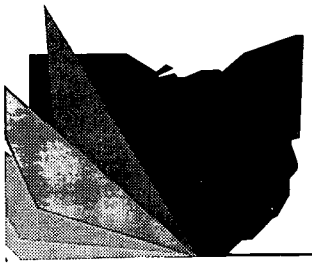
DOCUMENT RESUME

ED 402 345 TM 025 965

TITLE	Ohio Proficiency Tests for Grade 12. Fact Sheet. Twelfth-Grade Proficiency Test in Science.
INSTITUTION	Ohio State Dept. of Education, Columbus.
PUB DATE	95
NOTE	13p.; For related documents, see TM 025 962 and 025 963.
PUB TYPE	Reports - Descriptive (141)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Achievement Tests; Data Analysis; Data Collection; Grade 12; *Graduation Requirements; High Schools; *High School Seniors; Outcomes of Education; *Science Tests; *Scientific Literacy; Test Construction; *Test Items; Test Use
IDENTIFIERS	Fact Sheets; Knowledge Acquisition; *Twelfth Grade Proficiency Test

ABSTRACT

Twelfth-grade students in Ohio who have passed all the sections of the ninth-grade proficiency tests take the twelfth-grade tests. Beginning in 1995-96, these tests will include science, although science will not become a factor in earning a diploma until the year 2000. This fact sheet provides information about the Twelfth-grade Proficiency Test in science. It is based on 18 learning outcomes developed by a committee consisting primarily of educators. These outcomes are listed in the fact sheet. The test, which assesses performance in life science, physical science, earth and space science, and the nature of science, emphasizes both content and process. About 30% of the questions focus on acquiring scientific knowledge and test students' abilities to make observations and collect and organize data. About 40% of the questions concentrate on processing scientific knowledge, testing students' ability to interpret and analyze information. Another 30% of the questions deal with extending scientific knowledge, testing students' ability to apply knowledge and concepts to new situations. (SLD)



Fact Sheet

Twelfth-Grade Proficiency Test in Science

INTRODUCTION

Twelfth-grade students who have passed all areas of the Ninth-grade Proficiency Tests take the Twelfth-grade Proficiency Tests when they are administered annually in February. Beginning in 1995-96, the twelfth-grade tests will include science. While the Twelfth-grade Proficiency Tests will include the science portion, science will not become a factor in earning a Diploma with Honors until after September 15, 2000.

The purpose of this material is to provide information about the Twelfth-grade Proficiency Test in science. The information included in this fact sheet applies to most test questions; however, the descriptions may not cover all questions that could be used on the test. Schools may use this information as they prepare students for this important statewide testing program.

LEARNING OUTCOMES

The twelfth-grade science test is based upon eighteen learning outcomes developed by a committee consisting primarily of Ohio educators and adopted in 1994 by the State Board of Education. The work of this committee was based on the *Ohio Model Competency-Based Science Program* and other related documents. The science portion of the Twelfth-grade Proficiency Tests emphasizes both content and process. Questions developed from the learning outcomes emphasize basic facts, understanding of concepts, and ability to analyze and apply information in a given situation. The three kinds of questions that can be expected are described below.

Acquiring Scientific Knowledge (about 30% of the questions on the test)

Questions of this type test students' ability to make observations and collect and organize data. This may include the ability to make measurements; read graphs, charts, and tables; and classify objects on the basis of their characteristics.

Processing Scientific Knowledge (about 40% of the questions on the test)

Questions of this type test students' ability to interpret and analyze information. This may include the ability to make an inference from given information; recognize patterns and trends in data; use mathematics and mathematical models in science; and manipulate variables.

Extending Scientific Knowledge (about 30% of the questions on the test)

Questions of this type test students' ability to apply knowledge and concepts to new situations. This may include students' ability to develop models; draw conclusions; ask and evaluate questions; and make predictions.

The learning outcomes (in bold) and related information that follow describe the content for the science portion of the Twelfth-grade Proficiency Tests. The indented, italicized information that follows each learning outcome is an example that provides further clarification of the learning outcomes in non-science terms. It should become obvious that student preparation for the twelfth-grade test is a process that begins in Kindergarten and continues through schooling. The material for the twelfth-grade test was drawn from grades eight through ten in the Ohio Science Model. In general, this proficiency test is designed to assess long-term student learning—problem solving and thinking skills—and is not limited to rote knowledge and facts.

