ETS PRAXIS

Measuring the Power of Learning.®

The *Praxis*® Study Companion

Middle School Science

5440

www.ets.org/praxis

Welcome to *The Praxis® Study Companion*

Prepare to Show What You Know

You have been working to acquire the knowledge and skills you need for your teaching career. Now you are ready to demonstrate your abilities by taking a *Praxis®* test.

Using *The Praxis® Study Companion* is a smart way to prepare for the test so you can do your best on test day. This guide can help keep you on track and make the most efficient use of your study time.

The Study Companion contains practical information and helpful tools, including:

- An overview of the *Praxis* tests
- Specific information on the *Praxis* test you are taking
- A template study plan
- Study topics
- Practice questions and explanations of correct answers
- Test-taking tips and strategies
- Frequently asked questions
- Links to more detailed information

So where should you start? Begin by reviewing this guide in its entirety and note those sections that you need to revisit. Then you can create your own personalized study plan and schedule based on your individual needs and how much time you have before test day.

Keep in mind that study habits are individual. There are many different ways to successfully prepare for your test. Some people study better on their own, while others prefer a group dynamic. You may have more energy early in the day, but another test taker may concentrate better in the evening. So use this guide to develop the approach that works best for you.

Your teaching career begins with preparation. Good luck!

Know What to Expect

Which tests should I take?

Each state or agency that uses the *Praxis* tests sets its own requirements for which test or tests you must take for the teaching area you wish to pursue.

Before you register for a test, confirm your state or agency's testing requirements at www.ets.org/praxis/states.

How are the *Praxis* tests given?

Praxis tests are given on computer. Other formats are available for test takers approved for accommodations (see page 44).

What should I expect when taking the test on computer?

When taking the test on computer, you can expect to be asked to provide proper identification at the test center. Once admitted, you will be given the opportunity to learn how the computer interface works (how to answer questions, how to skip questions, how to go back to questions you skipped, etc.) before the testing time begins. Watch the What to Expect on Test Day video to see what the experience is like.

Where and when are the *Praxis* tests offered?

You can select the test center that is most convenient for you. The *Praxis* tests are administered through an international network of test centers, which includes Prometric® Testing Centers, some universities, and other locations throughout the world.

Testing schedules may differ, so see the *Praxis* web site for more detailed test registration information at www.ets.org/praxis/register.

Table of Contents

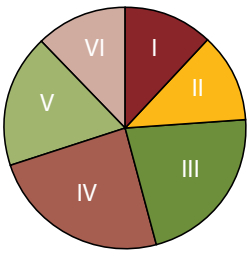
The Praxis® Study Companion guides you through the steps to success

1. Learn About Your Test

Learn about the specific test you will be taking

Middle School Science (5440)

Test at a Glance	
Test Name	Middle School Science
Test Code	5440
Time	2.5 hours
Number of Questions	125
Format	Selected-response questions
Test Delivery	Computer delivered



Content Categories		Approximate Number of Questions	Approximate Percentage of Examination
I.	Scientific Inquiry, Methodology, Techniques, and History	15	12%
II.	Basic Principles of Matter and Energy	15	12%
III.	Physical Sciences	28	22%
IV.	Life Sciences	30	24%
V.	Earth and Space Sciences	22	18%
VI.	Science, Technology, and Society	15	12%

About This Test

The Middle School Science test is designed to measure the knowledge and competencies necessary for a beginning teacher of middle school science. Test takers have typically completed or nearly completed a bachelor's degree program with appropriate coursework in science and education.

The development of the test questions and the construction of the test reflect the National Science Education Standards (NSES) and the National Science Teacher Association (NSTA) standards and recognize that there are conceptual and procedural schemes that unify the various scientific disciplines. These fundamental concepts and processes (systems; models; constancy and change; equilibrium; form and function) are useful in understanding the natural world. Insofar as possible, then, the test questions will have the primary objective of evaluating the content areas by using questions that focus on conceptual understanding, critical thinking, and problem solving in science. The test content is developed and reviewed in collaboration with practicing middle school science teachers, teacher-educators, and higher education content specialists to keep the test updated and representative of current standards.

The 125 selected-response questions include concepts, terms, phenomena, methods, applications, data analysis, and problem solving in science, and include an understanding of the impact of science and technology on the environment and human affairs. This also includes the ability to integrate basic topics from chemistry, physics, life science, and Earth and space science, which are typically covered in introductory college-level courses in these disciplines, although some questions of a more advanced nature are included, because secondary school

teachers must understand the subject matter from a more advanced viewpoint than that presented to their students.

Test takers will not need to use calculators in taking this test. The test contains a periodic table of the elements and a table of information that presents various physical constants and a few conversion factors among SI units. The periodic table of the elements and the information table are on the Help tab during the test. Whenever necessary, additional values of physical constants are included with the text of a question.

This test may contain some questions that will not count toward your score.

Test Specifications

Test specifications describe the knowledge and skills measured by the test. Study topics to help you prepare to answer test questions can be found on page 32.

I. Scientific Inquiry, Methodology, Techniques, and History

A. Understands methods of scientific inquiry and how they are used in basic problem solving

1. Observations, hypotheses, experiments, conclusions, theories, models, and laws
2. Experimental design, including independent and dependent variables, controls, and sources of error
3. Nature of scientific knowledge
   a. subject to change, consistent with evidence, based on reproducible evidence
   b. includes unifying concepts and processes (e.g., systems, models, constancy and change, equilibrium, form and function)

B. Understands the processes involved in scientific data collection and manipulation

1. Common units of measurement, including prefixes such as milli and kilo (e.g., units of length, time, mass, volume, pressure, energy, force)
2. Scientific notation and significant figures
3. Organization and presentation of data (e.g., graphs, tables, charts)
4. Basic error analysis (e.g., accuracy, precision)
5. Basic descriptive statistics (e.g., calculate averages, distinguish between mean, mode, and median)

C. Knows how to interpret and draw conclusions from data presented in tables, graphs, and charts

1. Trends in data
2. Relationships between variables
3. Predictions based on data
4. Drawing conclusions based on evidence

D. Is familiar with the procedures for safe and correct preparation, storage, use, and disposal of laboratory materials

1. Safe storage
2. Proper and safe disposal (e.g., chemicals, biohazards)
3. Proper preparation
4. Use of equipment such as fume hoods

E. Understands safety and emergency procedures in the laboratory

1. Equipment (e.g., eyewash stations, safety showers)
2. Appropriate student apparel and behavior (e.g., goggles, clothing)
3. Emergency procedures for minor burns and other injuries
4. Emergency procedures for mishaps (e.g., fires, chemical spills)
5. Evacuation procedures

F. Is familiar with how to use standard equipment in the laboratory

Appropriate use of equipment (e.g., thermometers, microscopes, barometers, graduated cylinders, Bunsen burners, balances, pH meters)

6. Basic care, preparation, and maintenance of equipment

G. Is familiar with the historical developments of science and the contributions of major historical figures

1. How major concepts developed over time (e.g., atomic models, genetics, plate tectonics)
2. Key historical figures and their contributions

II. Basic Principles of Matter and Energy

A. Is familiar with the structure and properties of matter

1. Solids, liquids, gases, and plasmas
2. Elements, atoms, compounds, molecules, and mixtures
3. Occurrence and abundance of the elements and their isotopes

B. Knows the basic relationships between energy and matter

1. Conservation of energy (first law of thermodynamics)
2. Entropy changes (second law of thermodynamics)
3. Conservation of matter in chemical systems
4. Forms of kinetic and potential energy (thermal, chemical, radiant, mechanical)
5. Energy transformations
6. Chemical and physical properties/changes
7. Temperature scales (e.g., Celsius, Fahrenheit, and Kelvin; comparisons and conversions between the scales)
8. Effect of thermal energy on matter and the measurement of thermal energy (e.g., specific heat capacity, joules)
9. Methods of heat transfer (e.g., convection, radiation, conduction)
10. Interdisciplinary applications of energy and matter relationships
    a. trophic levels
    b. matter cycling and energy flow in ecosystems
    c. convection currents in atmosphere, ocean, and mantle
    d. conservation of mass in the rock cycle
    e. nitrogen cycle
    f. chemical and physical changes in rocks
    g. impact of solar radiation on Earth and life
    h. photosynthesis and cellular respiration
    i. energy transformations in living systems

C. Knows the basic structure of the atom

1. Atomic models
2. Atomic structure including electrons, protons, and neutrons
3. Atomic number and mass
4. Ions
5. Electron arrangements
6. Radioisotopes, radioactive decay, half-life, fusion, and fission
7. Applications of radioactivity (e.g., carbon dating, evidence for evolution, medical imaging)

III. Physical Sciences

A. Physics

1. Understands mechanics
   a. Describe linear and circular motion in one and two dimensions
      – speed
      – velocity
      – acceleration
      – momentum
   b. Newton's first law: inertia
   c. Friction
   d. Work, energy, and power
   e. Mass, weight, and gravity
      – characteristics of gravitation (e.g., gravitational attraction, acceleration due to gravity, mass, distance)
      – distinguish between mass and weight
   f. Analyze motion and forces in a physical situation, including basic problems
      – Newton's second law: $F = ma$
      – Newton's third law: action-reaction forces
      – inclined planes
      – collisions
      – projectile motion
      – periodic motion (e.g., pendulums, springs, planetary orbits)
      – conservation of energy and conservation of momentum
   g. Simple machines and mechanical advantage
   h. Physical properties of fluids (e.g., buoyancy, density, pressure)
2. Knows electricity and magnetism
   a. Electrical nature of materials
      – electric charges
      – electrostatic attraction and repulsion
      – conductivity, conductors, and insulators
   b. Analyze basic series and parallel electrical circuits
      – DC and AC current
      – current, resistance, voltage, and power
      – Ohm's law
      – voltage sources (e.g., batteries, generators)
   c. Magnetic fields and forces
      – magnetic materials
      – magnetic forces and fields (e.g., magnetic poles, attractive and repulsive forces)
      – electromagnets
3. Understands basic waves and optics
   a. Characteristics of light and the electromagnetic spectrum
      – nature of light
      – visible spectrum and color
      – ultraviolet, infrared, microwave, and gamma
   b. Basic characteristics and types of waves
      – transverse and longitudinal
      – frequency, amplitude, wavelength, speed, intensity
   c. Basic wave phenomena
      – reflection, refraction, diffraction, and dispersion
      – absorption and transmission
      – interference, scattering, and polarization
      – doppler effect
   d. Basic characteristics and phenomena of sound
      – pitch/frequency and loudness/intensity
      – sound-wave production, air vibrations, and resonance (e.g., tuning forks)
   e. Basic optics
      – mirrors
      – lenses and their applications (e.g., the human eye, microscope, telescope)
      – prisms
      – fiber optics

B. Chemistry

1. Is familiar with how to use the periodic table to predict the physical and chemical properties of elements
   a. Organization of the periodic table
      – arranged in columns and rows (e.g., groups/families, periods)
      – includes symbol, atomic number, and atomic mass for each element
   b. General trends in chemical reactivity based on position of elements in the periodic table (e.g., metallic and nonmetallic elements, noble gases)
   c. General trends in physical properties based on position of elements in the periodic table (e.g., atomic radius, ionization energy)
2. Knows the types of chemical bonding and the composition of simple chemical compounds
   a. Covalent and ionic bonding
   b. Intermolecular attractions such as hydrogen bonding
   c. Names of simple chemical compounds
      – ionic
      – covalent compounds involving two elements
      – acids and bases
   d. Interpret chemical formulas
      – describe formulas in terms of moles of atoms
      – percent composition
      – empirical/molecular formulas
      – electron dot and structural formulas
3. Understands states of matter and phase changes between them
   a. Basic assumptions of the kinetic molecular theory of matter (e.g., particles in constant motion, speed and energy of gas particles are related to temperature)
   b. Ideal gas laws (e.g., Charles' law: volume is proportional to temperature; Boyle's law: pressure and volume are inversely proportional)
   c. Phase changes
      – melting/freezing
      – vaporization/condensation
      – sublimation
      – heating/cooling curves
4. Knows how to balance and use simple chemical equations
   a. Balance simple chemical reactions
   b. Simple stoichiometric calculations involving balanced equations
   c. Use chemical formulas to identify and describe simple chemical reaction equations
      – combustion
      – oxidation (e.g., iron rusting)
      – neutralization
      – single or double replacement
   d. Energy relationships (e.g., endothermic reactions, exothermic reactions)
   e. Factors that affect reaction rates (e.g., concentration, temperature, pressure, catalysts/enzymes)
5. Understands basic concepts in acid-base chemistry
   a. Chemical and physical properties of acids and bases
   b. pH scale
   c. Neutralization
   d. Buffers
6. Is familiar solutions and solubility
   a. Solution terminology and identification of different types of solutions
      – dilute and concentrated
      – saturated, unsaturated, and supersaturated
      – solvent and solute
      – concentrations of solutions in terms of molarity
7. Factors affecting the dissolving process and solubility of substances
      – effect of temperature and particle size on dissolving
      – effect of temperature on solubility
      – polar versus nonpolar solvents and solutes (e.g., like dissolves like)
      – ionic compounds dissociate into ions in solution (e.g., electrolytes)

