocks in the world have more in common with each other than all the devices in the world (i.e., a grandfather clock has more in common with an alarm clock than a car has with a paperclip), and all the digital clocks have more in common with each other than all clocks do.
8. Explain that increasing extension means increasing abstraction. (Something is “abstract” if it exists in your mind as an idea rather than as an actual object. A good rule of thumb: the harder something is to imagine, the more abstract it is.) Return to the board: “device” is more abstract

than “timepiece.” “Clock” is more abstract than “digital clock.” Ask students which term is more abstract and would therefore have a greater extension: “to think” or “to reason”?

9. Explain that increasing intension means increasing concreteness. (Something is more concrete the more easily imagined it is.) The more attributes a term has, the more concrete it is. A digital clock is more concrete than just a generic “clock” which is more concrete than the very vague “timepiece.”

SUGGESTED EXERCISE

If you have time, write the terms ANIMAL, APE, GORILLA, LIVING BEING, MAMMAL on the board, and have students individually put them in order of increasing extension, and then in order of increasing intension. Go over answers. (E.g., GORILLA, APE, MAMMAL, ANIMAL, LIVING BEING; II: LIVING BEING, ANIMAL, MAMMAL, APE, GORILLA)

ASSIGNMENTS

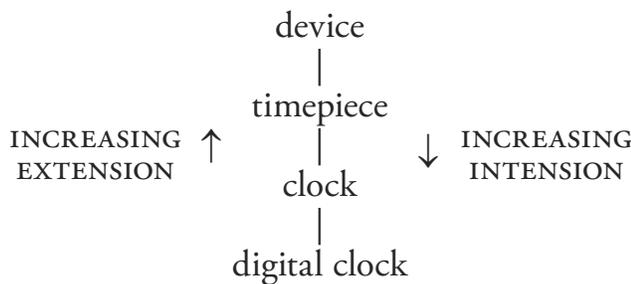
1. Have students complete Exercise 3, and go over it with them.
2. Start by writing a term on the board and have the students give a genus of it and a species of it. Then practice by arranging the three terms in order of increasing or decreasing extension or intension.
3. Remind students to study for the next class's quiz over Intro–Lesson 3. (*See page T-xiii for Quiz 1.*)

EXTENSION AND INTENSION

Two concepts closely associated with genus and species charts are extension and intension. The **extension** of a term is the sum of all the individual objects to which the term applies. Thus the extension of the term *book* is the set of all books—all novels, dictionaries, textbooks, manuals, etc. The extension of the term *helmet* would include every football helmet, bicycle helmet, space-suit helmet, and any other helmet imaginable.

All the objects included in the extension of a term have certain attributes in common. If they did not, we could not identify them with one term. The sum of the common attributes of a term is the **intension** of the term. Thus the intension of *book* would include attributes such as: having pages, on which words are written, which are bound together by some means. The intension of *helmet* would include these attributes: fitting on the head, resisting impact, made of protective material, and so on.

Extension and intension are inversely related. Given almost any genus and species chart, as you work your way up the chart, the extension of each term is greater than the previous terms, but the intension is smaller. Consider the hierarchy shown below:



The term *clock* has a greater extension than the term *digital clock*—that is, there are more clocks than there are digital clocks, because



DEFINITIONS

The **extension** of a term is the sum of all the individual objects described by it.

The **intension** of a term is the sum of all the common attributes denoted by the term.



KEY POINT

Extension and intension are inversely related.



THINKING DEEPER

It is possible to increase intension without simultaneously decreasing extension. For example, if we added the attribute *material* to *digital clock*, we have increased intension, but the extension has remained the same, since all digital clocks are material digital clocks. Similarly, since all digital clocks are *less than one mile in height*, adding this attribute would not change the extension. Is it possible to change extension without changing intension?



KEY POINTS

Greater extension means more abstraction; greater intension means more concreteness.

Understanding extension and intension will help you grasp various relationships among terms.

clock not only includes all digital clocks, but all other types of clocks as well. Similarly, there are more timepieces than there are clocks (can you name some?), so the extension of *timepiece* is greater than the extension of *clock*. As you go up a hierarchy, extension increases. However, intension *decreases* as you go up the chart, and increases as you go down. Timepieces have more attributes in common (i.e., a greater intension) than devices, clocks have more attributes in common than timepieces, and so on.

Increasing extension is parallel to increasing abstraction. The more abstract a term is, the greater its extent. *Device* is more abstract than *timepiece*. *To think* is more abstract than *to reason*, and thus would be higher on the genus and species chart, having a greater extension (though applying extension and intension to verbs tends to be more difficult than applying them to nouns).

Similarly, an increase in intension is accompanied by an increase in concreteness. The more attributes a term has, the more concrete it is. *Digital clock* is more concrete than *clock*, which is more concrete than *timepiece*.

The ability to list terms in order of increasing (or decreasing) extension (or intension) is a great help in understanding the relationships among them. Here we have in alphabetical order a number of terms from a genus and species hierarchy:

ANIMAL, APE, GORILLA, LIVING BEING, MAMMAL

Arranged in order of increasing extension (and decreasing intension), this list would look like this:

GORILLA, APE, MAMMAL, ANIMAL, LIVING BEING

Rearranged in order of increasing intension (that is, decreasing extension), the list would simply be placed in reverse order:

LIVING BEING, ANIMAL, MAMMAL, APE, GORILLA

The extension of a term is the sum of all the individual things to which a term applies. The intension of a term is the sum of the common attributes of the term. Extension and intension are inversely related; as extension increases, intension decreases, and vice versa.