This type of learning, according to the Ohio Science Model, is best achieved through hands on experience, the use of authentic science sources including but not limited to library references, textbooks, on-line sources, experts, and long-term activities as students ask questions, collect and analyze data, and make decisions. In this view of science, students' reasons and processes to find answers are more important than their memory of facts. The more experience students have with collecting and analyzing data and information, and justifying their answers, the better prepared they will be for the twelfth-grade science test.

Two references that teachers should consider using when deciding how to teach science concepts at the right level for their students are the *Ohio Model Competency-Based Science Program* available from the ODE and *Benchmarks for Scientific Literacy* (Oxford University Press) which is available at your local bookstore. There are many additional resources available for this purpose. It should be noted, however, that many conceptual errors and misconceptions exist in science books including science textbooks. Using good research methods such as checking several sources is not only a good idea, it is excellent modeling for students.

The outcomes for the twelfth-grade science proficiency test are designed to assess student performance along four strands of science:

- **Life Science**—Though life sciences are often the most familiar to us, this program strikes a balance between the life science concepts that are extremely complicated and laden with terminology with those that can be directly observed and explored by students. In these outcomes (6, 14, 16, 17, and 18), students' abilities to explain their choices and decisions are more important than their knowledge of terminology.

- **Physical Science**—Commonly thought of as physics and chemistry, physical science for this level includes physical principles that can be observed and explored and the inferences that can be made based on concrete experiences in the classroom or witnessed by other means without complicated instrumentation or theories. Three outcomes (1, 2, and 3) are focused on this strand.

- **Earth and Space Science**—Many of the phenomena of earth science are either too slow or too large to witness directly in action. Instruction for these outcomes (9, 10, and 11) generally involves events that students can witness either directly or indirectly through television or film. Using someone else's observations and inferences made based on evidence collected is also useful.

- **Nature of Science**—Built into this science test is an assessment of students' abilities and thinking habits in investigating science ideas. Seven outcomes (4, 5, 7, 8, 12, 13, and 15) in this strand overlap traditional science units and each other and should therefore be reinforced throughout the science curriculum—i.e., taught in context—at every grade level, in nearly every unit.

1. **Trace energy transformations, and/or apply the principles of mass/energy conservation to physical and biological systems.**

Identify the changes in the forms of energy within a system

Students should be able to distinguish between different forms of energy, such as potential and kinetic, and should be familiar with the conservation of energy in living and non-living systems. Students should also be familiar with concepts related to waves, such as frequency and wavelength. Students should be familiar with thermodynamics, how to measure energy, and how to evaluate the energy and mass relationships of a system.

2. **Utilize models of atomic and molecular structures and/or interactions to explain, interpret, or predict experimental results.**

Explain how a chemical reaction occurs on a molecular level

Students should have a basic understanding of models of atomic and molecular structure, and how these models can be used to explain the structure and interactions of matter. This includes concepts such as bonding, reaction kinetics, molecular shape, periodicity, equilibrium, gas laws, phases of matter, atomic theory, and stoichiometry.

3. **Use fundamental forces to explain and make predictions about motions and changes in systems.**

Explain how the path of a thrown ball can be predicted and why the ball falls toward the ground

Students should be familiar with the relationship between changes in the motion of an object and the forces applied to the object and the mass of the object. Students should be familiar with concepts such as forces that cause motion, the four fundamental forces, the effects of the forces, vector analysis, and Newton's three laws of motion.

4. **Analyze the results of changing a component of simple systems.**

Explain and predict how a change can affect a system like a lake, a machine, or a mountain range

Students should be able to recognize and evaluate the effect(s) of changing a component of a biological, chemical, electrical, geological, mechanical, or optical system. This includes concepts such as equilibrium, homeostasis, and system dynamics.

5. Relate structure and function in physical and biological systems.

Use the structure of wings and feathers to explain why birds can fly

Students should be able to recognize and have a basic understanding of the shape, material properties, position, and durability of components of systems as related to function. This would include such things as how geometric shape affects the strength of structures, as in buildings and bones, and how chemical structures relate to uses, such as polymers, enzymes, and crystals. Students should be able to recognize that the results of forces acting on matter throughout the universe are, to a large extent, both measurable and predictable.

