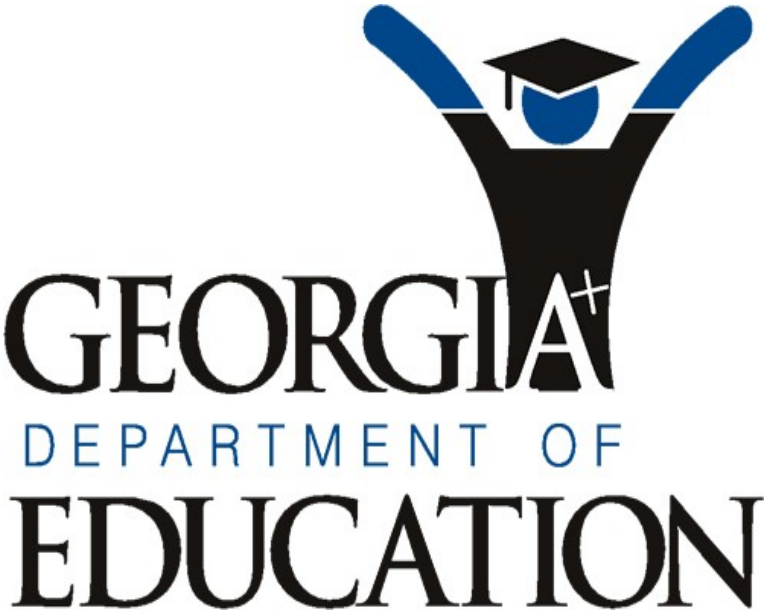
Georgia High School Graduation Tests



Test Content Descriptions

Based on the Georgia Performance Standards and the Quality Core Curriculum

Science

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Program Purpose
The Georgia High School Graduation Tests (GHSGT) measure whether Georgia High School students have mastered essential content from the state-adopted curriculum. Students earning a regular Georgia diploma must pass all four parts of the GHSGT and the Georgia High School Writing Assessment in addition to meeting other local and state graduation requirements.

The Georgia State Board of Education, in July 2004, approved the high school Georgia Performance Standards (GPS) in science for use in all Georgia public schools. Instruction in the new science high school performance standards begins in the fall of the 2005 – 2006 school year. The 2006 and 2007 Science GHSGT will reflect the transition to the GPS from the Georgia Quality Core Curriculum (QCC). First-time 11th grade test takers will take a transitional form of the Science GHSGT that is aligned to standards and content found in both the GPS and the QCC. The transitional tests assess only the standards and the content that students have an opportunity to learn whether they received instruction on the GPS or the QCC. Beginning in 2008, first-time 11th grade test takers will take a science graduation test based solely on the GPS.

Committees of science educators from throughout Georgia met in October and November of 2004 to identify common standards, content, and skills and make recommendations about how the information should be assessed. The revised GHSGT Content Descriptions for Science are the outcome of their discussions.

Reference Resources
The GHSGT allows students the use of two reference resources. These resources include a page of common equations and the Periodic Table of the Elements. These two reference resources are available to the students when testing and are printed in their test booklets. They are provided in Appendix A of this document.

GHSGT Content Descriptions
The Content Descriptions acquaint Georgia educators, students, parents, and others with the content assessed by the GHSGT. They provide an overview of the five content domains and list the associated skills and concepts that students should understand and be able to apply. They also provide the GPS and QCC standards under which the information assessed within each domain is taught.

The Content Descriptions refer to both the GPS and the QCC. The GPS can be accessed at www.georgiastandards.org, and the QCC can be accessed at www.glc.k12.ga.us. Additional information about the GHSGT program can be found at www.gadoe.org.

Georgia science teachers selected the standards included in the high school graduation transitional test based on (1) whether the content is essential for all graduates to demonstrate mastery of prior to graduation and (2) alignment and overlap with the QCC to ensure students who receive instruction on either curriculum have opportunities to learn the assessed information. Georgia teachers grouped the standards according to similar content themes, creating the five content domains for Science.