Exercise 3 (15 points)

1. Arrange in order of increasing extension:

FIGURE, PLANE FIGURE, POLYGON, RECTANGLE, SQUARE (3)

square, rectangle, polygon, plane figure, figure

2. Arrange in order of decreasing extension:

INSTRUMENT, SCIMITAR, CURVED SWORD, SWORD, WEAPON (3)

instrument, weapon, sword, curved sword, scimitar

3. Arrange in order of increasing intension:

ANCIENT LANGUAGE, CLASSICAL LATIN, COMMUNICATION, LANGUAGE, LATIN (3)

communication, language, ancient language, Latin, Classical Latin

4. Arrange in order of decreasing intension:

BAPTIST, CHRISTIAN, PROTESTANT, RELIGIOUS PERSON, SOUTHERN BAPTIST (3)

Southern Baptist, Baptist, Protestant, Christian, religious person

5. Determine the attribute or characteristic that distinguishes the term from the genus given in parentheses after the term. (3)

TIMEPIECE (DEVICE) designed to display the time of day

CLOCK (TIMEPIECE) other than a watch

DIGITAL CLOCK (CLOCK) with a digital display

QUIZ 1 (INTRO-LESSON 3)

STUDENT OBJECTIVE

Complete Quiz 1.

TEACHING INSTRUCTIONS

1. Give Quiz 1. Allow 30 minutes for it. Grade quiz with students and spend time reviewing (maybe re-explaining) any problems they struggled with.
2. If you have the time (and the desire) to do so, introduce Lesson 4. Another option would be to play twenty questions, teaching students how to identify a term by focusing in on its attributes.

INTRODUCTORY LOGIC | QUIZ 1

Introduction and Lessons 1–3 (30 points)

Name _____

1. What is *logic*? (3)

The science and the art of reasoning well.

2. Name the two branches of formal logic. (2)

Induction, Deduction

3. State the *Law of Identity*. (2)

If a statement is true then it is true.

4. Give an example of an ambiguous word, and write two different lexical definitions of it. (3)

To follow: to move behind in the same direction; to accept the authority of

(Answers may vary.)

5. What does it mean that a word is *vague*? What type of definition reduces vagueness? (3)

Unclear in extent. Precising.

6. *Human: an evolved ape*. What type of definition is this? Briefly defend your answer. (3)

This is a theoretical definition, because to accept it is to accept the theory of
evolution.

7. *The state lottery is a tax for people who are bad at calculating odds*. What type of definition is this? (2)

Persuasive.

8. What type of definition gives a new meaning to a word? (2)

Stipulative.

Problems 9–10: Fill in the blanks for the given term, identifying a) a genus, b) another species under that genus, and c) a species of the given term. (3 each)

9. *finger* a) digit (Answers may vary.)

b) thumb

c) ring finger

10. *to break* a) to separate (Answers may vary.)

b) to slice

c) to smash

11. What is the *extension* of a term? (2)

The sum of all the individual things to which the term applies.

12. Arrange in order of decreasing intension: OBJECT, SLINKY, TOY (2)

Slinky, toy, object

METHODS OF DEFINING

Introductory Logic, pp. 27–31

STUDENT OBJECTIVES

1. Identify three primary methods of defining terms.
2. Define terms by synonym, example, and genus and difference.
3. Complete Exercise 4.

TEACHING INSTRUCTIONS

1. Tell students that today you will be studying three different methods of defining terms, although there are at least a dozen more that you won't be covering (see "History" note on p. 27). Read "Lesson 4: Methods of Defining" (*Introductory Logic* pp. 27–29) aloud with students.
2. **Explain that there are several methods you can use to define terms, and that the best one to use may depend on the term and the circumstances.**
3. Ask students what a "feline" is. Hopefully, they will say "cat." Explain that they just defined by synonym (and have someone tell you what a synonym is). Write **Defining by synonym** on the board, and explain that defining a term by synonym is just that: giving a synonym of the term. Have them define by synonym words like "talk," "road," and "beautiful." Explain that this method of defining only works when you know what the *synonyms* themselves mean; otherwise you're right where you started. Explain also that some (maybe all?) words don't have

exact synonyms, and so can't be defined this way. Ask them to give examples of words with synonyms (such as "house," "sea," and "soda") and words without (such as "mango," "princess," and "foot"). Tell them that, when defining by synonym, they should use a synonym more readily understood (more common) than the term being defined.

4. Ask students to imagine that a space alien walks into the room and asks them what a textbook is. How would they answer? Most likely they would show the alien *Introductory Logic*. Write **Defining by example** on the board. Explain that the way most kids first learn the meanings of words is by example. Explain that one way to define by example is to give a *demonstration*, like with the space alien. Another way to define by example is to list *species* of the term, e.g., defining "vehicle," by listing car, train, plane, boat, and tricycle. The list can be comprehensive (see the "noble gas" definition on p. 28) or partial (see the "sickness" definition on p. 28). **A good definition by example usually includes some differing terms.** Warn students that defining by example can be dangerously vague: if you define a computer by showing someone a computer, they won't know what *part* of the contraption is the actual computer.
5. Ask students to define "backpack." Eventually they should come up with something like "a bag you carry on your back." Write **Defining by genus and difference** on the board, and explain

that **this is usually the best way to define a term**. Explain that you define a term by genus and difference when you name the term's genus (the broader category it falls into) and then add the descriptions that set the term apart from other species of the genus—the difference. A backpack is a bag (genus) you carry on your back (difference). Glasses are lenses (genus) you wear on your face (difference). An author is a person (genus) who writes books (difference).

6. Explain that to go about choosing a genus, you should ask yourself *what kind of thing* the term is. To determine the difference, you should think about what features of the term *distinguish it*. The difference you choose needs to exclude everything that the term excludes, and include everything that the term includes. For example, if you defined “house” as “a build-

ing where people sleep,” the difference would be too broad: it includes hotels too, and hotels are not houses. Also, the difference needs to be *essential*. A good definition of “president” is not “a man who lives in the White House.” That’s true, but it’s not helpful at all; stick with “the elected head of a republican state.”