IV. Life Sciences

A. Understands basic structure and function of cells and their organelles

1. Structure and function of cell membranes (e.g., passive and active transport, osmosis)
2. Structure and function of cell organelles
3. Levels of organization (cells, tissues, organs, organ systems)
4. Major cell types (e.g., muscle, nerve, epithelial)
5. Prokaryotes and eukaryotes

B. Understands basic cell reproduction

1. Cell cycle
2. Mitosis
3. Meiosis
4. Cytokinesis

C. Is familiar with the basic biochemistry of life

1. Cellular respiration
2. Photosynthesis
3. Biological molecules (e.g., DNA, carbohydrates, proteins, lipids, enzymes)

D. Understands basic genetics

1. DNA structure
2. Replication, transcription, and translation
3. Dominant and recessive alleles
4. Mendelian inheritance (e.g., genotype, phenotype, use of Punnett squares)
5. Mutations, chromosomal abnormalities, and common human genetic disorders

E. Understands the theory and key mechanisms of evolution

1. Mechanisms of evolution (e.g., natural selection, punctuated equilibrium)
2. Isolation mechanisms and speciation
3. Supporting evidence (e.g., fossil record, comparative genetics, homologous structures)

F. Knows the elements of the hierarchical classification scheme and the characteristics of the major groups of organisms

1. Classification schemes (e.g., domain, kingdom, phylum/division, class, order, family, genus, species)
2. Characteristics of animals, plants, fungi, protists, and monera

G. Knows the major structures and functions of plant organs and systems

1. Characteristics of vascular and nonvascular plants
2. Control mechanisms and responses to stimuli
3. Structure and function of leaves, roots, and stems
4. Asexual and sexual reproduction
5. Uptake and transport of nutrients and water
6. Growth

H. Knows the basic anatomy and physiology of animals, including structure and function of human body systems and the major differences between humans and other animals

1. Homeostasis
2. Exchange with the environment (e.g., respiratory, excretory, digestive systems)
3. Internal transport and exchange (e.g., circulatory system)
4. Movement and support (e.g., skeletal and muscular systems)
5. Reproduction and development
6. Immune systems
7. Control systems (e.g., nervous system, endocrine system)
8. Response to stimuli and other organismal behavior

I. Knows key aspects of ecology

1. Population dynamics (e.g., growth curves; carrying capacity; behavior such as territoriality, mating systems, and social systems)
2. Community ecology (e.g., niche, succession, species diversity, interspecific relationships such as predator-prey and parasitism)
3. Ecosystems
   a. biomes
   b. stability and disturbances (e.g., glaciation, effect of global warming)
   c. energy flow (e.g., trophic levels, food webs)
   d. biogeochemical cycles (e.g., water, nitrogen, and carbon cycles, biotic/abiotic interaction)

V. Earth and Space Sciences

A. Is familiar with physical geology

1. Types and characteristics of rocks, minerals, and their formation processes
   a. Characteristics of rocks and their formation processes (e.g., igneous, metamorphic, and sedimentary rocks; the rock cycle)
   b. Characteristics of minerals and their formation processes (e.g., classes of minerals, crystals, hardness)
2. Processes involved in erosion, weathering, and deposition of Earth's surface materials and soil formation
   a. Erosion and deposition (e.g., agents of erosion)
   b. Chemical and physical (mechanical) weathering
   c. Characteristics of soils (e.g., types, soil profile)
   d. Porosity and permeability
   e. Runoff and infiltration
3. Earth's basic structure and internal processes
   a. Earth's layers (e.g., lithosphere, mantle, core)
   b. Earth's shape and size
   c. Geographical features (e.g., mountains, plateaus, mid-ocean ridges)
   d. Earth's magnetic field
   e. Plate tectonics theory and evidence
      – folding and faulting
      – continental drift
      – magnetic reversals
      – characteristics of volcanoes (e.g., types, lava, eruptions)
      – characteristics of earthquakes (e.g., epicenters, faults, tsunamis)
      – seismic waves and triangulation
4. Water cycle
   a. Evaporation
   b. Condensation
   c. Precipitation
   d. Runoff

B. Is familiar with Historical Geology

1. Principle of uniformitarianism
2. Basic principles of stratigraphy (e.g., law of superposition)
3. Relative and absolute time (e.g., index fossils, radioactive dating)
4. Geologic time scale (e.g., eras, periods)
5. Fossil formation and the fossil record
6. Important events in Earth's geologic history (e.g., mass extinctions, Cambrian explosion, ice ages, meteor impacts)

C. Is familiar with the structure and processes of Earth's oceans and other bodies of water

1. Geographic location of Earth's oceans and seas
2. Tides, waves, and currents
3. Estuaries and barrier islands
4. Island, reef, and atoll formation
5. Polar ice caps, icebergs, and glaciers
6. Lakes, ponds, streams, rivers, and river deltas
7. Groundwater, water table, wells, and aquifers
8. Properties of water that affect Earth systems (e.g., density changes upon freezing, high heat capacity, polar solvent, hydrogen bonding)

D. Knows basic meteorology and major factors that affect climate and seasons

1. Basic meteorology
   a. Structure of Earth's atmosphere (e.g., troposphere, stratosphere)
   b. Composition of Earth's atmosphere (e.g., percent composition of oxygen and nitrogen)
   c. Atmospheric pressure and temperature
   d. Wind
   e. Cloud types and cloud formation
   f. Frontal systems, weather maps, storms, and severe weather
   g. Humidity, dew point, and frost point
   h. Forms of precipitation
2. Major factors that affect climate and seasons
   a. Climate zones (e.g., Tropics, Arctic)
   b. Proximity to mountains and oceans
   c. Global winds and ocean circulation
   d. Latitude, geographical location, and elevation
   e. Natural phenomena (e.g., volcanic eruptions)
   f. Human activity
   g. Effect of tilt of Earth's axis on seasons

E. Is familiar with astronomy

1. Major features of the solar system
   a. Structure of the solar system
   b. Characteristics of planets (e.g., composition, unique features)
   c. Characteristics of the Sun
   d. Asteroids and comets
   e. Theories of origin of the solar system
2. Interactions of the Earth-Moon-Sun system
   a. Earth's rotation and orbital revolution around the Sun
   b. Effect on seasons
   c. Phases of the Moon
   d. Effect on tides
   e. Eclipses
3. Major features of the universe and theories of its origins
   a. Galaxies
   b. Stars and their life cycle (e.g., types, nebulae, black holes)
   c. Units of celestial distance (e.g., light-year, astronomical unit)
   d. Theories of origin (e.g., Big Bang)
4. Contributions of space missions, exploration, and technology
   a. Remote-sensing devices (e.g., telescopes, satellites, space probes)
   b. Search for life and water on other planets

VI. Science, Technology, and Society

A. Understands the impact of science and technology on the environment and society

1. Air and water pollution
2. Greenhouse gases
3. Global climate and sea level change
4. Waste disposal
5. Acid rain
6. Loss of biodiversity
7. Ozone depletion

B. Knows major issues associated with energy production and the management of natural resources

1. Conservation and recycling
2. Renewable and nonrenewable energy resources
3. Pros and cons of power generation based on various sources (e.g., fossil, nuclear, water, wind, solar, biomass, geothermal)
4. Use and extraction of Earth's resources (e.g., mining, reclamation, deforestation)

C. Is familiar with applications of science and technology in daily life

1. Chemical properties of household products
2. Batteries, wireless devices, microchips, lasers, and fiber optics
3. Communication satellites
4. Contributions of space technology
5. Common agricultural practices (e.g., genetically modified crops, use of herbicides and insecticides)
6. DNA evidence in criminal investigations

D. Is familiar with the impact of science on public-health issues

1. Nutrition, disease, and medicine (e.g., food preservation, vitamins, vaccines, viruses)
2. Biotechnology (e.g., genetic engineering, *in vitro* fertilization)
3. Medical technologies (e.g., MRIs, X-rays, radiation therapy)

2. Familiarize Yourself with Test Questions

Become comfortable with the types of questions you'll find on the Praxis *tests*

The *Praxis* assessments include a variety of question types: constructed response (for which you write a response of your own); selected response, for which you select one or more answers from a list of choices or make another kind of selection (e.g., by clicking on a sentence in a text or by clicking on part of a graphic); and numeric entry, for which you enter a numeric value in an answer field. You may be familiar with these question formats from taking other standardized tests. If not, familiarize yourself with them so you don't spend time during the test figuring out how to answer them.

Understanding Computer-Delivered Questions

Questions on computer-delivered tests are interactive in the sense that you answer by selecting an option or entering text on the screen. If you see a format you are not familiar with, read the directions carefully. The directions always give clear instructions on how you are expected to respond.

For most questions, you respond by clicking an oval to select a single answer from a list of answer choices.

However, interactive question types may also ask you to respond by:

- **Clicking more than one oval** to select answers from a list of answer choices.
- **Typing in an entry box.** When the answer is a number, you may be asked to enter a numerical answer. Some questions may have more than one place to enter a response.
- **Clicking check boxes.** You may be asked to click check boxes instead of an oval when more than one choice within a set of answers can be selected.
- **Clicking parts of a graphic.** In some questions, you will select your answers by clicking on a location (or locations) on a graphic such as a map or chart, as opposed to choosing your answer from a list.
- **Clicking on sentences.** In questions with reading passages, you may be asked to choose your answers by clicking on a sentence (or sentences) within the reading passage.
- **Dragging and dropping answer choices into targets on the screen.** You may be asked to select answers from a list of choices and drag your answers to the appropriate location in a table, paragraph of text or graphic.
- **Selecting answers from a drop-down menu.** You may be asked to choose answers by selecting choices from a drop-down menu (e.g., to complete a sentence).

Remember that with every question you will get clear instructions.

Perhaps the best way to understand computer-delivered questions is to view the Computer-delivered Testing Demonstration on the Praxis web site to learn how a computer-delivered test works and see examples of some types of questions you may encounter.

Understanding Selected-Response Questions

Many selected-response questions begin with the phrase "which of the following." Take a look at this example:

Which of the following is a flavor made from beans?

(A) Strawberry

(B) Cherry

(C) Vanilla

(D) Mint

How would you answer this question?

All of the answer choices are flavors. Your job is to decide which of the flavors is the one made from beans.

Try following these steps to select the correct answer.

1) **Limit your answer to the choices given.** You may know that chocolate and coffee are also flavors made from beans, but they are not listed. Rather than thinking of other possible answers, focus only on the choices given ("which of the following").

2) **Eliminate incorrect answers.** You may know that strawberry and cherry flavors are made from fruit and that mint flavor is made from a plant. That leaves vanilla as the only possible answer.

3) **Verify your answer.** You can substitute "vanilla" for the phrase "which of the following" and turn the question into this statement: "Vanilla is a flavor made from beans." This will help you be sure that your answer is correct. If you're still uncertain, try substituting the other choices to see if they make sense. You may want to use this technique as you answer selected-response questions on the practice tests.