Biology Domains

- **Cells and Heredity**
  Students of life science must understand the importance of cells to all living things. Cells are made up of many organelles, each with a specific function in cell processes such as reproduction and homeostasis. DNA stores and transmits cellular information making it possible for traits to change or be passes on to other generations Students demonstrate understanding by identifying, analyzing, and explaining various cell structures and relating these structures to their functions. Students also relate cell structure to the complexity of organisms and systems and their ability to survive. Assessment of this domain focuses on students' abilities to understand specialized cell parts, to analyze elements in living cells, and to compare diffusion and osmosis. Assessments focus on concepts not specific laws, on essential elements and processes, on genetic terms and expressions at a chemical level, and practical applications of genetics.

  Ecology
  Students of life science must also understand the concept of interdependence among organisms, especially with regard to the flow of matter and energy within their ecosystems. Assessment in this domain focuses on students identifying, analyzing, and evaluating relationships among organisms, populations, communities, ecosystems, and biomes. Students relate biome types to the climate, geography, and vegetation of given areas, but do not locate biome types on maps. Students analyze the causes and effects of pollution, possible solutions, and preventative measures. Students analyze and evaluate change over time.

Physical Science Domains

- **Structure and Properties of Matter**
  Students of physical science must understand the structure of atoms and their particles. Our current understanding of the atom includes knowledge about the locations of subatomic particles, the effects of changes in the number or arrangement of subatomic particles in elements, and the characteristics of different elements and substances. Assessment in this domain focuses on the conceptual examination of the atom including the nucleus, protons, neutrons, and electrons. Students examine atoms with different numbers of neutrons and protons and use the first 20 elements of the Periodic Table to examine atomic mass and atomic number. Students also analyze properties of solutions.

- **Energy Transformations**
  Students of physical science must understand the various forms in which energy exists and how it may be transformed from one form to another. Assessment in this domain focuses on students' knowledge of the phases of matter. Students also compare and contrast the atomic and molecular motion of solids, liquids, gases, and plasmas. Students identify and analyze energy transformations and thermal energy changes as well as radioactive decay. Questions assess conceptual understanding of energy transformation.

- **Forces, Waves, and Electricity**
  Students of physical science must understand the relationship of force, mass, and motion through Newton's Laws of Motion. Assessment in this domain focuses on student's ability to apply the concepts of inertia and gravitational force, velocity and acceleration, mechanical advantage, waves, magnetism, and electricity. Students demonstrate understanding of these concepts in several ways including calculating velocity, acceleration, amount of work, and mechanical advantage using formula sheets. Students analyze factors affecting the transfer of energy by heat, light, sound, or mechanical waves including reflection, refraction, interference, and diffraction. Students apply knowledge of magnetism and electricity as they relate to the movement of electrical charges in electromagnets and simple motors.

Characteristics of Science

The Georgia Performance Standards in Science require that content be taught in conjunction with process skills identified as the Characteristics of Science. The term Characteristics of Science refers to the process skills used in the learning and practice of science, such as testing a hypothesis, record keeping, using correct safety procedures, using appropriate tools and instruments, applying math and technology, analyzing data, interpreting results, and communicating scientific information. It also refers to understanding how science knowledge grows and changes and the processes that drive those changes. These concepts and skills are also present in the QCC Core Skills for science.

Characteristics of Science items are integrated across the five content domains.

Overview of Characteristics of Science

- Students apply skills used in explaining and understanding the characteristics of science including comprehension, application, synthesis, evaluation, and the weighing of evidence.
  - Students examine new experiments that may reinforce or alter scientific understandings and suggest alternate explanations of scientific evidence.
  - Students apply knowledge of safety practices and identify appropriate laboratory techniques for a given situation.
  - Students choose procedures for investigation of scientific problems.
  - Students compare and analyze data using tables and graphs.
  - Students determine reasonable conclusions based on presented data.
  - Students evaluate reasonableness of conclusions after considering research methods and other scientific knowledge.
  - Students determine the most appropriate method for recording or organizing data.
  - Students solve scientific problems by substituting values into formulas, using dimensional analysis, or using simple algebra.
  - Students evaluate written reports of laboratory findings, scientific accounts, and supporting data.
  - Students determine appropriate data to support scientific claims.
  - Students recognize that scientific principles are universally applicable, discovered through experiment or observation, and subject to change.
  - Students understand the necessity of continuously evaluating current theories.
  - Students recognize that new hypotheses often require new experiments.
  - Students comprehend the importance of controls in scientific experiments.
  - Students explain why estimated and calculated answers to numerical problems may differ.
  - Students evaluate the effects of possible measurement errors in calculations.