7. Point out that the difference does not need to come after the genus in the definition (see the definition of “triangle” on p. 29 in *Introductory Logic*).
8. Ask students to think of a term that can easily be defined using all three methods.

ASSIGNMENT

Have students complete Exercise 4 and go over it with them.

METHODS OF DEFINING

There are many methods of defining (giving a meaning of) a term. One of these methods, defining by genus and difference, directly relates to the genus and species hierarchies of the last two sections. Before we examine that method, however, we will consider two others that are commonly used.

1. Defining by synonym. When you look in the dictionary for the definition of a word, you often find a synonym (a word with the same meaning) of the word listed. This can be helpful, but only if you already understand the meaning of the synonym. For example, look up *progeny* and you will probably find that it is a synonym of *descendants* or *children*. This is helpful, since you know what these words mean. However, it may not help you to find out that *vicissitude* means *mutability*. We all learned the meanings of words by this method when we were young. “Daddy, what’s *essential* mean?” “Son, *essential* means *necessary* or *important*.”

One limitation of defining by synonym is that many words do not have exact synonyms (indeed, some would argue that no two words mean *exactly* the same thing). For example, the word *oxygen* has no real synonym, and is best defined by some other method. The same could be said for the terms *bone*, *breakfast*, and *triangle*.

2. Defining by example. Another way children (and adults) are taught the meanings of words is by being given examples of them. A child, upon asking her mother what money is, may be given a penny or shown a dollar bill. My children all learned the meaning of the word *cow* by having cows pointed out to them as we were driving by a field. “Look at all the cows!”



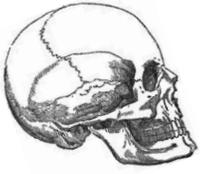
KEY POINT

There are several methods you can use to define a term. The best method to use may depend on the term and the circumstances.



HISTORY

Though we consider only three, the great Cassiodorus Senator (c. 480–575), in his book *An Introduction to Divine and Human Readings*, identifies no less than fifteen methods of defining terms. In addition to the three this text considers, Cassiodorus lists and explains the following methods: notional, qualitative, descriptive, distinguishing, metaphorical, negation of the opposite, use of image, statement of what is lacking, by way of praise or blame, proportional, relational, and causal.



CAUTION

When defining by example, include several differing terms to ensure your definition is complete enough.

Similarly, one can define words by example by using species of the term. We may define *noble gas* by listing helium, neon, argon, krypton, xenon, and radon. This would be a complete definition. Often, representative samples can give partial (though adequate) definitions. Defining *sickness* by giving chicken pox and the flu as examples will probably meet the need. In general, when defining by example, be sure to include several differing terms.

This method also has some limitations. When a child is shown a typewriter and calls it a computer, he demonstrates the ambiguity of this method. When shown a computer, the child is uncertain as to what part is the meaning of the word *computer*—the keyboard, the screen, or something else. Despite this and similar problems, giving examples is a common means of defining.



KEY POINT

Using genus and difference is usually the best way to define a term.

3. Defining by genus and difference. This is often the clearest method (though perhaps the most difficult) for defining terms, not being subject to the limitations of defining by synonym or example. In this method, a term is defined by naming its **genus**, and then adding descriptive words that distinguish that term from every other species under that genus—that is, by providing the **difference**. For example, the term *backpack* may be defined as “a bag carried on the back.” The genus is *bag*, the difference is *carried on the back*. The term *logic* has been defined as “the science of reasoning.” The genus is *science*, the difference is *of reasoning*. This difference distinguishes logic from other sciences, such as biology, chemistry, and physics.

To choose a genus, try to determine what kind of thing the term is. What kind of thing is a computer? Is it a tool? A machine? A box? Also, remember that you are not defining words *per se*, which are often ambiguous, but you are defining *terms*, the concepts behind words. When defining *church*, for example, you need to determine if you are considering the body of believers or the building where they meet before you develop a definition. When asked to define a term, only one definition is necessary.

When choosing the difference, remember that you are trying to distinguish the term from every other species under the genus. The difference should *exclude* species that the term does not *include*, and

vice versa. Consider this definition of *battle*: “a hostile encounter between two armies.” The difference “between two armies” excludes battles between ships at sea, among other things, and is thus too narrow. Also note that the difference should be an essential one. A painting is not “a picture drawn on canvas,” but “a picture drawn by means of paint.”

The difference need not come after the genus. “Three-sided polygon” is a good definition of *triangle* by method of genus and difference, even though the difference (*three-sided*) is given first.

You can see that this method of defining is particularly appropriate when the purpose is to show relationships between terms. The examples given in that section were examples of defining by genus and difference.

SUMMARY

Terms may be defined by synonym, by example, or by genus and difference. Terms are defined by genus and difference by stating the genus of the term along with words distinguishing that term from every other species under the genus.



Exercise 4 (24 points)

Define the following terms by listing three examples of each. (3 each)

1. nation

Japan
Israel
Egypt

2. board game

Monopoly
chess
Risk

3. candy

lollipop
chocolate bar
licorice

Define these terms by identifying a synonym of each. (1 each)

4. happy joyful

5. job occupation

6. dinner supper

Define the following words by genus and difference. (2 each)

7. brother male sibling

8. doe female deer

9. whisker short facial hair

10. queen female monarch

11. quiz short test

12. idol false god

RULES FOR DEFINING BY GENUS AND DIFFERENCE

Introductory Logic, pp. 33–38

STUDENT OBJECTIVES

1. List the six rules for defining terms.
2. Identify rules broken by improper definitions.
3. Write genus and difference definitions that follow the rules.
4. Complete Exercise 5.

SPECIAL NOTES

1. Tell students that their first test will be over Introduction–Lesson 5, and that you will use class time to prepare for it. Encourage students to begin studying the definitions and key points in the margins of *Introductory Logic*.