Try a more challenging example

The vanilla bean question is pretty straightforward, but you'll find that more challenging questions have a similar structure. For example:

Entries in outlines are generally arranged according to which of the following relationships of ideas?

(A) Literal and inferential

(B) Concrete and abstract

(C) Linear and recursive

(D) Main and subordinate

You'll notice that this example also contains the phrase "which of the following." This phrase helps you determine that your answer will be a "relationship of ideas" from the choices provided. You are supposed to find the choice that describes how entries, or ideas, in outlines are related.

Sometimes it helps to put the question in your own words. Here, you could paraphrase the question in this way: "How are outlines usually organized?" Since the ideas in outlines usually appear as main ideas and subordinate ideas, the answer is (D).

QUICK TIP: Don't be intimidated by words you may not understand. It might be easy to be thrown by words like "recursive" or "inferential." Read carefully to understand the question and look for an answer that fits. An outline is something you are probably familiar with and expect to teach to your students. So slow down, and use what you know.

Watch out for selected-response questions containing "NOT," "LEAST," and "EXCEPT"

This type of question asks you to select the choice that does not fit. You must be very careful because it is easy to forget that you are selecting the negative. This question type is used in situations in which there are several good solutions or ways to approach something, but also a clearly wrong way.

How to approach questions about graphs, tables, or reading passages

When answering questions about graphs, tables, or reading passages, provide only the information that the questions ask for. In the case of a map or graph, you might want to read the questions first, and then look at the map or graph. In the case of a long reading passage, you might want to go ahead and read the passage first, noting places you think are important, and then answer the questions. Again, the important thing is to be sure you answer the questions as they refer to the material presented. So read the questions carefully.

How to approach unfamiliar formats

New question formats are developed from time to time to find new ways of assessing knowledge. Tests may include audio and video components, such as a movie clip or animation, instead of a map or reading passage. Other tests may allow you to zoom in on details in a graphic or picture.

Tests may also include interactive questions. These questions take advantage of technology to assess knowledge and skills in ways that standard selected-response questions cannot. If you see a format you are not familiar with, **read the directions carefully**. The directions always give clear instructions on how you are expected to respond.

QUICK TIP: Don't make the questions more difficult than they are. Don't read for hidden meanings or tricks. There are no trick questions on *Praxis* tests. They are intended to be serious, straightforward tests of your knowledge.

Understanding Constructed-Response Questions

Constructed-response questions require you to demonstrate your knowledge in a subject area by creating your own response to particular topics. Essays and short-answer questions are types of constructed-response questions.

For example, an essay question might present you with a topic and ask you to discuss the extent to which you agree or disagree with the opinion stated. You must support your position with specific reasons and examples from your own experience, observations, or reading.

Take a look at a few sample essay topics:

- "Celebrities have a tremendous influence on the young, and for that reason, they have a responsibility to act as role models."
- "We are constantly bombarded by advertisements—on television and radio, in newspapers and magazines, on highway signs, and the sides of buses. They have become too pervasive. It's time to put limits on advertising."
- "Advances in computer technology have made the classroom unnecessary, since students and teachers are able to communicate with one another from computer terminals at home or at work."

Keep these things in mind when you respond to a constructed-response question

1) **Answer the question accurately.** Analyze what each part of the question is asking you to do. If the question asks you to describe or discuss, you should provide more than just a list.

2) **Answer the question completely.** If a question asks you to do three distinct things in your response, you should cover all three things for the best score. Otherwise, no matter how well you write, you will not be awarded full credit.

3) **Answer the question that is asked.** Do not change the question or challenge the basis of the question. You will receive no credit or a low score if you answer another question or if you state, for example, that there is no possible answer.

4) **Give a thorough and detailed response.** You must demonstrate that you have a thorough understanding of the subject matter. However, your response should be straightforward and not filled with unnecessary information.

5) **Reread your response.** Check that you have written what you thought you wrote. Be sure not to leave sentences unfinished or omit clarifying information.

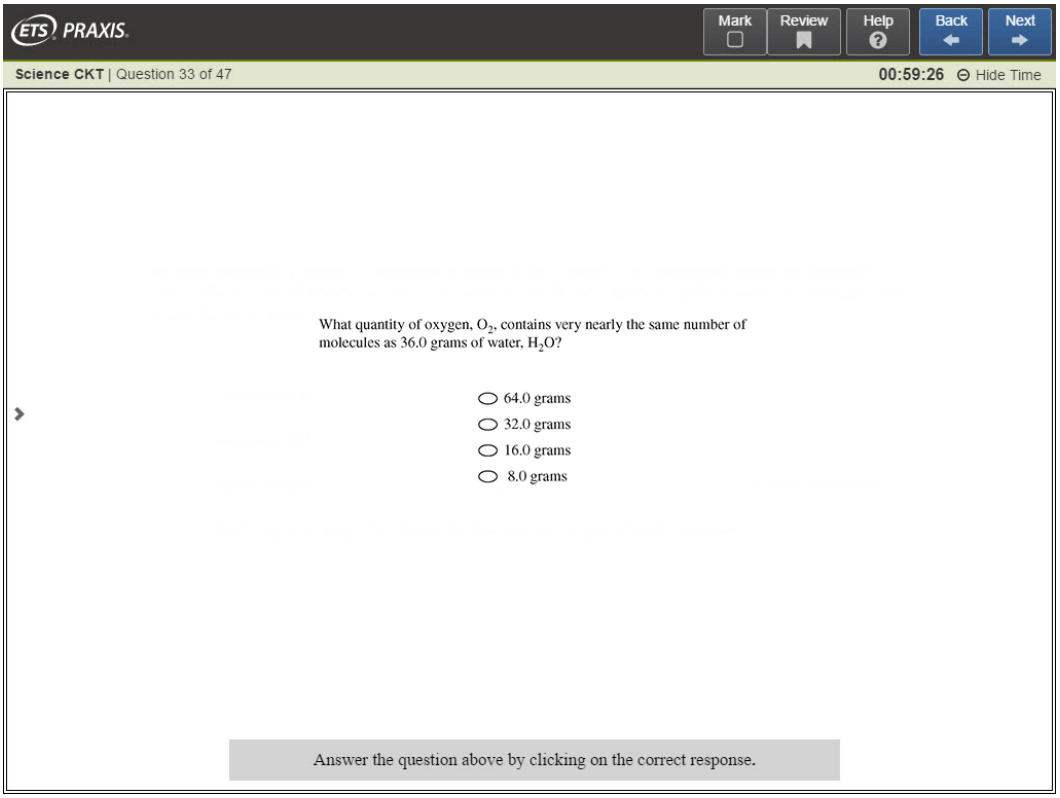
QUICK TIP: You may find that it helps to take notes on scratch paper so that you don't miss any details. Then you'll be sure to have all the information you need to answer the question.

3. Practice with Sample Test Questions

Answer practice questions and find explanations for correct answers

Computer Delivery

This test is available via computer delivery. To illustrate what the computer-delivered test looks like, the following sample question shows an actual screen used in a computer-delivered test. For the purposes of this guide, sample questions are provided as they would appear in a paper-delivered test.



Sample Test Questions

The sample questions that follow illustrate the types of questions in the test. They are not, however, representative of the entire scope of the test in either content or difficulty. Answers with explanations follow the questions.

Directions: Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one that is best in each case.

1. A student performed an experiment to determine the effect of temperature and light on the feeding behavior of *Daphnia magna*. The student placed 25 *Daphnia* in each of two identical glass bowls and then placed one bowl in a sunny, warm window and the other in a cooler, dark closet. The student measured the amount of food consumed in one week. Which of the following is the major flaw in this experiment?
   (A) Each *Daphnia* should have its own tank.
   (B) The length of the experiment is too long.
   (C) There are too many independent variables.
   (D) The sample size is too large.

2. A car traveling along a straight, level road at $10\ m/s$ uniformly increases its speed to $25\ m/s$ in $3\ s$. What is the magnitude of the acceleration of the car?
   (A) $3\ m/s^2$
   (B) $5\ m/s^2$
   (C) $10\ m/s^2$
   (D) $15\ m/s^2$

3. A sample of a material was collected from the surface of a pond. Which of the following characteristics will most clearly suggest that the material is alive?
   (A) The material is composed of dividing cells.
   (B) The material contains water and minerals.
   (C) The material is green in color.
   (D) The material includes a radioactive isotope of carbon.

4. Earth's surface is constantly changing as a result of processes such as tectonic activity, erosion, and deposition. Which of the following is the major agent of erosion on Earth's surface?
   (A) Ice
   (B) Running water
   (C) Wave action
   (D) Wind

5. Aluminum reacts with oxygen to form a white solid. Which of the following best describes the solid?
   (A) It is an alloy.
   (B) It is a compound.
   (C) It is an element.
   (D) It is a heterogeneous mixture of elements.

6. Which THREE of the following elements are metals?
   (A) Cs
   (B) V
   (C) Sr
   (D) I

7. If the skin cells of a man contain 46 chromosomes, how many chromosomes are in a sperm cell he produces?
   (A) 11
   (B) 23
   (C) 46
   (D) 92

8. An area near a convergent plate boundary is prone to which of the following?
   (A) Droughts
   (B) Tornadoes
   (C) Hurricanes
   (D) Earthquakes

9. Of the following, which is a greenhouse gas that is found in Earth's atmosphere?

   (A) Carbon dioxide
   (B) Hydrogen
   (C) Nitrogen
   (D) Radon

Nut Type	Average Calories per Nut
1	15,700
2	20,200
3	11,900

10. An experiment on squirrel food sources was conducted. Data on three nut types, which are all approximately the same size without the shells, are shown above. Which of the following statements is consistent with the data?

    (A) Nut type 2 is denser than types 1 or 3.
    (B) Nut type 2 is the most efficient source of energy.
    (C) Nut type 2 is more abundant than types 1 or 3.
    (D) Nut type 2 is most attractive to squirrels.

11. Newton's second law of motion is concerned with which of the following quantities?

    (A) Velocity and mass
    (B) Acceleration and time
    (C) Force, velocity, and time
    (D) Force, acceleration, and mass

12. The structure of a DNA molecule is most similar to which of the following?

    (A) A twisted ladder
    (B) An apple sliced in half
    (C) A leafy tree
    (D) A rectangular box without a lid

13. Fossil A is several layers above fossil B in a series of undisturbed sedimentary layers. Paleontologists use which of the following principles to determine that fossil A is younger than fossil B?

    (A) Superposition
    (B) Uniformitarianism
    (C) Natural selection
    (D) Uncertainty principle

14. A $4.0\ \text{kg}$ piece of metal absorbs $64.0\ \text{kJ}$ of heat, increasing in temperature from $20°\text{C}$ to $100°\text{C}$. How much heat is needed to increase the temperature of a $2.0\ \text{kg}$ piece of this same metal from $20°\text{C}$ to $100°\text{C}$?

    (A) $128\ \text{kJ}$
    (B) $64\ \text{kJ}$
    (C) $32\ \text{kJ}$
    (D) $16\ \text{kJ}$

15. The number of atoms contained in $12\ \text{g}$ of carbon is

    (A) 1
    (B) 12
    (C) 22.4
    (D) 6.02×10^{23}

16. Which of the following is the typical representation of a homozygous recessive genotype for a diploid organism?

    (A) a
    (B) aa
    (C) Aa
    (D) AA

17. Of the following statements, which best describes an atoll?
    (A) A flat area of the seafloor beyond the continental slope
    (B) A long, narrow island that runs parallel to the mainland
    (C) A coral reef or coral island surrounding a lagoon
    (D) A seamount that has been eroded to the seafloor by waves

18. Petroleum, natural gas, and coal are examples of
    (A) biomass
    (B) fossil fuels
    (C) carbohydrates
    (D) renewable resources

19. Which of the following scientists first proposed the theory that the members of a species who are best adapted to their environment will produce the most offspring?
    (A) Louis Pasteur
    (B) Gregor Mendel
    (C) Robert Hooke
    (D) Charles Darwin

20. Which of the following relates the electrostatic force between two charges to the distance separating the charges?
    (A) Newton's law of universal gravitation
    (B) Avogadro's law
    (C) Coulomb's law
    (D) Ohm's law

21. Which of the following marine organisms is a vertebrate?
    (A) Coral
    (B) Eel
    (C) Sea star
    (D) Shrimp

22. Which of the following is a true statement about tornadoes?
    (A) They typically form along weather fronts.
    (B) They usually form over warm water.
    (C) They often cause severe flooding.
    (D) They occur most frequently in the winter.