Associated GPS – Characteristics of Science

SCSh1 (b, c)	SCSh2 (a, b, c)	SCSh3 (b, d, e, f)	SCSh4 (a)
SCSh5 (a, b, e)	SCSh6 (a, b, c)	SCSh7 (a, b, c, d, e)	SCSh8 (a)

Associated QCC Standards

B 1.1	B 1.2	B 1.3	B 2.1
PS 1.1	PS 1.2	PS 3.1	PS 13.1
PS 14.1	PS 14.1	PS 15.3	

Science
Domain: Cells and Heredity (approximately 25% of the test)

Overview of the Domain

- Students describe the structures of cells and the structure and function of their components.
  - Students examine the similarities and differences between prokaryotic and eukaryotic cells.
- Students explain the process of inheritance of genetic traits.
  - Students differentiate between DNA and RNA, recognizing the role of each in heredity.
  - Students demonstrate understanding of Mendel's Laws in genetic inheritance and variability.
  - Students discuss the use of DNA technology in the fields of medicine and agriculture.
- Students analyze the similarities and differences between organisms of different kingdoms.

Associated Concepts and Skills

Assessment of this domain focuses on the following:

- describing the roles of cell organelles in the following:
  - information feedback
  - motility
  - obtaining, storing, and using energy
  - protein construction
  - reproduction
  - transport of material
  - waste disposal
- differentiating the functions of the macromolecules:
  - carbohydrates
  - lipids
  - nucleic acids
  - proteins
- understanding differences between DNA and RNA
- describing how DNA stores and transmits information
- understanding Mendel's Laws as they apply to variability between generations and cell division

- understanding how DNA technology is used today in medicine and agriculture, including but not limited to:
    - environmental factors in mutation
    - genotype and phenotype
- understanding the relationships between single-celled and multi-celled organisms, on a broad, conceptual level
- differentiating how organisms from different kingdoms obtain, transform, and transport, energy and/or material.

Associated GPS - Biology

SB1 (a, c)	SB2 (a, b, c, f)	SB3 (a)

Associated QCC Standards – Biology

4 (4.3–4.4)	5 (5.1–5.4)	6 (6.2–6.4)	8 (8.1–8.2)
9 (9.3)	10 (10.1–10.2)	11 (11.1–11.3)	

Science
Domain: Ecology (approximately 17% of the test)

Overview of the Domain

- Students analyze dependence of organisms on each other and the flow of energy and matter in an ecosystem.
  - Students evaluate relationships between organisms, populations, communities, ecosystems, and biomes.
  - Students describe the flow of matter and energy through an ecosystem by organizing the components of food chains and webs.

Associated Concepts and Skills

Assessment of this domain focuses on the following:

- understanding the identifying characteristics of major biomes of the world on a conceptual level, rather than identifying them on maps
- describing predator/prey, producer/consumer, parasite/host, scavenging, or decomposing relationships among organisms
- understanding and analyzing the physical conditions (food, space, water, air, and shelter) necessary for organisms to survive in an environment
- understanding that the amount of matter remains constant as it flows through an ecosystem
- explaining the flow of energy through an ecosystem and that energy may change from one form to another.
- using diagrams to interpret the interactions of organisms within food chains and webs
- determining the role of different organisms in food chains and webs

Associated GPS - Biology

SB4 (a, b1)

Associated QCC Standards – Biology

25 (25.1–25.5) 26 (26.2) 27 (27.1–27.2)

Science
Domain: Structure and Properties of Matter (approximately 26% of the test)

Overview of the Domain

- Students describe atoms, understanding the structure of an atom in terms of:
  - atomic mass and atomic number.
  - elements (atoms with different numbers of protons).
  - isotopes (atoms with different numbers of neutrons).
  - proton (positive charge), neutron (neutral), and electron (negative charge) locations.
- Students apply the properties of solutions, analyzing solutions in terms of solutes and solvents.