TEACHING INSTRUCTIONS

1. Remind students that they learned how to define by genus and difference. Have a student explain how it's done so that the concept is fresh in everyone's minds. Read "Lesson 5: Rules for Defining by Genus and Difference" (*Introductory Logic* pp. 33–35) aloud with students.
2. Explain that if you are going to define a term by genus and difference, there are rules you need to follow. Write **1) A definition should state the essential attributes of the term** on the board. Ask students what "essential attributes" means (the term wouldn't be what it is without them.) Explain that an essential attribute of your car is

its ability to take you places; the fact that your car is pink is only an accidental attribute, and so "pink" should not be part of the definition of "car." Explain that the way to tell whether a term is essential or not is to ask yourself whether changing the attribute would destroy the meaning of the term (turning the car blue does not make the car cease to be a car). Emphasize that **using only essential attributes in a definition conveys the most relevant information about the term and avoids redundancy.**

3. Ask students what is wrong with these definitions: "a circus performer is someone who performs at a circus"; "blindness is the state of being blind." Explain that definitions like this don't teach us anything new. Write **2) A definition should not be circular** on the board. In other words, don't use the word you're defining in the definition. Point out that sometimes it's okay to use *part* of a word you're defining in the definition (see definition of "polar bear" on p. 34). Also, drive home the point that students should **avoid using synonyms in definitions that use genus and difference**; that's what defining by synonym is for.
4. Ask students what is wrong with this definition of cereal: "Cereal is a food you eat with a spoon." Ask what is wrong with this definition of sky: "The sky is what is blue over our heads." Write **3) A definition should not be too broad nor too narrow** on the board. Explain that a definition that is too broad includes more than you mean, and a too-narrow definition includes less than you

mean. Explain that to test whether the extensions of a term and its definition are the same, students should look for counterexamples, terms that the definition includes or excludes by mistake. (Have them come up with some counterexamples for the definitions of “cereal” and “sky.”)

5. Write **4) A definition should not be unclear or figurative** on the board. Explain that ambiguous, vague, or obscure words make for unclear definitions. (See the definitions of “ray,” “year,” and “man” on p. 34). Explain that definitions can also be unclear if we try to get metaphorical and poetical with them (“a dog is a man’s best friend,” “rain is the tears of angels,” etc.). Have students come up with some of these.
6. Write **5) A definition should be stated positively, if possible** on the board. Explain that sometimes it’s easier to say what something *is not* than what it *is*, but that usually we have to do the extra work of finding a positive definition. “The ocean is the part of the planet that is not land or on land,” is perfectly true but sounds like a cop-out. Explain that some terms, though, like “bald,” “unhappy,” and “poor” are negative concepts, and would sound weird if you tried to define them positively. Students should **try to avoid negative definitions, but recognize that they are sometimes necessary**.
7. Write **6) A definition should be of the same part of speech as the term** on the board. Explain that if the term you’re defining is a noun,

the definition should be a noun. If a verb, a verb. And so on. Thus a good definition for “to eat” is not “what you do with food”; “to eat” is a verb and “what you do with food” is not. A good definition for “brave” is not “people who risk their lives,” because you are defining an adjective with a noun. Warn students also that **the use of words like “where” and “when” in a definition usually signals a problem with the definition**.

8. Have the students rewrite the rules of defining in their own words.
9. If you have time, discuss the “Thinking Deeper” section on p. 34. Another definition you could discuss is a definition of “God.” Lots of people have tried to define God. Have they succeeded? Is a definition of God possible? How does God define himself in his Word?
10. Discuss the importance of defining terms correctly. Think about or try to define *marriage*, *abortion*, *neighbor*, etc. Help the students see that God cares about definitions; He wants us to define these and other terms correctly.

ASSIGNMENTS

1. Have students complete Exercise 5 and go over it with them.
2. Remind students to study for the next class’s quiz on Lessons 4 and 5. (*See page T-xix for Quiz 2.*)

RULES FOR DEFINING BY GENUS AND DIFFERENCE

Up to this point, we have considered several methods of defining, and you have had some practice defining words by genus and difference. In order to use this method well, we need to keep a few rules in mind.

1. A definition should state the essential attributes of the term.

For any given term, some attributes are essential, while others can be considered merely accidental or superficial. Essential means necessary; i.e., without that attribute, the term would cease to be what it otherwise is. For example, an essential attribute of the term oven is its ability to heat. If a device could not heat, it would not be an oven. But the fact that ovens are usually shaped like a box is merely accidental (it is possible to have a round oven), and thus this attribute should not be part of the definition of the term.

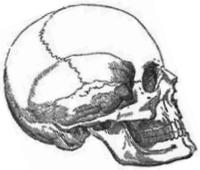
How can you tell the difference between essential and accidental attributes? First ask, “Would this term cease to be what it is if this attribute were somehow changed or removed?” If changing the attribute would destroy the meaning of the term, that attribute is essential. Secondly, essential attributes tend to be the cause of accidental attributes. Consider the term *shin*. Which attribute is essential: “located on the front of the leg below the knee,” or “often injured in soccer games”? The former is the essential attribute, since it is one cause of the latter.

Also, note that this rule implies that a definition should avoid redundancy. For example, consider this definition of a triangle: “A polygon with three straight sides and three angles.” This definition is redundant in two places: all polygons have straight sides, and any polygon with three sides necessarily has three angles. A better definition for triangle is simply “A polygon with three sides.”



KEY POINT

Using only essential attributes in a definition conveys the most relevant information about the term and avoids redundancy.



CAUTION

Avoid using synonyms in definitions that use genus and difference.



THINKING DEEPER

We must be careful not to think that once we have produced a proper genus and difference definition we have somehow gotten to the *essence* of the thing defined. This analytic method has value in making our thoughts clear and distinct, but a more synthetic or poetic approach should be considered when we are seeking to fully learn what something is. For example, an analytic definition of *the Word of God* might be “God’s powerful, meaningful self-expression.” But how does the Bible describe the Word of God? Consider Psalm 19: “The law of the Lord is perfect, converting the soul: the testimony of the Lord is sure, making wise the simple....More to be desired are they than gold, yea, than much fine gold: sweeter also than honey and the honeycomb.”