23. Which of the following is an isotope of $^{13}_{6}C$?
    (A) $^{13}_{5}B$
    (B) $^{12}_{6}C$
    (C) $^{13}_{7}N$
    (D) $^{26}_{13}Al$

24. Which of the following equations represents a combustion reaction?
    (A) $2\ O_3 \rightarrow 3\ O_2$
    (B) $H_2SO_4 + 2\ NaOH \rightarrow Na_2SO_4 + 2\ H_2O$
    (C) $2\ HCl + Fe \rightarrow FeCl_2 + H_2$
    (D) $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

25. Which TWO of the following statements about the vascular system in plants are correct?
    (A) Vascular tissue is found in all plants.
    (B) Vascular tissue extends from the plant roots through the stems to the leaves.
    (C) Xylem carries water and minerals, and phloem carries sugars.
    (D) Phloem carries water and minerals, and xylem carries sugars.

26. During a total solar eclipse, when the Moon completely covers the disk of the Sun, which of the following can most easily be seen?
    (A) Core
    (B) Photosphere
    (C) Sunspots
    (D) Corona

27. Which of the following diseases is most directly linked with obesity?

    (A) Lung cancer
    (B) Alzheimer's disease
    (C) Type 2 diabetes
    (D) Rheumatoid arthritis

28. Which of the following properties of light determines the color of an opaque object?

    (A) Refraction
    (B) Polarization
    (C) Transmission
    (D) Reflection

29. In humans, which of the following hormones most directly controls the level of blood sugar?

    (A) Growth hormone
    (B) Insulin
    (C) Melatonin
    (D) Testosterone

30. At $25°C$, an acidic solution could have which of the following pH values?

    (A) 4.0
    (B) 7.0
    (C) 8.0
    (D) 10.0

31. Which of the following representations best shows energy flow among the organisms of a community that includes autotrophs, heterotrophs, omnivores, and carnivores?

    (A) Energy pyramid
    (B) Food chain
    (C) Food web
    (D) Nutrient cycle

Answers to Sample Questions

1. The correct answer is (C). The student manipulated two variables (the amount of light and temperature) during the experiment. As a result, the student cannot determine the individual effect of either temperature or light on the feeding behavior of the *Daphnia*. To improve the experimental plan, the student should have varied the amount of light at a constant temperature or varied the temperature while keeping the amount of light constant.

2. The correct answer is (B). Acceleration is the change in speed per unit of time. The change in speed of the car is equal to $25 \text{ m/s} - 10 \text{ m/s} = 15 \text{ m/s}$, and the time is 3 s. The acceleration is $15 \text{ m/s} \div 3 \text{ s} = 5 \text{ m/s}^2$.

3. The correct answer is (A). If the material is composed of dividing cells, then it is alive. Cells are the smallest units of life that can replicate independently.

4. The correct answer is (B). Running water is the major agent of erosion on Earth's surface. Runoff and streams carry sediments from higher elevation to lower elevation.

5. The correct answer is (B). Aluminum (Al) reacts with oxygen (O_2) to form aluminum oxide (Al_2O_3), a compound. A compound is a substance that is composed of two or more elements chemically bonded.

6. The correct answers are (A), (B), and (C). Cs, V, and Sr are metals. Elements in columns one and two on the periodic table are metals, and elements in columns three through twelve are transition metals. The element I is a nonmetal. The elements in column 17 are all nonmetals.

7. The correct answer is (B). A human skin cell is diploid ($2n = 46$), which means that it contains two complete sets of chromosomes, one from each parent. A sperm cell is haploid ($n = 23$); it contains one set of chromosomes from the male individual.

8. The correct answer is (D). Areas near a convergent plate boundary are prone to earthquakes. Stress causes deformation of rocks, and earthquakes occur whenever there is sudden movement along a fault and energy is released. Many of the world's largest earthquakes occur along the Ring of Fire, where, in general, the Pacific Plate is being subducted under other plates.

9. The correct answer is (A). Carbon dioxide is a greenhouse gas in Earth's atmosphere, but hydrogen, nitrogen, and radon are not.

10. The correct answer is (B). A calorie is a unit of energy. Therefore, nut type 2 contains more energy per nut and is the most efficient source of energy. Although the statements in (A), (C), and (D) may be true, the data do not support the statements.

11. The correct answer is (D). Based on Newton's second law of motion, the force F acting on an object is equal its mass m multiplied by its acceleration a. It is represented by the equation $F = ma$.

12. The correct answer is (A). DNA is made of two strands of nucleotides. Each nucleotide has a phosphate group and deoxyribose that make up the sides of the ladder, and a nitrogenous base that is complementary to a base on the other strand. The pairs of complementary bases make up the rungs of the ladder. The ladder forms a double helical structure.

13. The correct answer is (A). According to the principle of superposition, in a series of undisturbed sedimentary rock layers, the younger rock layers overlie the older rock layers; thus fossil A is younger than fossil B.

14. The correct answer is (C). The amount of heat absorbed or lost by a sample of a pure substance is $q = mc\Delta T$, where m is the mass of the sample, c is the specific heat capacity, and ΔT is the change in temperature. Based on the equation, if the mass of the piece of metal is one-half the first piece, then one-half the amount of heat is needed to increase its temperature by the same amount.

15. The correct answer is (D). Twelve grams of carbon is equal to one mole of carbon. The number of atoms in one mole of an element is equal to Avogadro's number, 6.02×10^{23}. Thus, 12 g of carbon contains 6.02×10^{23} atoms of carbon.

16. The correct answer is (B). A genotype that is homozygous contains two alleles of the same type. A dominant allele is typically represented by an uppercase italicized letter, and a recessive allele is typically represented by a lowercase italicized letter.

17. The correct answer is (C). An atoll is a coral reef or coral island surrounding a lagoon. A coral reef grows around a volcanic island, and the extinct volcano erodes or subsides below the surface of the warm ocean waters, resulting in an atoll.

18. The correct answer is (B). Petroleum, natural gas, and coal are fossil fuels. They were formed by natural processes over a very long period from the buried remains of organisms. They are considered to be nonrenewable resources because they cannot be replenished as quickly as they are used.

19. The correct answer is (D). The idea of natural selection as a mechanism of evolution was first proposed by Charles Darwin. The members of a species who are best adapted to the environment are likely to have a survival advantage and thus produce more offspring over their lifetimes than other members who do not live as long.

20. The correct answer is (C). Coulomb's law is $F = k\frac{q_1 q_2}{r^2}$, where F is the electrostatic force between two charges q_1 and q_2, and r is the distance between the two charges. F is attractive if the charges have opposite signs and repulsive if the charges have the same sign.

21. The correct answer is (B). An eel, a type of bony fish, has a vertebral column and a spinal cord. Corals, sea stars, and shrimp are invertebrates.

22. The correct answer is (A). Tornadoes usually form along weather fronts where two air masses meet and certain wind conditions cause air to rotate.

23. The correct answer is (B). Isotopes of an element have the same number of protons but a different number of neutrons. The sum of the number of protons and neutrons is equal to the mass number. ${}^{13}_{6}C$ has six protons and 7 neutrons. Its isotope ${}^{12}_{6}C$ has 6 protons and 6 neutrons.

24. The correct answer is (D). A combustion reaction is the exothermic reaction of a substance with an oxidizer, such as oxygen (O_2). Combustion reactions of oxygen with hydrocarbons like C_3H_8 produce carbon dioxide and water.

25. The correct answers are (B) and (C). Vascular tissue, which includes the xylem and the phloem, extends from the plant roots through the stems to the leaves. The xylem carries water and minerals from the roots to the leaves. The phloem carries sugars from the leaves to the roots. Nonvascular plants, such as mosses, lack vascular tissue.

26. The correct answer is (D). The Sun's corona has extremely low density and is much dimmer than the Sun's surface. Consequently, it is visible only during a total solar eclipse, when the Moon completely covers the disk of the Sun, or by using a coronagraph.

27. The correct answer is (C). Type 2 diabetes is a metabolic disease that is characterized by high blood-sugar levels. The disease is usually caused by insulin resistance in the cells of the body, but it can also be caused by a lack of insulin. It typically develops in adults, particularly those who are overweight and not physically active.

28. The correct answer is (D). An object is opaque when light does not pass through it. Some wavelengths of light are absorbed, while others are reflected. The color of the object is determined by the wavelengths of the reflected light.

29. The correct answer is (B). Insulin is a hormone secreted by cells of the pancreas to help regulate the level of sugar in the blood. The regulation of the blood–sugar level by insulin and glucagon is an example of homeostasis.

30. The correct answer is (A). The pH scale ranges from 0 to 14. A solution that is acidic has a pH less than 7 at $25°C$. A basic solution has a pH greater than 7.

31. The correct answer is (C). A food web best represents the energy flow in a community. A food web can include more than one species at higher levels. A food chain typically includes a single species at each level. Autotrophs are organisms that produce their own food through photosynthesis or chemosynthesis. Heterotrophs obtain their energy by consuming other organisms and can be herbivores, carnivores, or omnivores.

4. Determine Your Strategy for Success

Set clear goals and deadlines so your test preparation is focused and efficient

Effective *Praxis* test preparation doesn't just happen. You'll want to set clear goals and deadlines for yourself along the way. Otherwise, you may not feel ready and confident on test day.

1) Learn what the test covers.

You may have heard that there are several different versions of the same test. It's true. You may take one version of the test and your friend may take a different version a few months later. Each test has different questions covering the same subject area, but both versions of the test measure the same skills and content knowledge.

You'll find specific information on the test you're taking on page 5, which outlines the content categories that the test measures and what percentage of the test covers each topic. Visit www.ets.org/praxis/testprep for information on other *Praxis* tests.

2) Assess how well you know the content.

Research shows that test takers tend to overestimate their preparedness—this is why some test takers assume they did well and then find out they did not pass.

The *Praxis* tests are demanding enough to require serious review of likely content, and the longer you've been away from the content, the more preparation you will most likely need. If it has been longer than a few months since you've studied your content area, make a concerted effort to prepare.

3) Collect study materials.

Gathering and organizing your materials for review are critical steps in preparing for the *Praxis* tests. Consider the following reference sources as you plan your study:

- Did you take a course in which the content area was covered? If yes, do you still have your books or your notes?
- Does your local library have a high school-level textbook in this area? Does your college library have a good introductory college-level textbook in this area?

Practice materials are available for purchase for many *Praxis* tests at www.ets.org/praxis/testprep. Test preparation materials include sample questions and answers with explanations.

4) Plan and organize your time.

You can begin to plan and organize your time while you are still collecting materials. Allow yourself plenty of review time to avoid cramming new material at the end. Here are a few tips:

- Choose a test date far enough in the future to leave you plenty of preparation time. Test dates can be found at www.ets.org/praxis/register/dates_centers.
- Work backward from that date to figure out how much time you will need for review.
- Set a realistic schedule—and stick to it.

5) Practice explaining the key concepts.

Praxis tests with constructed-response questions assess your ability to explain material effectively. As a teacher, you'll need to be able to explain concepts and processes to students in a clear, understandable way. What are the major concepts you will be required to teach? Can you explain them in your own words accurately, completely, and clearly? Practice explaining these concepts to test your ability to effectively explain what you know.

6) Understand how questions will be scored.

Scoring information can be found on page 47.

7) Develop a study plan.

A study plan provides a road map to prepare for the *Praxis* tests. It can help you understand what skills and knowledge are covered on the test and where to focus your attention. Use the study plan template on page 30 to organize your efforts.

And most important—get started!

Would a Study Group Work for You?

Using this guide as part of a study group

People who have a lot of studying to do sometimes find it helpful to form a study group with others who are working toward the same goal. Study groups give members opportunities to ask questions and get detailed answers. In a group, some members usually have a better understanding of certain topics, while others in the group may be better at other topics. As members take turns explaining concepts to one another, everyone builds self-confidence.