Associated Concepts and Skills

Assessment of this domain focuses on the following:

- understanding that atoms are composed of a nucleus encompassed by a cloud of electrons
- recognizing that electrons are arranged in the electron cloud in energy levels
- understanding that the nucleus of a typical atom is composed of protons and neutrons
- understanding that the atomic mass of an atom is concentrated in the nucleus of the atom
- identifying the symbol, atomic number, and atomic mass of the first 20 elements on the periodic table
- recognizing the difference between atomic mass and atomic number
- identifying the effect of differing numbers of neutrons in atoms of the same element, primarily in the context of radioactive isotopes
- differentiating among elements
- understanding solutions, including describing the components of solutions as solutes or solvents

Associated GPS – Physical Science

SPS1 (a1–a4) SPS6 (a1)

Associated QCC Standards – Physical Science

4 (4.1–4.5) 7 (7.1–7.3) 8 (8.1)

Associated QCC Standards – Chemistry

5 (5.1)

Science
Domain: Energy Transformations (approximately 16% of the test)

Overview of the Domain

- Students understand radioactivity.
  - Students describe half-lives of elements.
- Students examine the phases of matter and the related atomic and molecular motion.
- Students analyze energy transformations and the flow of energy in systems.
  - Students understand molecular motion involved in thermal energy changes due to conduction, convection, and radiation.

Associated Concepts and Skills

Assessment of this domain focuses on the following:

- describing the process of radioactive decay in which the unstable nucleus of a radioactive isotope spontaneously decays
- calculating the amount of a radioactive substance that will remain after one half-life
- analyzing graphs, tables, and other displays of data to determine the length of a half-life or the amount of material remaining after one half-life
- understanding that as temperature increases, the motion of the atoms increases
- describing a solid as a composition of particles closely situated in position giving a definite shape and definite volume and that little motion occurs between particles as compared to other phases of matter
- describing a liquid as a composition of particles free to move, giving a definite volume but not a definite shape and that particles have a greater range of motion as compared to solids
- describing a gas as a composition of particles that move more than the particles of either a solid or a liquid, giving no definite volume or shape, and colliding more randomly than the particles of solids and liquids
- understanding that phase changes require a gain or loss of energy
- describing the two forms of energy encountered during a given single energy transformation, including chemical, heat, light, electrical, and mechanical
- identifying the processes of conduction, convection, and radiation that occur during thermal energy changes

Associated GPS – Physical Science

SPS3 (c)	SPS5 (a)	SPS7 (a, b)	

Associated QCC Standards – Physical Science

4 (4.2, 4.4, 4.5)	6	7 (7.1, 7.3)	12 (12.2–12.5)

Science
Domain: Forces, Wave, and Electricity (approximately 16% of the test)

Overview of the Domain

- Students understand the relationships between force, mass, and motion.
  - Students calculate velocity and acceleration.
  - Students apply Newton's First Law of Motion, the law of inertia.
  - Students relate falling objects to the force of gravity.
  - Students understand the difference between mass and weight.
  - Students calculate work and mechanical advantage.
- Students describe the properties of waves.
  - Students understand that all waves transfer energy.
  - Students associate frequency and wavelength with the energy transferred by electromagnetic and mechanical waves.
  - Students understand the concepts and can identify examples of reflection, refraction, interference, and diffraction.
  - Students analyze the effects of different mediums on the speed of sound.
- Students understand the properties of electricity and magnetism.
  - Students describe magnetism and electrical charges in the context of electricity, magnetism, electromagnets, and simple motors.

Associated Concepts and Skills

Assessment of this domain focuses on the following:

- using the following formulas to solve for velocity and acceleration:
  - acceleration: $a = \frac{v_f - v_i}{t}$
  - velocity: $v = \frac{d}{t}$
- applying knowledge of Newton's First Law of Motion to given situations:
  - an object in motion stays in motion unless acted on by an unbalanced force
  - an object at rest remains at rest unless acted on by an unbalanced force
- understanding that gravity causes objects to accelerate as they fall
- understanding factors that affect the force of gravity on an object
- explaining the difference between mass and weight
- calculating work using the formula $W = Fd$ (Work = force×distance)
- understanding the concept of mechanical advantage in relation to simple machines
- understanding that waves carry energy
- relating the frequency and wavelength to the energy carried by the waves
- understanding how frequency and wavelength are related
- understanding that electromagnetic waves do not require a medium
- understanding how electromagnetic waves differ in the amount of energy transferred based on position on the electromagnetic spectrum