2. A definition should not be circular. The word being defined should not be used as part of the definition. The difficulty this rule seeks to prevent is that circular definitions go nowhere. If a student defines *logic* as “the study of logic,” he hasn’t really given the meaning at all.

This rule is not necessarily broken when part of a word is used in its definition. The definition of *polar bear* as “a white bear that inhabits the arctic regions” is not circular, even though the word “bear” appears in both parts.

This rule generally excludes the use of synonyms. If synonyms are allowed, then define the word by synonym, not by genus and difference.

3. A definition should not be too broad nor too narrow. This rule is violated when a definition includes what it should exclude, or excludes what it should include. Consider this definition for the term *table*: “a piece of furniture consisting of a flat slab of wood fixed on legs.” The problem is that this definition excludes tables made of metal or other material. Its extension is too small. A definition for table that *includes* too much is “a piece of furniture with legs.” This would include chairs, couches, and other things which are not tables.

To check if the extensions of a term and its definition are equivalent, look for counterexamples. Is a *baby* a newborn person? What about a six-month-old baby? Is logic the science of thinking, or are some types of thinking outside the scope of logic?

4. A definition should not be unclear or figurative. Definitions can be unclear for a variety of reasons. A definition may be unclear because it uses words that are ambiguous, vague, or obscure. If you define *ray* as “a light beam,” your definition is ambiguous. Light has several meanings, and so does beam. However, simply rearranging the words in the definition to be “a beam of light” helps to clarify these ambiguities. Defining *year* as “a long period of time” breaks this rule, because the definition is vague. Defining *man* as “a ratiocinative hominid” breaks this rule because both “ratiocinative” and “hominid” are too obscure for most people.

Definitions also may be unclear when the language of the definition is figurative or metaphorical. “*Ray*: a drop of golden sun” is a

figurative definition. Such definitions may be poetic, but they often do not provide a clear meaning for the term.

5. A definition should be stated positively, if possible. Sometimes when trying to define a term we are tempted to say what it *is not*, when we should say what it is. Such definitions by process of elimination break this rule. The term *magazine* should not be defined as “a periodical that is not a newspaper.” To define an *isosceles triangle* as “a triangle that is neither equilateral nor scalene” breaks this rule, even though the term and its definition have exactly the same extension.

Some terms are necessarily negative, such as *bald*, *empty*, and *peniless*. The definitions of these would be awkward if written positively, and thus they may be negative without really breaking the rule.

6. A definition should be of the same part of speech as the term.

If the term being defined is a noun, then the definition should be a noun. Similarly for the other main parts of speech: verbs, adjectives, and so on. This rule is broken, for example, when *to run* is defined as “faster than walking.” The term is a verb, the given definition is not. Defining *to sew* as “a needle pulling thread” breaks this rule as well—*to sew* is a verb, “a needle pulling thread” is a noun.

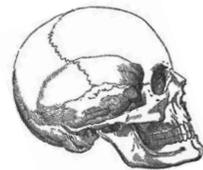
A similar error occurs in this definition of *to run*: “when you go faster than walking.” Is *to run* a time? Of course not, so don’t use the word *when*. Similar problems often crop up when the words *who*, *what*, *where*, *why* and *how* appear in definitions. These are best avoided, if possible.

When terms are defined by genus and difference, certain rules should be followed. A definition should 1) state the essential attributes of the term, 2) not be circular, 3) not be too broad or too narrow, 4) not be unclear or figurative, 5) be stated positively if possible, and 6) be of the same part of speech as the term.



KEY POINT

Try to avoid negative definitions, but recognize that they are sometimes necessary.



CAUTION

The use of words like *where* and *when* in a definition usually signals a problem with the definition.

SUMMARY

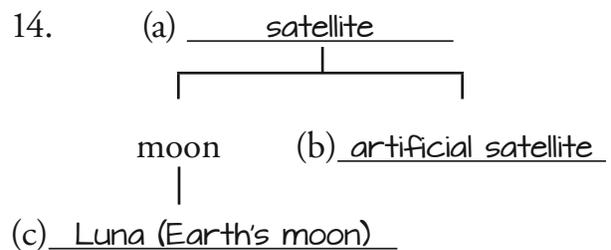
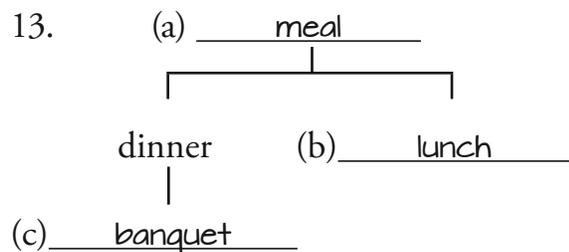


Exercise 5 (54 points)

