

FROM THE MAKERS OF THE ACT®

THE  
OFFICIAL  
ACT®

SCIENCE GUIDE

THIRD EDITION

A Step-by-Step Guide Outlining the Preparation for the ACT®

FEATURES

- Understand the detailed breakdown of each science reporting category
- Learn how to quickly and efficiently read graphs, charts, and data
- Review the science vocabulary section with words you should know to succeed
- In-depth examples of each passage type using official ACT® samples
- Includes 100s of official ACT® questions with answers and explanations

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THE  
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# Introduction

So you want to do well on the ACT science test. That's a good goal to have! Whether you've already taken the test once or are planning to do so in the near or even distant future, this book will help you achieve your goal.

This guide is designed to provide you with a road map for what types of passages and items you might see on the ACT science test. There are a lot of facts, figures, and theories that are taught in science classes in school. The great thing is that you aren't expected to know every single fact, figure, and theory you've ever been taught when taking the ACT science test. This book will provide you with the guidance you need to succeed by telling you what you should focus on, sharing details on how to prepare, and offering a lot of practice questions.

In [chapter 1](#), you will see an introduction to the overall structure of the ACT science test, including a brief introduction to the passage types and reporting categories. This chapter will also provide you with some basic tips about time management when taking the science test.

In [chapters 2-4](#), you'll see examples of the three types of passages on the science test. Knowing how to approach each of these passages is essential to getting through the science section in the time allowed. Each passage type presents you with scientific information in a different format: perhaps a series of graphs and tables, a description of an experiment with different trials and results, or several contrasting hypotheses regarding some premise or data set. The examples will provide you with strategies for how to best approach and conquer each passage type.

In [chapters 5-7](#), you're going to see detailed explanations of the three reporting categories on the ACT science test and strategies for how to best approach each one in your studies. A science reporting category is ACT's way of breaking down the science test into smaller, more understandable subsections. You'll be given official ACT science test sample questions tied directly to each reporting category so that you will know what to expect when you take the test.

In [chapter 8](#) you'll see more specifics about what you should review to achieve success on the ACT science test. Remember: you don't need to remember everything you've ever learned in your science classes, just a few specific things. More important is that you need to have a solid overall grasp of the *idea* of science and how to perform and interpret scientific investigations. In this chapter you'll start by exploring what the scientific method is, and then you'll learn how to formulate a hypothesis, design an experiment, draw conclusions from the results, and make predictions based on those results. Again, all of this will be shown through explanations of official ACT science test sample items.

In [chapter 9](#) you'll review how to approach graphs and charts. The chapter starts with the basics of how to read a graph and moves on from there. A major focus is to help you not get overwhelmed by the different kinds of data presented. The chapter will help you learn how to pick out what you need from a graph or chart through provided examples and ignore the excess information given to you. The ACT science test is filled with graphs and charts of all kinds so having a solid understanding of how to read them is extremely beneficial.

After reviewing the graphs and charts you should realize just how important and prevalent numbers and

measurements are in science. [Chapter 10](#) provides an in-depth review of the major types of measurements and units you might encounter when taking the ACT science test, such as what the metric system is, how prefixes are used, and a detailed discussion of many of the most commonly used SI units. You aren't expected to become an expert on every type of measure and unit. This chapter just helps you gain some familiarity with the measurements you might see on the ACT science test, increasing your confidence when taking the test.

In the same way, understanding and being comfortable with the vocabulary of science is paramount to succeeding on the test. No one resource can prepare you for the number of content-specific terms when reading science material. However, this book will help you become familiar with the most commonly used terms on the ACT science test for each of the major scientific disciplines. Most important, [chapter 11](#) will show you how to deal with words that you have never seen before and don't know the meaning of. You don't need to understand every term on the test, but you'll want to know how to approach those unknown words. This way, when you encounter a science word you aren't familiar with on the test, you won't have to waste time trying to figure out what it means. You'll just be able to keep right on going without any loss of time or focus.