If the group encounters a question that none of the members can answer well, the group can go to a teacher or other expert and get answers efficiently. Because study groups schedule regular meetings, members study in a more disciplined fashion. They also gain emotional support. The group should be large enough so that multiple people can contribute different kinds of knowledge, but small enough so that it stays focused. Often, three to six members is a good size.

Here are some ways to use this guide as part of a study group:

- **Plan the group's study program.** Parts of the study plan template, beginning on page 30, can help to structure your group's study program. By filling out the first five columns and sharing the worksheets, everyone will learn more about your group's mix of abilities and about the resources, such as textbooks, that members can share with the group. In the sixth column ("Dates I will study the content"), you can create an overall schedule for your group's study program.
- **Plan individual group sessions.** At the end of each session, the group should decide what specific topics will be covered at the next meeting and who will present each topic. Use the topic headings and subheadings in the Test at a Glance table on page 5 to select topics, and then select practice questions, beginning on page 18.
- **Prepare your presentation for the group.** When it's your turn to present, prepare something that is more than a lecture. Write two or three original questions to pose to the group. Practicing writing actual questions can help you better understand the topics covered on the test as well as the types of questions you will encounter on the test. It will also give other members of the group extra practice at answering questions.

- **Take a practice test together.** The idea of a practice test is to simulate an actual administration of the test, so scheduling a test session with the group will add to the realism and may also help boost everyone's confidence. Remember, complete the practice test using only the time that will be allotted for that test on your administration day.
- **Learn from the results of the practice test.** Review the results of the practice test, including the number of questions answered correctly in each content category. For tests that contain constructed-response questions, look at the Sample Test Questions section, which also contain sample responses to those questions and shows how they were scored. Then try to follow the same guidelines that the test scorers use.
- **Be as critical as you can.** You're not doing your study partner(s) any favors by letting them get away with an answer that does not cover all parts of the question adequately.
- **Be specific.** Write comments that are as detailed as the comments about the sample responses. Indicate where and how your study partner(s) are doing an inadequate job of answering the question. Writing notes in the margins of the answer sheet may also help.
- **Be supportive.** Include comments that point out what your study partner(s) got right.

Then plan one or more study sessions based on aspects of the questions on which group members performed poorly. For example, each group member might be responsible for rewriting one paragraph of a response in which someone else did an inadequate job.

Whether you decide to study alone or with a group, remember that the best way to prepare is to have an organized plan. The plan should set goals based on specific topics and skills that you need to learn, and it should commit you to a realistic set of deadlines for meeting those goals. Then you need to discipline yourself to stick with your plan and accomplish your goals on schedule.

5. Develop Your Study Plan

Develop a personalized study plan and schedule

Planning your study time is important because it will help ensure that you review all content areas covered on the test. Use the sample study plan below as a guide. It shows a plan for the *Core Academic Skills for Educators: Reading* test. Following that is a study plan template that you can fill out to create your own plan. Use the "Learn about Your Test" and "Test Specifications" information beginning on page 5 to help complete it.

Use this worksheet to:
1. **Define Content Areas:** List the most important content areas for your test as defined in chapter 1.
2. **Determine Strengths and Weaknesses:** Identify your strengths and weaknesses in each content area.
3. **Identify Resources:** Identify the books, courses, and other resources you plan to use for each content area.
4. **Study:** Create and commit to a schedule that provides for regular study periods.

Praxis Test Name (Test Code): Core Academic Skills for Educators: Reading (5712)
Test Date: 9/15/15

Content covered	Description of content	How well do I know the content? (scale 1–5)	What resources do I have/need for the content?	Where can I find the resources I need?	Dates I will study the content	Date completed
Key Ideas and Details						
Close reading	Draw inferences and implications from the directly stated content of a reading selection	3	Middle school English textbook	College library, middle school teacher	7/15/15	7/15/15
Determining Ideas	Identify summaries or paraphrases of the main idea or primary purpose of a reading selection	3	Middle school English textbook	College library, middle school teacher	7/17/15	7/17/15
Determining Ideas	Identify summaries or paraphrases of the supporting ideas and specific details in a reading selection	3	Middle and high school English textbook	College library, middle and high school teachers	7/20/15	7/21/15
Craft, Structure, and Language Skills						
Interpreting tone	Determine the author's attitude toward material discussed in a reading selection	4	Middle and high school English textbook	College library, middle and high school teachers	7/25/15	7/26/15
Analysis of structure	Identify key transition words and phrases in a reading selection and how they are used	3	Middle and high school English textbook, dictionary	College library, middle and high school teachers	7/25/15	7/27/15
Analysis of structure	Identify how a reading selection is organized in terms of cause/effect, compare/contrast, problem/solution, etc.	5	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/1/15	8/1/15
Author's purpose	Determine the role that an idea, reference, or piece of information plays in an author's discussion or argument	5	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/1/15	8/1/15

(continued on next page)

Content covered	Description of content	How well do I know the content? (scale 1–5)	What resources do I have/need for the content?	Where can I find the resources I need?	Dates I will study the content	Date completed
Language in different contexts	Determine whether information presented in a reading selection is presented as fact or opinion	4	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/1/15	8/1/15
Contextual meaning	Identify the meanings of words as they are used in the context of a reading selection	2	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/1/15	8/1/15
Figurative Language	Understand figurative language and nuances in word meanings	2	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/8/15	8/8/15
Vocabulary range	Understand a range of words and phrases sufficient for reading at the college and career readiness level	2	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/15/15	8/17/15
Integration of Knowledge and Ideas						
Diverse media and formats	Analyze content presented in diverse media and formats, including visually and quantitatively, as well as in words	2	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/22/15	8/24/15
Evaluation of arguments	Identify the relationship among ideas presented in a reading selection	4	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/24/15	8/24/15
Evaluation of arguments	Determine whether evidence strengthens, weakens, or is relevant to the arguments in a reading selection	3	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/27/15	8/27/15
Evaluation of arguments	Determine the logical assumptions upon which an argument or conclusion is based	5	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/28/15	8/30/15
Evaluation of arguments	Draw conclusions from material presented in a reading selection	5	High school textbook, college course notes	College library, course notes, high school teacher, college professor	8/30/15	8/31/15
Comparison of texts	Recognize or predict ideas or situations that are extensions of or similar to what has been presented in a reading selection	4	High school textbook, college course notes	College library, course notes, high school teacher, college professor	9/3/15	9/4/15
Comparison of texts	Apply ideas presented in a reading selection to other situations	2	High school textbook, college course notes	College library, course notes, high school teacher, college professor	9/5/15	9/6/15

My Study Plan

Use this worksheet to:

1. **Define Content Areas:** List the most important content areas for your test as defined in chapter 1.
2. **Determine Strengths and Weaknesses:** Identify your strengths and weaknesses in each content area.
3. **Identify Resources:** Identify the books, courses, and other resources you plan to use for each content area.
4. **Study:** Create and commit to a schedule that provides for regular study periods.

Praxis Test Name (Test Code): _____

Test Date: _____

Content covered	Description of content	How well do I know the content? (scale 1–5)	What resources do I have/need for this content?	Where can I find the resources I need?	Dates I will study this content	Date completed

(continued on next page)

Content covered	Description of content	How well do I know the content? (scale 1–5)	What resources do I have/need for the content?	Where can I find the resources I need?	Dates I will study the content	Date completed

6. Study Topics

Detailed study topics with questions for discussion

Using the Study Topics That Follow

The Middle School Science test is designed to measure the knowledge and skills necessary for a beginning teacher.

This chapter is intended to help you organize your preparation for the test and to give you a clear indication of the depth and breadth of the knowledge required for success on the test.

Virtually all accredited programs address the topics covered by the test; however, you are not expected to be an expert on all aspects of the topics that follow.

You are likely to find that the topics below are covered by most introductory textbooks. Consult materials and resources, including lecture and laboratory notes, from all your coursework. You should be able to match up specific topics and subtopics with what you have covered in your courses.

Try not to be overwhelmed by the volume and scope of content knowledge in this guide. Although a specific term may not seem familiar as you see it here, you might find you can understand it when applied to a real-life situation. Many of the items on the actual test will provide you with a context to apply to these topics or terms.

Discussion Areas

Interspersed throughout the study topics are discussion areas, presented as open-ended questions or statements. These discussion areas are intended to help test your knowledge of fundamental concepts and your ability to apply those concepts to situations in the classroom or the real world. Most of the areas require you to combine several pieces of knowledge to formulate an integrated understanding and response. If you spend time on these areas, you will gain increased understanding and facility with the subject matter covered on the test. You may want to discuss these areas and your answers with a teacher or mentor.

Note that this study companion *does **not** provide answers for the discussion area questions*, but thinking about the answers to them will help improve your understanding of fundamental concepts and will probably help you answer a broad range of questions on the test.

Study Topics

An overview of the areas covered on the test, along with their subareas, follows.

I. Scientific Inquiry, Methodology, Techniques, and History

A. Understands methods of scientific inquiry and how they are used in basic problem solving

1. Observations, hypotheses, experiments, conclusions, theories, models, and laws
2. Experimental design, including independent and dependent variables, controls, and sources of error
3. Nature of scientific knowledge
   a. subject to change, consistent with evidence, based on reproducible evidence
   b. includes unifying concepts and processes (e.g., systems, models, constancy and change, equilibrium, form and function)

B. Understands the processes involved in scientific data collection and manipulation

1. Common units of measurement, including prefixes such as milli and kilo (e.g., units of length, time, mass, volume, pressure, energy, force)
2. Scientific notation and significant figures
3. Organization and presentation of data (e.g., graphs, tables, charts)
4. Basic error analysis (e.g., accuracy, precision)
5. Basic descriptive statistics (e.g., calculate averages, distinguish between mean, mode, and median)

C. Knows how to interpret and draw conclusions from data presented in tables, graphs, and charts

1. Trends in data
2. Relationships between variables
3. Predictions based on data
4. Drawing conclusions based on evidence

D. Is familiar with the procedures for safe and correct preparation, storage, use, and disposal of laboratory materials

1. Safe storage
2. Proper and safe disposal (e.g., chemicals, biohazards)
3. Proper preparation
4. Use of equipment such as fume hoods

E. Understands safety and emergency procedures in the laboratory

1. Equipment (e.g., eyewash stations, safety showers)
2. Appropriate student apparel and behavior (e.g., goggles, clothing)
3. Emergency procedures for minor burns and other injuries
4. Emergency procedures for mishaps (e.g., fires, chemical spills)
5. Evacuation procedures

F. Is familiar with how to use standard equipment in the laboratory

1. Appropriate use of equipment (e.g., thermometers, microscopes, barometers, graduated cylinders, Bunsen burners, balances, pH meters)
2. Basic care, preparation, and maintenance of equipment

G. Is familiar with the historical developments of science and the contributions of major historical figures

1. How major concepts developed over time (e.g., atomic models, genetics, plate tectonics)
2. Key historical figures and their contributions

Discussion areas: Scientific Inquiry, Methodology, Techniques, and History

- What is a scientific hypothesis?
- 1×10^{-3} gram is equal to how many kilograms?
- What is the area, to the correct number of significant figures, of a rectangle having a width of 2 cm and a length of 6.7 cm
- Describe how to prepare 500 mL of 5 M NaCl solution. What safety precautions should be taken when preparing this solution?
- What is a graduated cylinder typically used for?
- Who is largely credited with developing the theory of continental drift? Why was the theory initially rejected by many scientists?