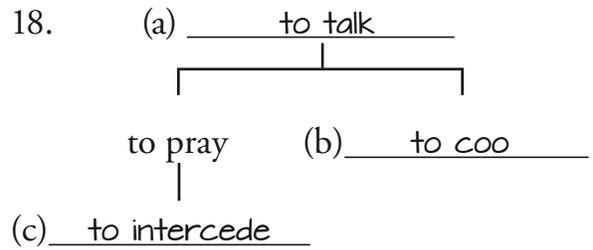
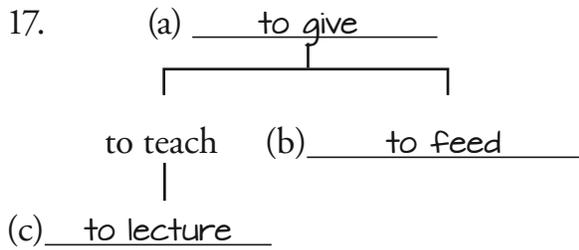
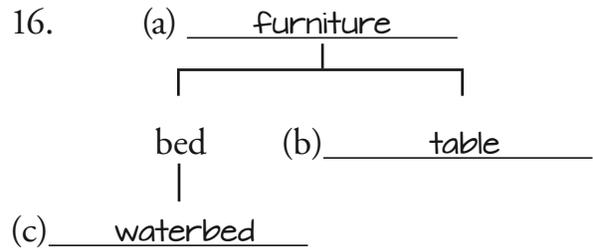
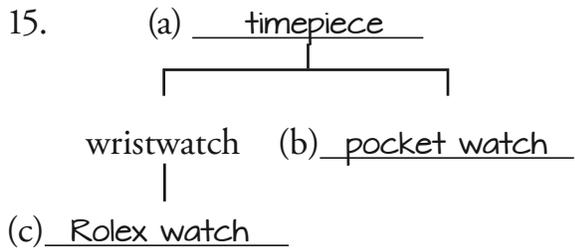
Identify the rule(s) broken by circling the correct number(s). Use the numbers in the following list: **A definition should** (1) *State the essential attributes of the term*, (2) *Not be circular*, (3) *Not be too broad or too narrow*, (4) *Not be unclear or figurative*, (5) *Be stated positively if possible*, and (6) *Be of the same part of speech as the term*. (2 each)

DEFINITION	RULE #S BROKEN
1. <i>Mountain</i> : A natural object bigger than a hill.	1 2 (3) 4 5 6
2. <i>Wife</i> : Adam's rib.	(1) 2 3 (4) 5 6
3. <i>Brick</i> : Dried clay shaped into a brick.	1 (2) 3 4 5 6
4. <i>Rectangle</i> : The shape of a typical textbook.	(1) 2 3 4 5 6
5. <i>Headache</i> : When your head hurts.	1 2 (3) 4 5 (6)
6. <i>Capitalist</i> : A person who is not a socialist.	(1) 2 (3) 4 (5) 6
7. <i>To hate</i> : How you feel when you don't like something.	1 2 (3) 4 5 (6)
8. <i>Carpet</i> : Floor covering.	1 2 (3) 4 5 6
9. <i>To float</i> : To hover.	1 (2) (3) 4 5 6
10. <i>Bag</i> : A pliant repository.	1 2 3 (4) 5 6
11. <i>Large</i> : Something that is not small.	1 2 3 4 (5) (6)
12. <i>Life</i> : A roller coaster that we all ride.	(1) 2 3 (4) 5 6

Fill in the genus and species hierarchy for each term given, identifying a) a genus for the term, b) another species under that genus, and c) a species of the term. (3 each)



INTRODUCTORY LOGIC



Define the following terms by genus and difference, using the same genus from any corresponding terms in the charts above. Be careful not break any of the rules! (2 each)

19. dinner the main meal of the day
20. moon a natural satellite
21. wristwatch a timepiece worn on the wrist
22. bed furniture designed for sleeping on
23. to teach to give knowledge
24. to pray to talk to God or a god

QUIZ 2 (LESSONS 4–5)

STUDENT OBJECTIVE

1. Complete Quiz 2.

TEACHING INSTRUCTIONS

1. Give Quiz 2. Allow 30 min. for it. Grade quiz with students and spend time reviewing (maybe re-explaining) any problems they struggled with.
2. If you have extra time, begin reviewing for Test 1.

INTRODUCTORY LOGIC | QUIZ 2

Lessons 4–5 (23 points)

Name _____

Problems 1–3: Define the word by synonym. (1 each)

1. *stone* rock _____

2. *to rescue* to save _____

3. *lovely* beautiful _____

4. What is one limitation of defining by synonym? (2)

Many words do not have synonyms. _____

Problems 5–6: Define the word by example. Remember to include a variety. (2 each)

5. *sport* football, hockey, gymnastics (Answers may vary.) _____

6. *religion* Christianity, Islam, Hinduism (Answers may vary.) _____

7. We can define a word by example by listing species of it. What is another way to define by example? (2)

By demonstration, by showing or pointing to _____

Problems 8–10: What is the primary error made by the given definition? (2 each)

8. *yacht*: a vessel used for yacht racing. Circular _____

9. *to shave*: to truncate the prosopic stubble. Unclear (obscure) _____

10. *socks*: garments for the feet other than shoes. Negative when it could be positive _____

Problems 11–12: Write a proper genus and difference definition for the given term. (3 each)

11. *driveway* A short road connecting a public road to a house. _____

12. *to whisper* To speak softly by using only one's breath. _____

REVIEW FOR TEST 1 (INTRO-LESSON 5)

Introductory Logic, pp. 39–40

TEACHING INSTRUCTIONS

1. Ask students the questions below and have them answer aloud. Allow them to look for the answers in their textbooks, but only after they have made a valiant attempt to answer from memory.
2. If you'd like, give students "Test 1: Form A" from the *Introductory Logic Test and Quiz Packet* as a practice exam. Go over the answers together.
5. Distinguish between induction and deduction. (Induction is reasoning to probable conclusions from examples or experience; deduction is reasoning with certainty from premises to conclusions. Inductive arguments are either strong or weak; deductive arguments are either valid or invalid.)
6. Construct the Logic Chart.

STUDENT OBJECTIVES

Complete the objectives from the Introduction through Lesson 5. (Answers are provided in parentheses for the teacher.)