In [chapters 12](#) and [13](#), you're provided with a large set of ACT science test questions. There is a thorough breakdown of the solution for each question. This section will prove invaluable because each question is tied directly to a specific reporting category. Practice is beneficial to success in any endeavor in life, and test taking is not any different, so use these questions to prepare yourself for the ACT science test.

You definitely want to pick up the other ACT subject guides, and you'll eventually want to take at least one full-length practice exam from *The Official ACT Prep Guide*, but with the use of this guide, you can and will succeed with your goal of doing well on the ACT science test. So read on and let's get started.

# Chapter 1:

## An Overview of the ACT Science Test

The ACT science test presents a passage or scientific scenario that is followed by several questions related to the passage. Many questions rely only on information in the passage: for example, a question that asks about how the value of one variable changes when another variable increases. Other items require that you integrate prior science knowledge with information from the passage to engage in three-dimensional scientific sense making using science and engineering practices, crosscutting concepts in science, and science content knowledge to answer the question.

### Passage Types

The ACT science test uses three types of passages: Data Representation, Research Summary, and Conflicting Viewpoints. Data Representation passages have a short passage that introduces the scientific phenomena that is displayed in the graphics which may include tables, graphs, and diagrams. These are covered more fully in [chapter 2](#). Research Summary passages are of medium length and describe one or more related experiments including information about the methods and tools used in the experiment which may include diagrams. Specific information for each experiment is separated by headers such as Experiment 1 or Study 2. These typically include several graphics (tables, graphs, or diagrams). These are covered in [chapter 3](#). The Conflicting Viewpoints passage begins with an overview of a scientific phenomenon. This is

followed by two to four scientific explanations or models (each separated by a header such as Student 1 or Scientist 2) that provide a causal explanation with supporting evidence and reasoning. These are the longest passages on the ACT science test and are covered in [chapter 4](#).

## Overall Test Structure and Content Coverage

The ACT science test contains 40 items and 7 passages that must be answered in 40 minutes. Six of the seven passages count towards your score and the remaining passage includes six items that do not count toward your score. Since you cannot tell which passage is not scored, you should do your best on all the passages. Overall, the test has 34 scored items that all count for one point and six field test items that do not count towards your score.

Type of Passage	Number of Operational Passages	Passage Length
Data Representation	2	Short (approximately 100 standard words)
Research Summary	3	Medium (approximately 275 standard words)
Conflicting Viewpoints	1	Long (approximately 350 standard words)

## Science Content Coverage

Each passage has a primary focus on a specific science discipline: Biology, Chemistry, Physics, or Earth and Space

Science. Some passages, like science itself, are interdisciplinary involving information from more than one discipline, but the primary focus is used to identify the passage. For example, if a passage measures the impact of acid rain on plant growth, the primary focus is biology (plant growth in response to environmental factors) and the passage would count as a biology passage even if some items required you to use chemistry knowledge like acids have a pH below 7. ACT’s Recommended Core Curriculum for science is that you should take three credits of lab-based science classes including Biology and either Chemistry or Physics and following that curriculum will help you develop the science knowledge and skills in class that will help prepare you to do well not only on the ACT science test but also in your college science courses.

Additionally, some passages will have a secondary focus for **Engineering and Design Thinking** (EDT). EDT passages involve using science to solve real world problems which may include experiments to identify the extent of the problem or tests of possible solutions. Every ACT science test has at least one passage with an EDT focus in addition to its primary content focus. It is entirely possible to have EDT passages for any passage type and with any science discipline. The table below shows how many passages in each discipline and a brief sample of specific topics in each discipline.