- relating frequencies and wavelengths on the electromagnetic spectrum to technological advances such as microwaves and radio waves.
- understanding how light interacts with lenses and mirrors.
- using the terms absorption, reflection, refraction, interference, and diffraction to describe how waves (including sound waves) interact with obstacles, within mediums, and with other waves
- describing how the speed of sound varies with the type of medium and temperature of a medium
- relating magnetism and electricity
- describing electromagnets, including their uses in electric motors, generators, radio, television, and other technologies
- explaining how an electromagnet transforms electrical energy into mechanical energy

Associated GPS – Physical Science

SPS8 (a, b1, c, d, e) SPS9 (a, b, d, e) SPS10 (c1, c2)

Associated QCC Standards – Physical Science

13 (13.2) 14 (14.1) 15 (15.1–15.2) 16 (16.1–16.5)
17 (17.5–17.6)

Appendix A

Reference Resources

SCIENCE FACTS AND FORMULAS

Some of the questions in this test require you to solve problems. This page contains all the basic facts and formulas you will need to solve those problems. You may refer to this page as often as you wish while you take the test. Some questions may require information from the Periodic Table. This table can be found at the end of the test booklet.

Basic Facts

Acceleration due to gravity = 9.8 meters/second/second (9.8 m/s^2)
Weight = Mass (m) × Acceleration due to gravity (g) (W = mg)
Density = Mass/Volume
Volume of a Rectangular Solid = Length × Width × Height
1 newton = 1 kilogram·meter/second/second
1 joule = 1 newton·meter
1 watt = 1 newton·meter/second = 1 joule/second

Motion

Velocity = distance/time $v = \frac{d}{t}$

Acceleration = Change in Velocity/Time Elapsed $a = \frac{v_f - v_i}{t}$

Force, Mechanical Advantage, Power, Work

Force = Mass × Acceleration ($F = ma$)

Mechanical Advantage

Actual Mechanical Advantage: $\left(AMA = \frac{F_R}{F_E} \right)$,

where F_R is Force due to resistance and F_E is Force due to effort.

Ideal Mechanical Advantage: $\left(IMA = \frac{\text{Effort Length}}{\text{Resistance Length}} \right)$

Power = Work/Time $\left(P = \frac{w}{t} \right)$

Work = Force × Distance ($W = Fd$)

Electricity

Voltage = Current × Resistance ($V = IR$)