Introduction

1. Define *logic*. (The science and art of reasoning well.)
2. Define *reasoning*. (Drawing proper conclusions from other information.)
3. Identify and state the three laws of thought (Law of Excluded Middle: any statement is either true or false; Law of Identity: if a statement is true, then it is true; Law of Non-contradiction: a statement cannot be both true and false.)
4. Distinguish between formal and informal logic. (Formal logic deals directly with reasoning; informal logic deals with operations of thinking indirectly related to reasoning.)
5. List and align the six purposes and five types of definitions, and give examples.
 - to show relationships ("father" is a male parent, "mother" is a female parent)
 - to remove ambiguity (lexical definition—"love is to treat others lawfully from the heart")
 - to reduce vagueness (precising definition—"warm is 80 degrees")
 - to increase vocabulary (stipulative definition—"a blog is a website on which . . .")
 - to explain concepts theoretically (theoretical definition—"water is H₂O")
 - to influence attitudes (persuasive definition—"abortion is the murder of unborn children")
2. Define "ambiguous" and "vague." (An ambiguous word has more than one definition; a vague word is one whose extent is unclear)
3. Define the five types of definition. (Lexical: a definition that shows relationships or reduces ambiguity by providing a single established meaning of a term; precising: a definition that

seeks, for a particular situation, to make precise what previously was vague or fuzzy; stipulative: a definition given to a new word or an existing word applied in a new way; theoretical: a definition given to a term that is not understood, usually scientific or philosophical in nature; persuasive: a definition aimed at persuading the listener one way or another toward the term being defined.)

Lesson 2

1. Define “genus” and “species.” (A “genus” of a term is a term that is more general, broad, or abstract than the original term and includes it; a “species” of a term is a term that is more specific, narrow, or concrete than the original term and is included by it.)
2. Construct genus and species charts.
3. Correct errors in genus and species charts. (Make sure species are mutually exclusive, terms are at correct level in chart, words are not ambiguous, species are types of genus, not parts, and a consistent dividing principle is used.)

Lesson 3

1. Define “extension” and “intension” and relate these to genus and species. (The “extension” of a term is the sum of all the individual objects described by it; the “intension” of a term is the sum of all the common attributes denoted by the term.)
2. Arrange terms according to extension and intension. (Extension and intension are inversely related; increasing extension is increasing abstraction and increasing intension is increasing concreteness.)

Lesson 4:

1. Identify the primary methods of defining terms. (Defining by synonym, defining by example, defining by genus and difference.)
2. Define terms by synonym, example, and genus and difference (synonym: “lovely means beautiful, gorgeous”; example: “a sickness is the flu, chicken pox, measles, etc.”; genus and difference: “a backpack is a bag carried on the back.”)

Lesson 5

1. List the six rules for defining terms.
 - A definition should state the essential attributes of the term.
 - A definition should not be circular.
 - A definition should not be too broad nor too narrow.
 - A definition should not be unclear or figurative.
 - A definition should be stated positively, if possible.
 - A definition should be of the same part of speech as the term.
2. Identify rules broken by improper definitions. (Look out for definitions that include accidental or redundant attributes, definitions that are circular or try to define using both synonym and genus and difference, definitions that exclude or include more than the term does, ambiguous, vague, obscure, or metaphorical definitions, negative definitions, definitions that use words like “who,” “what,” “where,” “when,” etc.)

ASSIGNMENT

Have students study for Test 1 using the review questions on pp. 39–40 and, at your discretion, the additional exercises on pp. 41–54 of *Introductory Logic*. (See page T-xxiii for Test 1.)

TEST 1 (INTRO-LESSON 5)

STUDENT OBJECTIVE

Complete Test 1.

TEACHING INSTRUCTIONS

1. Give Test 1: Form B from the *Introductory Logic Test and Quiz Packet*. Allow one hour for it.
2. Grade tests. Have them ready to hand back to students within a week.

INTRODUCTORY LOGIC | Test 1, Form A
Introduction and Lessons 1–5 (52 points)

Name _____

1. What is *logic*? (3)

The science and the art of reasoning well.

2. State the *Law of Excluded Middle*. (2)

Any statement is either true or false.

3. What is the primary difference between *formal logic* and *informal logic*? (3)

Formal logic deals directly with reasoning. Informal logic deals with operations of thinking which are only indirectly related to reasoning.

Problems 4–7: Write the letter corresponding to the type of definition in the blank next to its description (1 each):

A. Lexical B. Precising C. Stipulative D. Theoretical E. Persuasive

4. A definition that reduces the vagueness of a term in a given situation. B

5. A definition that removes ambiguity by giving an established meaning of a term. A

6. A definition that is meant to influence one's attitude about the term. E

7. A definition which supplies the meaning of a new term. C

8. Arrange these terms in order of *decreasing extension*: ALGEBRA, MATH, SUBJECT (2)

subject, math, algebra.

9. Arrange these terms in order of *increasing intension*: AUTOMOBILE, DRAGSTER, VEHICLE (2)

vehicle, automobile, dragster.

10. One method of defining terms is by genus and difference. Name two other methods of defining terms, and then define the term "house" using each method. (7)

Genus and difference a building made for a family to live in.

Synonym: home, domicile, residence.

Example: my house, the White House, Monticello. (Answers may vary.)

Problems 11–12: Fill in the blanks for the given term, identifying (a) a genus, (b) another species under that genus, and (c) a species of the given term. (3 each)

11. *lock* a) mechanism (Answers may vary.)

b) hinge

c) padlock

12. *cake* a) baked good (Answers may vary.)

b) cookie

c) wedding cake

13. Write out the six rules for defining terms by genus and difference. “A definition must...” (6)

RULE 1 State the essential attributes of the term.

RULE 2 Not be circular.

RULE 3 Not be too broad or too narrow.

RULE 4 Not be unclear or figurative.

RULE 5 Be stated positively, if possible.

RULE 6 Be the same part of speech as the term.

Problems 14–17: Explain the primary error made by the given genus and difference definition. (2 each)

14. *clang*: a cacophonous tintinnabulation.

Unclear; uses obscure words.

15. *bed*: anything used as a bed.

Circular.

16. *truck*: an automobile that is not a car.

Negative when it could be positive.

17. *victory*: to defeat the opposition.

Wrong part of speech.