<b>Science Discipline</b>	<b>Number of Passages</b>	<b>Example topics</b>
Biology	2	Genetics, cells, natural selection, ecology
Chemistry	1-2	Chemical reactions, acids, bonding

<b>Science Discipline</b>	<b>Number of Passages</b>	<b>Example topics</b>
Physics	1-2	Kinematics, magnetism, friction, optics
Earth and Space Science	1-2	Plate tectonics, rock cycle, atmospheric composition, properties of stars and planets
SECONDARY FOCUS: Engineering and Design Thinking	1-3	

## **Reporting Categories**

For many years, the ACT science test has focused on science practices and skills that are transferable not only among the sciences but also with other disciplines. Most state science standards refer to this kind of knowledge as Science and Engineering Practices (SEP) and Crosscutting Concepts in Science (CCC). SEP are things that scientists, and by extension student scientists, do like interpret data, plan and carry out investigations, and engage in scientific argument from evidence using a claim-evidence-reasoning model of argument. CCC are how scientists and students think, like looking for patterns, cause and effect relationships, and constructing and using models (both physical and conceptual). These have been viewed as more important by college instructors than the third dimension of science knowledge and learning, Disciplinary Content Information (DCI). Together these make up the three strands of the science standards. All items require the use

of SEP and CCC, while 15%–25% of items require integrating content knowledge with SEP and CCC to answer the question. The ACT science test clusters these skills into three reporting categories: Interpretation of Data (IOD), Evaluating Models and Scientific Arguments with Evidence (EMI), and Scientific Investigation (SIN). These are covered in greater detail in [chapters 5, 6, and 7](#), respectively. Since every item is only counted towards one reporting category based on the most cognitively demanding step, it is important to know that some EMI and SIN items require an underlying IOD skill to get to the correct answer. For example, to evaluate a claim about a trend in the data (EMI), you may first need to find the data in the graphic and determine how the dependent variable changes in response to the independent variable (IOD). Consequently, the skills in the IOD domain are used on over half of the items on the science test, even when they are not the most challenging or apex skill.

<b>Reporting Category</b>	<b>Number of Scored Items</b>	<b>Percentage of Scored Items</b>
Interpretation of Data (IOD)	13-17	38%-50%
Scientific Investigation (SIN)	6-11	18%-32%
Evaluation of Models and Scientific Arguments with Evidence (EMI)	8-13	24%-38%

## **Test Timing and Time Management**

The ACT science test has 40 items and 40 minutes to complete them. ACT recently conducted a reading rate study and it found that students, when not rushing, read at approximately 225–250 standard words per minute. This

study found rates similar to other researchers and that this reading rate is similar to students over the last several decades. That means that a typical student should spend approximately half a minute on the Data Representation passage reading the passage and making sense of the graphics (headers, legends, keys, etc. discussed in [chapter 9](#)). The Research Summary and the Conflicting Viewpoints passages should both take between one and two minutes to read. You may take a little longer if you are making notes for online testing or marking up the passage for paper testing. However, the majority of the time on the ACT science test should be used to answer questions.

ACT Research in cognitive labs found that for most students the most efficient way to answer questions correctly was to read the passage first and then answer the questions. Many students who answered correctly made notes in the margins of a paper test or on scratch paper to help them find answers quickly and efficiently. It is important to note that the ACT science test is an open book test in that you do not need to read to memorize the facts of the passage but should read at a pace that you understand the main idea of each viewpoint and key aspects of the experiments. You should generally only re-read a part of the passage in order to answer a specific question. It is important to remember that you only get points for answering questions correctly, so you need to spend the majority of your time answering questions. Some students find that it is more effective for them to read only the information until the first subheading or graphic. Other students have found that going to the questions first works best for them, especially if they are short on time and know that they are willing to guess and move on if a question does not direct them to a part of the passage (for example, Based on the Experiment, Based on Table 1, Based on Figure 2 and Table 1, ...). You may want to try different

methods based on how much time is remaining. The more you practice reading passages and answering questions, the more likely you are to improve your speed and accuracy. You will also learn what kinds of items that you struggle with and take more time so that you can flag those items to return, guess, and move on.

All items count the same, so it is important not to spend too much time on any one item. Other recent ACT research found that students frequently spent large amounts of time on items that they did not know how to answer the question. They frequently reread the question and answers without moving towards finding the correct answer. It was not unusual for some students to spend four or more minutes on one question in the study. It is important to develop metacognition (knowing what you know and what you do not know) as a college and career readiness skill. You should apply this to the questions on the ACT test in general and the science test in particular. If you do not know how to begin to find the answer to a question after 15 seconds or you get stuck after 45 seconds, you should guess on that item and mark it to come back to (circle the item number in your paper test booklet or use the flag item button online). You should try to eliminate answers that you know are not correct, if you can, to improve the likelihood that you guess the correct answer. If you spend too much time on an early question that you do not know how to answer, you may not have time left for other questions that you do know how to answer later in the test.