II. Basic Principles of Matter and Energy

A. Is familiar with the structure and properties of matter

1. Solids, liquids, gases, and plasmas
2. Elements, atoms, compounds, molecules, and mixtures
3. Occurrence and abundance of the elements and their isotopes

B. Knows the basic relationships between energy and matter

1. Conservation of energy (first law of thermodynamics)
2. Entropy changes (second law of thermodynamics)
3. Conservation of matter in chemical systems
4. Forms of kinetic and potential energy (thermal, chemical, radiant, mechanical)
5. Chemical and physical properties/changes
6. Temperature scales (e.g., Celsius, Fahrenheit, and Kelvin; comparisons and conversions between the scales)
7. Effect of thermal energy on matter and the measurement of thermal energy (e.g., specific heat capacity, joules)
8. Methods of heat transfer (e.g., convection, radiation, conduction)
9. Interdisciplinary applications of energy and matter relationships
   a. trophic levels
   b. matter cycling and energy flow in ecosystems
   c. convection currents in atmosphere, ocean, and mantle
   d. conservation of mass in the rock cycle
   e. nitrogen cycle
   f. chemical and physical changes in rocks
   g. impact of solar radiation on Earth and life
   h. photosynthesis and cellular respiration
   i. energy transformations in living systems

C. Knows the basic structure of the atom

1. Atomic models
2. Atomic structure including electrons, protons, and neutrons
3. Atomic number and mass
4. Ions
5. Electron arrangements
6. Radioisotopes, radioactive decay, half-life, fusion, and fission
7. Applications of radioactivity (e.g., carbon dating, evidence for evolution, medical imaging)

Discussion areas: Basic Principles of Matter and Energy

- How are solids different from liquids?
- What is the most common isotope of carbon?
- When a reaction in solution produces energy, what happens to the temperature of the solution?
- What entropy changes occur when a substance changes from a liquid to a gas?
- What energy change occurs to a mass that starts from rest and slides from the top to the bottom of an inclined plane in the absence of friction? What additional energy changes occur when there is friction between the mass and the inclined plane?
- How are physical changes in a substance different from chemical changes?
- How much energy is needed to heat 100 g of water at 20°C to a temperature of 30°C ?
- How many neutrons are in ${}^{14}_{6}C$?
- What are the three most common types of radioactive decay?
- If a sample that initially contains 100 g of a radioactive isotope that has a half-life of 2 days, how much of the isotope remains after 6 days?

III. Physical Sciences

A. Physics

1. Understands mechanics
   a. describe linear and circular motion in one and two dimensions
      – speed
      – velocity
      – acceleration
      – momentum
   b. Newton's first law: inertia
   c. friction
   d. work, energy, and power
   e. mass, weight, and gravity
      – characteristics of gravitation (e.g., gravitational attraction, acceleration due to gravity, mass, distance)
      – distinguish between mass and weight

f. Analyze motion and forces in a physical situation, including basic problems
   - Newton's second law: $F = ma$
   - Newton's third law: action-reaction forces
   - inclined planes
   - collisions
   - projectile motion
   - periodic motion (e.g., pendulums, springs, planetary orbits)
   - conservation of energy and conservation of momentum

g. simple machines and mechanical advantage

h. physical properties of fluids (e.g., buoyancy, density, pressure)

2. Knows electricity and magnetism

a. electrical nature of materials
   - electric charges
   - electrostatic attraction and repulsion
   - conductivity, conductors, and insulators

b. analyze basic series and parallel electrical circuits
   - DC and AC current
   - current, resistance, voltage, and power
   - Ohm's law
   - voltage sources (e.g., batteries, generators)

c. magnetic fields and forces
   - magnetic materials
   - magnetic forces and fields (e.g., magnetic poles, attractive and repulsive forces)
   - electromagnets

3. Understands basic waves and optics

a. characteristics of light and the electromagnetic spectrum
   - nature of light
   - visible spectrum and color
   - ultraviolet, infrared, microwave, and gamma

b. basic characteristics and types of waves
   - transverse and longitudinal
   - frequency, amplitude, wavelength, speed, intensity

c. basic wave phenomena
   - reflection, refraction, diffraction, and dispersion
   - absorption and transmission
   - interference, scattering, and polarization
   - Doppler effect

d. basic characteristics and phenomena of sound
   - pitch/frequency and loudness/intensity
   - sound-wave production, air vibrations, and resonance (e.g., tuning forks)

e. basic optics
   - mirrors
   - lenses and their applications (e.g., the human eye, microscope, telescope)
   - prisms
   - fiber optics

Discussion areas: Physics

- Draw a velocity-versus-time graph for an object moving with constant acceleration.
- If the speed of an object is doubled, by what factor does its kinetic energy change?
- Which requires more work: lifting a 100 kg sack a vertical distance of 2 m or lifting a 50 kg sack a vertical distance of 4 m?
- Does mass affect the acceleration of a falling object?
- If the distance between two masses is doubled, what happens to the gravitational force between the two masses?
- In the absence of air resistance, what is the only force acting on projectile?
- What variables affect the period of a pendulum?
- When a moving object collides with an object at rest, is it possible for both objects to be at rest after the collision?
- What type of simple machine is a wheelbarrow?
- What affects the buoyant force acting on an object?
- If the distance between two charges is halved, what happens to the electrostatic force between the two charges?
- What is the current flowing through a $10\ \Omega$ resistor that is connected in series to a 50 V source?
- Which circuit has the larger equivalent resistance: a circuit with two $10\ \Omega$ resistors connected in parallel or a circuit with two $10\ \Omega$ resistors connected in series?

- How are the energy and frequency of red light different from that blue light?
- Why does the sky appear blue when viewed from the surface of Earth?
- How do polarized sunglasses reduce the glare from reflective surfaces, such as the surface of a lake?
- Compare and contrast light waves and sound waves.
- Describe the size and location of an image formed in a plane mirror.
- What type of lens is used in a magnifying glass?

B. Chemistry

1. Is familiar with how to use the periodic table to predict the physical and chemical properties of elements
   a. organization of the periodic table
   b. arranged in columns and rows (e.g., groups/families, periods)
   c. includes symbol, atomic number, and atomic mass for each element
   d. general trends in chemical reactivity based on position of elements in the periodic table (e.g., metallic and nonmetallic elements, noble gases)
   e. general trends in physical properties based on position of elements in the periodic table (e.g., atomic radius, ionization energy)
2. Knows the types of chemical bonding and the composition of simple chemical compounds
   a. covalent and ionic bonding
   b. intermolecular attractions such as hydrogen bonding
   c. names of simple chemical compounds
      – ionic
      – covalent compounds involving two elements
      – acids and bases
   d. Interpret chemical formulas
      – describe formulas in terms of moles of atoms
      – percent composition
      – empirical/molecular formulas
      – electron dot and structural formulas
3. Understands states of matter and phase changes between them
   a. basic assumptions of the kinetic molecular theory of matter (e.g., particles in constant motion, speed and energy of gas particles are related to temperature)
   b. ideal gas laws (e.g., Charles' law: volume is proportional to temperature; Boyle's law: pressure and volume are inversely proportional)
   c. phase changes
      – melting/freezing
      – vaporization/condensation
      – sublimation
      – heating/cooling curves
4. Knows how to balance and use simple chemical equations
   a. balance simple chemical reactions
   b. simple stoichiometric calculations involving balanced equations
   c. use chemical formulas to identify and describe simple chemical reaction equations
      – combustion
      – oxidation (e.g., iron rusting)
      – neutralization
      – single or double replacement
   d. energy relationships (e.g., endothermic reactions, exothermic reactions)
   e. factors that affect reaction rates (e.g., concentration, temperature, pressure, catalysts/enzymes)
5. Understands basic concepts in acid-base chemistry
   a. chemical and physical properties of acids and bases
   b. pH scale
   c. neutralization
   d. buffers
6. Is familiar solutions and solubility
   a. solution terminology and identification of different types of solutions
      – dilute and concentrated
      – saturated, unsaturated, and supersaturated
      – solvent and solute
      – concentrations of solutions in terms of molarity
7. Factors affecting the dissolving process and solubility of substances
   a. effect of temperature and particle size on dissolving
   b. effect of temperature on solubility

c. polar versus nonpolar solvents and solutes (e.g., like dissolves like)
d. ionic compounds dissociate into ions in solution (e.g., electrolytes)

Discussion areas: Chemistry

- What is the relationship between the position of an element on the periodic table and the number of valence electrons in the atoms of the element?
- Which of the following elements will most readily react with chlorine: Na, Al, or Cs?
- Which element, Na or Cl, has a larger atomic radius? The higher first ionization energy?
- What types of bonding are exhibited by MgO, SO_2, and O_2?
- What are the correct names for Na_2S, Na_2SO_4, SCl_2, and H_2SO_4?
- How many oxygen atoms are in 3 moles of CO_2?
- Write the electron dot and structural formulas for methane, CH_4?
- If a sample of gas is heated at a constant volume, what will happen to the pressure of the gas?
- What phase changes require the input of energy?
- Balance the following equation: $Na + MgSO_4 \rightarrow Mg + Na_2SO_4$? What type of chemical reaction is it?
- What is the pH of a base?
- What will happen to the pH of an aqueous solution of HCl when a base such as NaOH is added?
- A solute is completely dissolved in a solvent. Is the solution saturated or unsaturated? Can adding more solute help determine if the solution is saturated or unsaturated?
- What factors affect the rate of dissolving?
- Will increasing temperature always increase solubility?
- When $CaCl_2$ is dissolved in water, what ions are formed?

IV. Life Sciences

A. Understands basic structure and function of cells and their organelles

1. Structure and function of cell membranes (e.g., passive and active transport, osmosis)
2. Structure and function of cell organelles
3. Levels of organization (cells, tissues, organs, organ systems)
4. Major cell types (e.g., muscle, nerve, epithelial)
5. Prokaryotes and eukaryotes

B. Understands basic cell reproduction

1. Cell cycle
2. Mitosis
3. Meiosis
4. Cytokinesis

C. Is familiar with the basic biochemistry of life

1. Cellular respiration
2. Photosynthesis
3. Biological molecules (e.g., DNA, carbohydrates, proteins, lipids, enzymes)

D. Understands basic genetics

1. DNA structure
2. Replication, transcription, and translation
3. Dominant and recessive alleles
4. Mendelian inheritance (e.g., genotype, phenotype, use of Punnett squares)
5. Mutations, chromosomal abnormalities, and common human genetic disorders

E. Understands the theory and key mechanisms of evolution

1. Mechanisms of evolution (e.g., natural selection, punctuated equilibrium)
2. Isolation mechanisms and speciation
3. Supporting evidence (e.g., fossil record, comparative genetics, homologous structures)

F. Knows the elements of the hierarchical classification scheme and the characteristics of the major groups of organisms

1. Classification schemes (e.g., domain, kingdom, phylum/division, class, order, family, genus, species)
2. Characteristics of animals, plants, fungi, protists, and monera

G. Knows the major structures and functions of plant organs and systems

1. Characteristics of vascular and nonvascular plants
2. Control mechanisms and responses to stimuli
3. Structure and function of leaves, roots, and stems
4. Asexual and sexual reproduction
5. Uptake and transport of nutrients and water
6. Growth

H. Knows the basic anatomy and physiology of animals, including structure and function of human body systems and the major differences between humans and other animals

1. Homeostasis
2. Exchange with the environment (e.g., respiratory, excretory, digestive systems)
3. Internal transport and exchange (e.g., circulatory system)
4. Movement and support (e.g., skeletal and muscular systems)
5. Reproduction and development
6. Immune systems
7. Control systems (e.g., nervous system, endocrine system)
8. Response to stimuli and other organismal behavior

I. Knows key aspects of ecology

1. Population dynamics (e.g., growth curves; carrying capacity; behavior such as territoriality, mating systems, and social systems)
2. Community ecology (e.g., niche, succession, species diversity, interspecific relationships such as predator-prey and parasitism)
3. Ecosystems
   a. biomes
   b. stability and disturbances (e.g., glaciation, effect of global warming)
   c. energy flow (e.g., trophic levels, food webs)
   d. biogeochemical cycles (e.g., water, nitrogen, and carbon cycles, biotic/abiotic interaction)

Discussion areas: Life Sciences

- Name a structure that is found in a plant cell, but not in an animal cell, and describe its function.
- List the levels of organization for the human nervous system in order from the simplest to the most complex.
- Explain mitosis and meiosis in terms of the number of chromosomes in the parent and daughter cells.
- Why is cellular respiration important?
- What are the subunits that compose carbohydrates and proteins?
- Describe Watson and Crick's model for DNA structure.
- In pea plants, purple flower color is dominant to white flower color. Using a Punnett square, demonstrate how a cross between two plants with purple flowers leads to some offspring with white flower color.
- Compare and contrast the causes of cystic fibrosis and Down syndrome.
- Discuss the significance of Darwin's finches.
- What structures are involved in the uptake and transport of nutrients and water in vascular plants?
- What plant structures are involved in sexual reproduction?
- Compare how a mammal and reptile maintain body temperature.
- What are the major components of the human digestive system and their functions?
- What factors in an environment limit the population size of a species?
- What are the types of climate, animals, and plants that are characteristic of the major biomes?
- Identify the trophic level for each of the following organisms: coyote, grass, grasshopper, hawk, meadowlark, rabbit, snake, and wildflower. Based on the trophic levels, create a food web. Describe how a drought would affect the ecosystem.