Problems 18–20: Define the given term by genus and difference definition. Do not break any of the rules. (3 each)

18. *stranger* a person one does not know.

19. *coin* a piece of stamped metal money.

20. *to reason* to draw conclusions from other information.

INTRODUCTORY LOGIC | Test 1, Form B
Introduction and Lessons 1–5 (54 points)

Name _____

- Logic is defined as “the science and the art of reasoning well.” What is *reasoning*? (3)
_____ Drawing proper conclusions from other information _____
- State the *Law of Noncontradiction*. (2)
_____ A statement cannot be both true and false. _____

- The conclusions of inductive arguments are strong or weak. What type of argument has a valid or invalid conclusion? (1) deductive _____
- One of the purposes of lexical definitions is to eliminate ambiguity. What does it mean that a word is *ambiguous*? (2)
_____ It has more than one possible meaning. _____
- What is the other purpose of lexical definitions besides “to remove ambiguity”? (2)
_____ To show relationships _____
- What is the purpose of precisising definitions? (2)
_____ To reduce vagueness _____
- Write a persuasive definition for the word *summer* from the point of view of a student at the beginning of the school year. (2)
_____ Summer is a rapidly fading time of bliss. (Answers may vary.) _____
- Arrange these terms in order of *increasing extension*: COMPUTER, DEVICE, LAPTOP (2)
_____ Laptop, computer, device _____
- Arrange these terms in order of *decreasing intension*: BIBLE, BOOK, KING JAMES BIBLE (2)
_____ King James Bible, Bible, book _____
- One method of defining terms is by genus and difference. Name two other methods of defining terms, and then define the term “ball” using each method. (7)
Genus and difference _____ a spherically shaped object _____
Synonym _____ globe, orb _____
Example _____ basketball, cannonball, or marble. (Answers may vary.) _____

Problems 11–12: Fill in the blanks for the given term, identifying (a) a genus, (b) another species under that genus, and (c) a species of the given term. (3 each)

11. *boat* a) water vessel (Answers may vary.)

b) raft

c) canoe

12. *flower* a) plant (Answers may vary.)

b) weed

c) rose

13. Write out the rules for defining terms by genus and difference. The first is done for you. (6)

RULE 1 *A definition must state the essential attributes of the term.*

RULE 2 not be circular

RULE 3 not be too broad or too narrow

RULE 4 not be unclear or figurative

RULE 5 be stated positively, if possible

RULE 6 be the same part of speech as the term

Problems 14–17: Explain the primary error made by the given genus and difference definition. (2 each)

14. *child*: a person who is as young as a child.

Circular

15. *school*: the place children gather in different rooms on weekdays, except during summer.

Does not state the essential attributes

16. *tiny*: a very small thing.

Wrong part of speech

17. *planet*: a celestial body that is not a moon, comet, or star.

Negative when it could be positive

Problems 18–20: Define the given term by genus and difference definition. Do not break any of the rules. (3 each)

18. *nightmare* a frightening dream

19. *mask* a covering to disguise the face

20. *to spit* to eject saliva

REVIEW QUESTIONS

Answers can be found in the lesson under which the questions are listed.

Introduction

1. What is reasoning?
2. Why has God given men the ability to reason?
3. What is formal logic? In what way is logic an “attribute” of God?
4. What is the Law of Excluded Middle?
5. What is the Law of Identity?
6. What is the Law of Non-contradiction?
7. How does formal logic differ from informal logic?
8. What are some of the topics dealt with under informal logic?
9. What are the two branches of formal logic?
10. What are some differences between *induction* and *deduction*?
11. What are two branches of deduction?
12. Who first developed categorical logic, and when did he live?
13. What is one difference between *categorical logic* and *propositional logic*?
14. What are the branches of logic dealt with in this book?

Lesson 1: The Purposes and Types of Definitions,

1. What is a term?
2. What is the connection between a *term* and a *word*?
3. What does it mean to define a term?
4. What are six purposes for defining terms?
5. What are the five types of definitions?
6. Which types would you likely find in a dictionary?
7. What is an ambiguous word?
8. What is a vague word?
9. What is a lexical definition?
10. What is a precisising definition?
11. What is a stipulative definition?

12. What is a theoretical definition?
13. What is a persuasive definition?

Lesson 2: Genus and Species

1. What is a genus?
2. What is a species?
3. Can a term be both the *genus* of one term and the *species* of another?
4. What are some of the common errors made in constructing genus and species charts?

Lesson 3: Extension and Intension

1. What is the extension of a term?
2. What is the intension of a term?
3. How are *extension* and *intension* related in any given genus and species chart?

Lesson 4: Methods of Defining

1. What are three methods of defining terms?
2. Do other methods exist?
3. What are some limitations of defining by synonym?
4. What are some rules for defining by example?
5. How is a term defined by genus and difference?

Lesson 5: Rules for Defining by Genus and Difference

1. What are the six rules for defining by genus and difference?
2. Can you restate these rules in your own words?
3. What is the difference between an *essential* and an *accidental* attribute?
4. What are three ways that a definition can be unclear?

REVIEW EXERCISES

Students may do these exercises for further review of this unit.

Lesson 1: Additional Exercises

1. Write (or find) lexical definitions for the following pairs of words that will show the relationship between them. Explain the relationship: How are the words similar? How are they different?

a) brother: male sibling
sister: female sibling
relationship: The definitions show that the terms comprise the two
genders of siblings

b) circle: 2-D figure consisting of the set of points equidistant from a point
sphere: 3-D figure consisting of the set of points equidistant from a point
relationship: Both terms describe figures made up of a set of points
equidistant from a given point (the center). One describes a 2-D figure
and the other describes a 3-D figure.

c) newspaper: daily or weekly periodical printed on large sheets of thin paper
magazine weekly or monthly periodical printed in a paperback format
relationship: Both are periodicals, but their publication frequency and
printing format are different.