## **Format of this guide**

This guide is grouped by clusters of related chapters. [Chapters 2-4](#) cover the passage formats. [Chapters 5-7](#) focus on the skills in each reporting category. [Chapters 8-](#)

[10](#) focus on knowledge common to all fields of science such as understanding a control of variables experimental approach; understanding data presentations in graphs, charts, tables, and diagrams; and common scientific units and measurement. [Chapter 11](#) gives an overview of content topics, vocabulary, and concepts that you might encounter on the ACT science test. [Chapters 12](#) and [13](#) include a large set of the types of items and passages that you might encounter on the ACT science test and explanations for the answers. Many of these items have been used on actual ACT science test, but all are representative of the range of complexities and topics that might be used on the test.

used, so this was not a variable. **C** is incorrect; the plant mass was a dependent variable. **D** is incorrect; the plant height was a dependent variable.

28. **The best answer is J.** According to the information in Tables 1, 2, and 3, as the height decreased, the mass decreased. A plot of this data would result in a line with a positive slope. Therefore, **J** is correct. **F** and **G** are incorrect; the line would have a slope because the mass changed as the height changed. **H** is incorrect; the line would have a positive slope because the mass increased as the height increased.
29. **The best answer is D.** L1, L2, and L3 all had *AtNHX1* introduced. L4 did not have *AtNHX1* introduced; L4 was the control. Therefore, **D** is correct; L4 was not altered. **A**, **B**, and **C** are incorrect; L1, L2, and L3 all contained different genotypes for *AtNHX1*.

### Passage VI

30. **The best answer is H.** According to Figure 2, at 300 MPa the solubility of CO<sub>2</sub> in rhyolite magma is 2,000 ppmw at 800°C. Therefore, **H** is correct. **F** is incorrect; the solubility is approximately 2,350 ppmw at 700°C. **G** is incorrect; the solubility is approximately 2,200 ppmw at 750°C. **J** is incorrect; the solubility is approximately 1,875 ppmw at 850°C.
31. **The best answer is D.** According to Figure 1, at 1,150°C and 50 MPa, the solubility of CO<sub>2</sub> in basanite magma was 300 ppmw, and at 1,150°C and 125 MPa, the solubility was 1,000 ppmw. At 1,150°C and 200 MPa, the solubility of CO<sub>2</sub> in tholeiitic basalt magma was 700 ppmw, and at 1,150°C and 250 MPa, the solubility of CO<sub>2</sub> was 1,000 ppmw. The

CO<sub>2</sub> solubilities were closest in value when basanite magma was at 125 MPa and tholeiitic basalt magma was at 250 Mpa. Therefore, **D** is correct. **A**, **B**, and **C** are incorrect; the CO<sub>2</sub> solubilities for both types of magma were 1,000 ppmw at 125 Mpa for basanite magma and 250 Mpa for tholeiitic basalt magma.