V. Earth and Space Sciences

A. Is familiar with physical geology

1. Types and characteristics of rocks, minerals, and their formation processes
   a. characteristics of rocks and their formation processes (e.g., igneous, metamorphic, and sedimentary rocks; the rock cycle)
   b. characteristics of minerals and their formation processes (e.g., classes of minerals, crystals, hardness)
2. Processes involved in erosion, weathering, and deposition of Earth's surface materials and soil formation
   a. erosion and deposition (e.g., agents of erosion)
   b. chemical and physical (mechanical) weathering
   c. characteristics of soils (e.g., types, soil profile)
   d. porosity and permeability
   e. runoff and infiltration
3. Earth's basic structure and internal processes
   a. Earth's layers (e.g., lithosphere, mantle, core)
   b. Earth's shape and size
   c. geographical features (e.g., mountains, plateaus, mid-ocean ridges)
   d. Earth's magnetic field
   e. plate tectonics theory and evidence
      – folding and faulting
      – continental drift
      – magnetic reversals
      – characteristics of volcanoes (e.g., types, lava, eruptions)
      – characteristics of earthquakes (e.g., epicenters, faults, tsunamis)
      – seismic waves and triangulation
4. Water cycle
   a. evaporation
   b. condensation
   c. precipitation
   d. runoff

B. Is familiar with Historical Geology

1. Principle of uniformitarianism
2. Basic principles of stratigraphy (e.g., law of superposition)
3. Relative and absolute time (e.g., index fossils, radioactive dating)
4. Geologic time scale (e.g., eras, periods)
5. Fossil formation and the fossil record
6. Important events in Earth's geologic history (e.g., mass extinctions, Cambrian explosion, ice ages, meteor impacts)

C. Is familiar with the structure and processes of Earth's oceans and other bodies of water

1. Geographic location of Earth's oceans and seas
2. Tides, waves, and currents
3. Estuaries and barrier islands
4. Island, reef, and atoll formation
5. Polar ice caps, icebergs, and glaciers
6. Lakes, ponds, streams, rivers, and river deltas
7. Groundwater, water table, wells, and aquifers
8. Properties of water that affect Earth systems (e.g., density changes upon freezing, high heat capacity, polar solvent, hydrogen bonding)

D. Knows basic meteorology and major factors that affect climate and seasons

1. Basic meteorology
   a. structure of Earth's atmosphere (e.g., troposphere, stratosphere)
   b. composition of Earth's atmosphere (e.g., percent composition of oxygen and nitrogen)
   c. atmospheric pressure and temperature
   d. wind
   e. cloud types and cloud formation
   f. frontal systems, weather maps, storms, and severe weather
   g. humidity, dew point, and frost point
   h. forms of precipitation
2. Major factors that affect climate and seasons
   a. climate zones (e.g., Tropics, Arctic)
   b. proximity to mountains and oceans
   c. global winds and ocean circulation
   d. latitude, geographical location, and elevation
   e. natural phenomena (e.g., volcanic eruptions)
   f. human activity
   g. effect of tilt of Earth's axis on seasons

E. Is familiar with astronomy

1. Major features of the solar system
   a. structure of the solar system
   b. characteristics of planets (e.g., composition, unique features)
   c. characteristics of the Sun
   d. asteroids and comets
   e. theories of origin of the solar system

2. Interactions of the Earth-Moon-Sun system
   a. Earth's rotation and orbital revolution around the Sun
   b. effect on seasons
   c. phases of the Moon
   d. effect on tides
   e. eclipses
3. Major features of the universe and theories of its origins
   a. galaxies
   b. stars and their life cycle (e.g., types, nebulae, black holes)
   c. units of celestial distance (e.g., light-year, astronomical unit)
   d. theories of origin (e.g., Big Bang)
4. Contributions of space missions, exploration, and technology
   a. remote-sensing devices (e.g., telescopes, satellites, space probes)
   b. search for life and water on other planets

Discussion areas: Earth and Space Sciences

- Describe how each type of rock can be changed into the other types of rock.
- What is the relationship between minerals and rocks?
- What are the major agents of erosion?
- What is the difference between weathering and erosion?
- What are the characteristics of each of Earth's layers?
- Describe the processes that occur at plate boundaries and the landforms that result?
- What is a hot spot?
- What are the roles of gravity and the Sun in the water cycle?
- Is radioactive dating used to determine relative or absolute age?
- How can fossils be useful to a geologist in correlating the north and south walls of the Grand Canyon?
- How do the Sun and Moon influence tides?
- What are the relative amounts of fresh and salt water on Earth?
- What cloud types are generally associated with precipitation?
- Why do weather systems generally move across the United States from west to east?
- How do ocean currents, landforms, and global wind belts affect the climate of a region?
- How can a volcanic eruption affect both regional and worldwide climate conditions?
- What are the characteristics that distinguish the inner planets from the outer planets?
- How do the Sun and other stars generate their energy?
- What is the relationship between Earth's rotation, longitude, and time zone?
- What are the relative positions of Earth, the Moon, and the Sun during a solar eclipse?
- What type of galaxy is the Milky Way?
- What information about stars and their life cycle can be obtained from a Hertzsprung-Russell (H-R) diagram?
- What is the origin of the astronomical unit?
- What limitation of Earth-based telescopes has been solved by the Hubble space telescope?

VI. Science, Technology, and Society

A. Understands the impact of science and technology on the environment and society

1. Air and water pollution
2. Greenhouse gases
3. Global climate and sea level change
4. Waste disposal
5. Acid rain
6. Loss of biodiversity
7. Ozone depletion

B. Knows major issues associated with energy production and the management of natural resources

1. Conservation and recycling
2. Renewable and nonrenewable energy resources

3. Pros and cons of power generation based on various sources (e.g., fossil, nuclear, water, wind, solar, biomass, geothermal)
4. Use and extraction of Earth's resources (e.g., mining, reclamation, deforestation)

C. Is familiar with applications of science and technology in daily life

1. Chemical properties of household products
2. Batteries, wireless devices, microchips, lasers, and fiber optics
3. Communication satellites
4. Contributions of space technology
5. Common agricultural practices (e.g., genetically modified crops, use of herbicides and insecticides)
6. DNA evidence in criminal investigations

D. Is familiar with the impact of science on public-health issues

1. Nutrition, disease, and medicine (e.g., food preservation, vitamins, vaccines, viruses)
2. Biotechnology (e.g., genetic engineering, *in vitro* fertilization)
3. Medical technologies (e.g., MRIs, X-rays, radiation therapy)

Discussion areas: Science, Technology, and Society

- Describe how clear-cutting of tropical rain forests negatively impacts humans and the environment.
- What is the effect of the presence of chlorofluorocarbons in the stratosphere?
- What are ways to reduce the amount of plastic waste in landfills?
- Compare the availabilities and limitations of the following sources of power: geothermal, nuclear, hydroelectric, solar, and fossil fuel.
- Compare the depletion of mineral resources with that of fossil fuels.
- What is the connection between genetically modified crops and pesticide use?
- What are the advantages to using DNA analysis over other forms of analysis such as fingerprinting and blood typing to identify individuals during a criminal investigation?
- Explain why antibiotics are not prescribed to treat the common cold.
- Compare the applications of and benefits of using an MRI to those of x-rays to diagnose and evaluate medical conditions.
- What is the effect of invasive species?

7. Review Smart Tips for Success

Follow test-taking tips developed by experts

Learn from the experts. Take advantage of the following answers to questions you may have and practical tips to help you navigate the *Praxis* test and make the best use of your time.

Should I guess?

Yes. Your score is based on the number of questions you answer correctly, with no penalty or subtraction for an incorrect answer. When you don't know the answer to a question, try to eliminate any obviously wrong answers and then guess at the correct one. Try to pace yourself so that you have enough time to carefully consider every question.

Can I answer the questions in any order?

You can answer the questions in order or skip questions and come back to them later. If you skip a question, you can also mark it so that you can remember to return and answer it later. Remember that questions left unanswered are treated the same as questions answered incorrectly, so it is to your advantage to answer every question.

Are there trick questions on the test?

No. There are no hidden meanings or trick questions. All of the questions on the test ask about subject matter knowledge in a straightforward manner.

Are there answer patterns on the test?

No. You might have heard this myth: the answers on tests follow patterns. Another myth is that there will never be more than two questions in a row with the correct answer in the same position among the choices. Neither myth is true. Select the answer you think is correct based on your knowledge of the subject.

Can I write on the scratch paper I am given?

Yes. You can work out problems on the scratch paper, make notes to yourself, or write anything at all. Your scratch paper will be destroyed after you are finished with it, so use it in any way that is helpful to you. But make sure to select or enter your answers on the computer.

Smart Tips for Taking the Test

1. **Skip the questions you find extremely difficult.** Rather than trying to answer these on your first pass through the test, you may want to leave them blank and mark them so that you can return to them later. Pay attention to the time as you answer the rest of the questions on the test, and try to finish with 10 or 15 minutes remaining so that you can go back over the questions you left blank. Even if you don't know the answer the second time you read the questions, see if you can narrow down the possible answers, and then guess. Your score is based on the number of right answers, so it is to your advantage to answer every question.

2. **Keep track of the time.** The on-screen clock will tell you how much time you have left. You will probably have plenty of time to answer all of the questions, but if you find yourself becoming bogged down, you might decide to move on and come back to any unanswered questions later.

3. **Read all of the possible answers before selecting one.** For questions that require you to select more than one answer, or to make another kind of selection, consider the most likely answers given what the question is asking. Then reread the question to be sure the answer(s) you have given really answer the question. Remember, a question that contains a phrase such as "Which of the following does NOT …" is asking for the one answer that is NOT a correct statement or conclusion.

4. **Check your answers.** If you have extra time left over at the end of the test, look over each question and make sure that you have answered it as you intended. Many test takers make careless mistakes that they could have corrected if they had checked their answers.

5. **Don't worry about your score when you are taking the test.** No one is expected to answer all of the questions correctly. Your score on this test is not analogous to your score on the *GRE*® or other tests. It doesn't matter on the *Praxis* tests whether you score very high or barely pass. If you meet the minimum passing scores for your state and you meet the state's other requirements for obtaining a teaching license, you will receive a license. In other words, what matters is meeting the minimum passing score. You can find passing scores for all states that use the *Praxis* tests at http://www.ets.org/s/praxis/pdf/passing_scores.pdf or on the web site of the state for which you are seeking certification/licensure.

6. **Use your energy to take the test, not to get frustrated by it.** Getting frustrated only increases stress and decreases the likelihood that you will do your best. Highly qualified educators and test development professionals, all with backgrounds in teaching, worked diligently to make the test a fair and valid measure of your knowledge and skills. Your state painstakingly reviewed the test before adopting it as a licensure requirement. The best thing to do is concentrate on answering the questions.

8. Check on Testing Accommodations

See if you qualify for accommodations to take the Praxis *test*

What if English is not my primary language?

Praxis tests are given only in English. If your primary language is not English (PLNE), you may be eligible for extended testing time. For more details, visit www.ets.org/praxis/register/plne_accommodations/.

What if I have a disability or other health-related need?