PERIODIC TABLE

PERIODS	GROUP 1 (Ia)	2 (IIa)	3	4	5	6	7	8	9	10	11	12	13 (IIIa)	14 (IVa)	15 (Va)	16 (VIa)	17 (VIIa)	18 (VIIIa)
1	1 **H** *Hydrogen* 1.00797 1																	2 **He** *Helium* 4.0026 2
2	3 **Li** *Lithium* 6.941 2, 1	4 **Be** *Beryllium* 9.0122 2, 2											5 **B** *Boron* 10.811 2, 3	6 **C** *Carbon* 12.011 2, 4	7 **N** *Nitrogen* 14.0067 2, 5	8 **O** *Oxygen* 15.9994 2, 6	9 **F** *Fluorine* 18.998 2, 7	10 **Ne** *Neon* 20.183 2, 8
3	11 **Na** *Sodium* 22.9898 2, 8, 1	12 **Mg** *Magnesium* 24.312 2, 8, 2											13 **Al** *Aluminum* 26.9815 2, 8, 3	14 **Si** *Silicon* 28.086 2, 8, 4	15 **P** *Phosphorus* 30.9738 2, 8, 5	16 **S** *Sulfur* 32.064 2, 8, 6	17 **Cl** *Chlorine* 35.453 2, 8, 7	18 **Ar** *Argon* 39.948 2, 8, 8
4	19 **K** *Potassium* 39.102 2, 8, 8, 1	20 **Ca** *Calcium* 40.08 2, 8, 8, 2	21 **Sc** *Scandium* 44.956 2, 8, 9, 2	22 **Ti** *Titanium* 47.90 2, 8, 10, 2	23 **V** *Vanadium* 50.942 2, 8, 11, 2	24 **Cr** *Chromium* 51.996 2, 8, 13, 1	25 **Mn** *Manganese* 54.9380 2, 8, 13, 2	26 **Fe** *Iron* 55.847 2, 8, 14, 2	27 **Co** *Cobalt* 58.9332 2, 8, 15, 2	28 **Ni** *Nickel* 58.71 2, 8, 16, 2	29 **Cu** *Copper* 63.546 2, 8, 18, 1	30 **Zn** *Zinc* 65.37 2, 8, 18, 2	31 **Ga** *Gallium* 69.72 2, 8, 18, 3	32 **Ge** *Germanium* 72.59 2, 8, 18, 4	33 **As** *Arsenic* 74.9216 2, 8, 18, 5	34 **Se** *Selenium* 78.96 2, 8, 18, 6	35 **Br** *Bromine* 79.904 2, 8, 18, 7	36 **Kr** *Krypton* 83.80 2, 8, 18, 8
5	37 **Rb** *Rubidium* 85.47 2, 8, 18, 8, 1	38 **Sr** *Strontium* 88.905 2, 8, 18, 8, 2	39 **Y** *Yttrium* 88.905 2, 8, 18, 9, 2	40 **Zr** *Zirconium* 91.22 2,8,18, 10, 2	41 **Nb** *Niobium* 92.906 2,8,18,12,1	42 **Mo** *Molybdenum* 95.94 2,8,18,13,1	43 **Tc** *Technetium* (97) 2,8,18,13, 2	44 **Ru** *Ruthenium* 101.07 2,8,18,15,1	45 **Rh** *Rhodium* 102.905 2,8,18,16, 1	46 **Pd** *Palladium* 106.4 2,8,18,18,0	47 **Ag** *Silver* 107.868 2,8,18,18,1	48 **Cd** *Cadmium* 112.40 2,8,18,18,2	49 **In** *Indium* 114.82 2,8,18,18,3	50 **Sn** *Tin* 118.69 2,8,18,18,4	51 **Sb** *Antimony* 121.75 2,8,18,18,5	52 **Te** *Tellurium* 127.60 2,8,18,18,6	53 **I** *Iodine* 126.9045 2,8,18,18,7	54 **Xe** *Xenon* 131.30 2,8,18,18,8
6	55 **Cs** *Cesium* 132.905 2,8,18,18,8,1	56 **Ba** *Barium* 137.34 2,8,18,18,8,2	57–71 *Lanthanide Series**	72 **Hf** *Hafnium* 178.49 2,8,18,32,10,2	73 **Ta** *Tantalum* 180.9488 2,8,18,32,11,2	74 **W** *Tungsten* 183.85 2,8,18,32,12,2	75 **Re** *Rhenium* 186.2 2,8,18,32,13,2	76 **Os** *Osmium* 190.2 2,8,18,32,14,2	77 **Ir** *Iridium* 192.2 2,8,18,32,15,2	78 **Pt** *Platinum* 195.09 2,8,18,32,16,2	79 **Au** *Gold* 196.967 2,8,18,32,18,1	80 **Hg** *Mercury* 200.59 2,8,18,32,18,2	81 **Tl** *Thallium* 204.37 2,8,18,32,18,3	82 **Pb** *Lead* 207.19 2,8,18,32,18,4	83 **Bi** *Bismuth* 208.9806 2,8,18,32,18,5	84 **Po** *Polonium* (209) 2,8,18,32,18,6	85 **At** *Astatine* (210) 2,8,18,32,18,7	86 **Rn** *Radon* (222) 2,8,18,32,18,8
7	87 **Fr** *Francium* (223) 2,8,18,32,18,8,1	88 **Ra** *Radium* (226) 2,8,18,32,18,8,2	89–103 *Actinide Series**	104	105													

KEY
atomic number – 5
atomic symbol – **B**
name of element – *Boron*
atomic weight – 10.811
electron arrangement – 2, 3