32. **The best answer is G.** According to Figure 1, at 1,150°C and 150 Mpa, the solubility of CO<sub>2</sub> in leucite magma was 3,000 ppmw and the solubility of CO<sub>2</sub> in rhyolite magma was 700 ppmw. The solubility in leucite magma was 2,300 ppmw greater. Therefore, **G** is correct. **F** is incorrect; the solubility is 2,300 ppmw greater in leucite magma. **H** and **J** are incorrect; the solubility was greater in the leucite magma than in the rhyolite magma.
33. **The best answer is A.** According to Figure 2, as the temperature increased from 650°C to 1,150°C, the solubility of CO<sub>2</sub> in rhyolite magma at 100 MPa decreased from 800 ppmw to 400 ppmw and the solubility at 300 MPa decreased from 2,600 ppmw to 1,300 ppmw. Increasing the temperature had a smaller effect on the solubility of CO<sub>2</sub> at 100 MPa. Therefore, **A** is correct. **B** is incorrect; the solubility decreased by only 400 ppmw, from 800 ppmw to 400 ppmw. **C** and **D** are incorrect; a greater effect was seen at 300 Mpa.
34. **The best answer is F.** According to Figure 2, at 750°C and 200 Mpa, the solubility of CO<sub>2</sub> in rhyolite magma is 1,500 ppmw. Figure 3 shows that at 200 Mpa and a CO<sub>2</sub> solubility of 1,500 ppmw, rhyolite magma contains 0% H<sub>2</sub>O. Therefore, **F** is correct. **G** is incorrect; rhyolite magma with 2% H<sub>2</sub>O has a CO<sub>2</sub> solubility of 1,250 ppmw at 200 Mpa. **H** is incorrect;

rhyolite magma with 4% H<sub>2</sub>O has a CO<sub>2</sub> solubility of 700 ppmw at 200 Mpa. **J** is incorrect; CO<sub>2</sub> is insoluble in rhyolite magma with 6% H<sub>2</sub>O at 200 Mpa.

### Passage VII

35. **The best answer is A.** According to Hypothesis 1, Earth is the solar system's central body and other bodies move around Earth in looped orbits. Hypothesis 2 states that the Sun is the solar system's central body and the planets move around the Sun in elliptical orbits. Therefore, **A** is correct. **B** is incorrect; Hypothesis 2 claims that the planets follow elliptical orbits around the Sun, not Earth. **C** and **D** are incorrect; Hypothesis 1 claims that the planets follow looped orbits.
36. **The best answer is H.** According to Figure 2, as Mars loops, the distance between Earth and Mars varies. Figure 3 shows that as Earth and Mars orbit the Sun, the distance between them varies. This is obvious because they are relatively near one another on 10/01/2005 and 12/10/2005 and farther apart on 7/24/2005 and 2/26/2006. Therefore, **H** is correct. **F**, **G**, and **J** are incorrect; both Figures 2 and 3 imply that the distance between Earth and Mars varies.
37. **The best answer is A.** The top portion of Figure 3 is consistent with Hypothesis 2, showing that, over time, Earth will move a greater percentage of its smaller orbit than will Mars. Therefore, **A** is correct. **B** is incorrect; Earth is shown as having a smaller orbit. **C** and **D** are incorrect; the top portion is consistent with the reasoning presented in Hypothesis 2.

38. **The best answer is G.** According to the passage, Mars appears to move retrograde when it is moving westward relative to the stars. Figure 1 shows that Mars is moving westward, and therefore retrograde, between 10/01/2005 and 12/10/2005, a period of 70 days. Therefore, **G** is correct. **F**, **H**, and **J** are incorrect; Mars is retrograde for 70 days.
39. **The best answer is D.** Figure 2 shows that Mars's deferent is a counterclockwise circle around Earth, the central body of the solar system according to Hypothesis 1. Figure 3 shows that Mars moves in a counterclockwise circle around the Sun, the central body of the solar system according to Hypothesis 2. Therefore, **D** is correct. **A** and **B** are incorrect; according to the hypotheses, Mars moves in a counterclockwise direction around the central body of the solar system. **C** is incorrect; Hypothesis 1 states that Mars orbits Earth.
40. **The best answer is G.** According to Figure 1, the first position shown on Figure 3 corresponds to 7/24/2005, the second corresponds to 10/01/2005, and the third corresponds to 12/10/2005. On November 7, 2005, the positions of Earth and Mars would be between those found on 10/01/2005 and 12/10/2005. Therefore, **G** is correct; this figure best shows the likely positions of Earth and Mars in November. **F** is incorrect; this figure illustrates the position of Mars in October and that of Earth in December. **H** is incorrect; this figure illustrates the position of Earth in October and that of Mars in December. **J** is incorrect; this figure illustrates the likely position of Earth around April or May.