The following accommodations are available for *Praxis* test takers who meet the Americans with Disabilities Act (ADA) Amendments Act disability requirements:

- Extended testing time
- Additional rest breaks
- Separate testing room
- Writer/recorder of answers
- Test reader
- Sign language interpreter for spoken directions only
- Perkins Brailler
- Braille slate and stylus
- Printed copy of spoken directions
- Oral interpreter
- Audio test
- Braille test
- Large print test book
- Large print answer sheet
- Listening section omitted

For more information on these accommodations, visit www.ets.org/praxis/register/disabilities.

Note: Test takers who have health-related needs requiring them to bring equipment, beverages, or snacks into the testing room or to take extra or extended breaks must request these accommodations by following the procedures described in the *Bulletin Supplement for Test Takers with Disabilities or Health-Related Needs* (PDF), which can be found at www.ets.org/s/praxis/pdf/bulletin_supplement_test_takers_with_disabilities_health_needs.pdf.

You can find additional information on available resources for test takers with disabilities or health-related needs at www.ets.org/disabilities.

9. Do Your Best on Test Day

Get ready for test day so you will be calm and confident

You followed your study plan. You prepared for the test. Now it's time to prepare for test day.

Plan to end your review a day or two before the actual test date so you avoid cramming. Take a dry run to the test center so you're sure of the route, traffic conditions, and parking. Most of all, you want to eliminate any unexpected factors that could distract you from your ultimate goal—passing the *Praxis* test!

On the day of the test, you should:

- be well rested
- wear comfortable clothes and dress in layers
- eat before you take the test
- bring an acceptable and valid photo identification with you
- bring an approved calculator only if one is specifically permitted for the test you are taking (see Calculator Use, at http://www.ets.org/praxis/test_day/policies/calculators)
- be prepared to stand in line to check in or to wait while other test takers check in

You can't control the testing situation, but you can control yourself. Stay calm. The supervisors are well trained and make every effort to provide uniform testing conditions, but don't let it bother you if the test doesn't start exactly on time. You will have the allotted amount of time once it does start.

You can think of preparing for this test as training for an athletic event. Once you've trained, prepared, and rested, give it everything you've got.

What items am I restricted from bringing into the test center?

You cannot bring into the test center personal items such as:

- handbags, knapsacks, or briefcases
- water bottles or canned or bottled beverages
- study materials, books, or notes
- pens, pencils, scrap paper, or calculators, unless specifically permitted for the test you are taking (see Calculator Use, at http://www.ets.org/praxis/test_day/policies/calculators)
- any electronic, photographic, recording, or listening devices

Personal items are not allowed in the testing room and will not be available to you during the test or during breaks. You may also be asked to empty your pockets. At some centers, you will be assigned a space to store your belongings, such as handbags and study materials. Some centers do not have secure storage space available, so please plan accordingly.

Test centers assume no responsibility for your personal items.

If you have health-related needs requiring you to bring equipment, beverages or snacks into the testing room or to take extra or extended breaks, you need to request accommodations in advance. Procedures for requesting accommodations are described in the Bulletin Supplement for Test Takers with Disabilities or Health-related Needs (PDF).

Note: All cell phones, smart phones (e.g., Android® devices, iPhones®, etc.), and other electronic, photographic, recording, or listening devices are strictly prohibited from the test center. If you are seen with such a device, you will be dismissed from the test, your test scores will be canceled, and you will forfeit your test fees. If you are seen *using* such a device, the device will be confiscated and inspected. For more information on what you can bring to the test center, visit www.ets.org/praxis/test_day/bring.

Are You Ready?

Complete this checklist to determine whether you are ready to take your test.

- ❒ Do you know the testing requirements for the license or certification you are seeking in the state(s) where you plan to teach?
- ❒ Have you followed all of the test registration procedures?
- ❒ Do you know the topics that will be covered in each test you plan to take?
- ❒ Have you reviewed any textbooks, class notes, and course readings that relate to the topics covered?
- ❒ Do you know how long the test will take and the number of questions it contains?
- ❒ Have you considered how you will pace your work?
- ❒ Are you familiar with the types of questions for your test?
- ❒ Are you familiar with the recommended test-taking strategies?
- ❒ Have you practiced by working through the practice questions in this study companion or in a study guide or practice test?
- ❒ If constructed-response questions are part of your test, do you understand the scoring criteria for these questions?
- ❒ If you are repeating a *Praxis* test, have you analyzed your previous score report to determine areas where additional study and test preparation could be useful?

If you answered "yes" to the questions above, your preparation has paid off. Now take the *Praxis* test, do your best, pass it—and begin your teaching career!

10. Understand Your Scores

Understand how tests are scored and how to interpret your test scores

Of course, passing the *Praxis* test is important to you so you need to understand what your scores mean and what your state requirements are.

What are the score requirements for my state?

States, institutions, and associations that require the tests set their own passing scores. Visit www.ets.org/praxis/states for the most up-to-date information.

If I move to another state, will my new state accept my scores?

The *Praxis* tests are part of a national testing program, meaning that they are required in many states for licensure. The advantage of a national program is that if you move to another state that also requires *Praxis* tests, you can transfer your scores. Each state has specific test requirements and passing scores, which you can find at www.ets.org/praxis/states.

How do I know whether I passed the test?

Your score report will include information on passing scores for the states you identified as recipients of your test results. If you test in a state with automatic score reporting, you will also receive passing score information for that state.

A list of states and their passing scores for each test are available online at www.ets.org/praxis/states.

What your *Praxis* scores mean

You received your score report. Now what does it mean? It's important to interpret your score report correctly and to know what to do if you have questions about your scores.

Visit http://www.ets.org/s/praxis/pdf/sample_score_report.pdf to see a sample score report.
To access *Understanding Your Praxis Scores*, a document that provides additional information on how to read your score report, visit www.ets.org/praxis/scores/understand.

Put your scores in perspective

Your score report indicates:

- Your score and whether you passed
- The range of possible scores
- The raw points available in each content category
- The range of the middle 50 percent of scores on the test

If you have taken the same *Praxis* test or other *Praxis* tests in last 10 years, your score report also lists the highest score you earned on each test taken.

Content category scores and score interpretation

Questions on the *Praxis* tests are categorized by content. To help you in future study or in preparing to retake the test, your score report shows how many raw points you earned in each content category. Compare your "raw points earned" with the maximum points you could have earned ("raw points available"). The greater the difference, the greater the opportunity to improve your score by further study.

Score scale changes

ETS updates *Praxis* tests on a regular basis to ensure they accurately measure the knowledge and skills that are required for licensure. When tests are updated, the meaning of the score scale may change, so requirements may vary between the new and previous versions. All scores for previous, discontinued tests are valid and reportable for 10 years, provided that your state or licensing agency still accepts them.

These resources may also help you interpret your scores:

- *Understanding Your Praxis Scores* (PDF), found at www.ets.org/praxis/scores/understand
- *The Praxis Passing Scores* (PDF), found at www.ets.org/praxis/scores/understand
- State requirements, found at www.ets.org/praxis/states

Appendix: Other Questions You May Have

Here is some supplemental information that can give you a better understanding of the *Praxis* tests.

What do the *Praxis* tests measure?

The *Praxis* tests measure the specific knowledge and skills that beginning teachers need. The tests do not measure an individual's disposition toward teaching or potential for success, nor do they measure your actual teaching ability. The assessments are designed to be comprehensive and inclusive but are limited to what can be covered in a finite number of questions and question types. Teaching requires many complex skills that are typically measured in other ways, including classroom observation, video recordings, and portfolios.

Ranging from Agriculture to World Languages, there are more than 80 *Praxis* tests, which contain selected-response questions or constructed-response questions, or a combination of both.

Who takes the tests and why?

Some colleges and universities use the *Praxis* Core Academic Skills for Educators tests (Reading, Writing, and Mathematics) to evaluate individuals for entry into teacher education programs. The assessments are generally taken early in your college career. Many states also require Core Academic Skills test scores as part of their teacher licensing process.

Individuals entering the teaching profession take the *Praxis* content and pedagogy tests as part of the teacher licensing and certification process required by many states. In addition, some professional associations and organizations require *Praxis* Subject Assessments for professional licensing.

Do all states require these tests?

The *Praxis* tests are currently required for teacher licensure in approximately 40 states and United States territories. These tests are also used by several professional licensing agencies and by several hundred colleges and universities. Teacher candidates can test in one state and submit their scores in any other state that requires *Praxis* testing for licensure. You can find details at www.ets.org/praxis/states.

What is licensure/certification?

Licensure in any area—medicine, law, architecture, accounting, cosmetology—is an assurance to the public that the person holding the license possesses sufficient knowledge and skills to perform important occupational activities safely and effectively. In the case of teacher licensing, a license tells the public that the individual has met predefined competency standards for beginning teaching practice.

Because a license makes such a serious claim about its holder, licensure tests are usually quite demanding. In some fields, licensure tests have more than one part and last for more than one day. Candidates for licensure in all fields plan intensive study as part of their professional preparation. Some join study groups, others study alone. But preparing to take a licensure test is, in all cases, a professional activity. Because a licensure exam surveys a broad body of knowledge, preparing for a licensure exam takes planning, discipline, and sustained effort.

Why does my state require the *Praxis* tests?

Your state chose the *Praxis* tests because they assess the breadth and depth of content—called the "domain"—that your state wants its teachers to possess before they begin to teach. The level of content knowledge, reflected in the passing score, is based on recommendations of panels of teachers and teacher educators in

each subject area. The state licensing agency and, in some states, the state legislature ratify the passing scores that have been recommended by panels of teachers.

How were the tests developed?

ETS consulted with practicing teachers and teacher educators around the country during every step of the *Praxis* test development process. First, ETS asked them what knowledge and skills a beginning teacher needs to be effective. Their responses were then ranked in order of importance and reviewed by hundreds of teachers.

After the results were analyzed and consensus was reached, guidelines, or specifications, for the selected-response and constructed-response tests were developed by teachers and teacher educators. Following these guidelines, teachers and professional test developers created test questions that met content requirements and *ETS Standards for Quality and Fairness*.*

When your state adopted the research-based *Praxis* tests, local panels of teachers and teacher educators evaluated each question for its relevance to beginning teachers in your state. During this "validity study," the panel also provided a passing-score recommendation based on how many of the test questions a beginning teacher in your state would be able to answer correctly. Your state's licensing agency determined the final passing-score requirement.

ETS follows well-established industry procedures and standards designed to ensure that the tests measure what they are intended to measure. When you pass the *Praxis* tests your state requires, you are proving that you have the knowledge and skills you need to begin your teaching career.

How are the tests updated to ensure the content remains current?

Praxis tests are reviewed regularly. During the first phase of review, ETS conducts an analysis of relevant state and association standards and of the current test content. State licensure titles and the results of relevant job analyses are also considered. Revised test questions are then produced following the standard test development methodology. National advisory committees may also be convened to review and revise existing test specifications and to evaluate test forms for alignment with the specifications.

How long will it take to receive my scores?

Scores for tests that do not include constructed-response questions are available on screen immediately after the test. Scores for tests that contain constructed-response questions or essays aren't available immediately after the test because of the scoring process involved. Official score reports are available to you and your designated score recipients approximately two to three weeks after the test date for tests delivered continuously, or two to three weeks after the testing window closes for other tests. See the test dates and deadlines calendar at www.ets.org/praxis/register/dates_centers for exact score reporting dates.

Can I access my scores on the web?

All test takers can access their test scores via My *Praxis* Account free of charge for one year from the posting date. This online access replaces the mailing of a paper score report.

The process is easy—simply log into My *Praxis* Account at www.ets.org/praxis and click on your score report. If you do not already have a *Praxis* account, you must create one to view your scores.

Note: You must create a *Praxis* account to access your scores, even if you registered by mail or phone.

**ETS Standards for Quality and Fairness* (2014, Princeton, N.J.) are consistent with the *Standards for Educational and Psychological Testing*, industry standards issued jointly by the American Educational Research Association, the American Psychological Association, and the National Council on Measurement in Education (2014, Washington, D.C.).

Your teaching career is worth preparing for, so start today!

Let the Praxis® Study Companion guide you.

To search for the *Praxis* test prep resources
that meet your specific needs, visit:

www.ets.org/praxis/testprep

To purchase official test prep made by the creators
of the *Praxis* tests, visit the ETS Store:

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