6. Predict the effect on an ecosystem due to a given or proposed environmental change.

Identify how an environmental change will disrupt the balance of an ecosystem

Students should have a basic understanding of the interrelationships between living and non-living components of ecosystems. This includes the concepts of trophic structure, food webs, and interactions between species. Students should also understand how environmental changes, both biotic and abiotic, may affect an ecosystem. This includes concepts such as species introductions, extinction, pollution, and changes in abiotic factors, such as rainfall and temperature, or the impact of the human population on the environment.

7. Evaluate the scientific validity of data used in persuasive communication.

Evaluate the advertising claim of a soap product

Students should be able to evaluate the use of scientific information in persuasive communications, such as advertisements, periodicals, public information, and political statements. For example, if students are given a newspaper report relating to science, they should be able to evaluate the validity of the information in the report.

8. Formulate an experimental design to test a given hypothesis.

Design an experiment that will test an idea

Students should be able to devise experiments to test a given idea and analyze the results. Students should be familiar with the scientific method and the concept of a control.

9. Demonstrate an understanding of the impact of natural phenomena on the Earth's geological formations over short and long time spans.

Explain how and why mountains, rivers, and lakes change

Students should be familiar with the theory and processes of weathering, erosion, glaciation, rock formation, geochemical cycles, and plate tectonics (vulcanism, earthquakes, rifting, mountain building, etc.). Students should understand how earth-changing processes are reflected in the geomorphology of Earth's surface.

10. Analyze and interpret meteorological data and predict weather for a specified location.

Use data to predict weather

Students should have a basic understanding of weather and climate. Students should be able to interpret meteorological charts and maps to analyze local weather conditions and global weather patterns.

11. Relate planetary cycles and observations to natural phenomena including seasons, tides, days/nights, phases of the moon, and eclipses.

Explain the tides or an eclipse of the sun

Students should be familiar with the concepts of axial tilt, rate of rotation and revolution, orbital shape, and gravity. Students should understand how these factors are related to phenomena on Earth, such as seasons and tides.

12. Demonstrate an understanding of units of measure and precision by using an appropriate measuring device for an application.

Identify the appropriate instrument needed to make a given measurement

Students should be familiar with the uses of common laboratory devices, such as balances, graduated cylinders, and rulers. Students should be able to use the International System of Units and other measurement systems as appropriate to science topics.

13. Identify the safety precautions that should be taken given a Material Safety Data Sheet (MSDS) or a product label with a key.

Know how to interpret safety precautions given on an MSDS or a product label

Occupational safety regulations, and safety concepts in general, involve the management, storage, and disposal of materials that may be in use at work and at home. MSDS are available from materials suppliers or from the main office of any workplace in Ohio. Students should be able to interpret and use the information on an MSDS or a product label and identify appropriate safety precautions that should be followed.

14. Relate the effects of biotic and abiotic factors to animal life including growth, reproduction, and behavior.

Describe how living and nonliving factors (like fleas and floods) can affect animal life

Students should have a basic understanding of animal biology at the molecular, cellular, tissue, organ, individual, population, and ecological levels. This may include homeostatic mechanisms.

15. Demonstrate an understanding that scientific theories and methods have developed and continue to develop through time.

Describe how explanations of eclipses have changed over time

Students should have an understanding of the tentative nature of science including how and why scientific theories and methods have changed over time. These may include, but are not limited to, models of the solar system, germ theory, models of the atom, heat, elements, and genetics.

16. Relate the effect of light and other factors on various aspects of plant life and growth, including photosynthesis and respiration, germination, and tropisms.

Describe how light and water affect plants

Students should have a basic understanding of plant biology (including algae) at the molecular, cellular, tissue, individual, and ecological levels. This may include homeostatic mechanisms.

17. Relate patterns of diversity, extinction, adaptation, and speciation as a result of natural selection at the molecular and population levels.

Explain why maple seeds that spin as they fall provide a survival advantage to the maple tree;
Use DNA to explain how bulldogs and greyhounds are alike and different

Students should have a basic understanding of the structure and function of DNA, protein synthesis, heredity, and genetic variability. Students should also have a basic understanding of change through time and natural selection, which contribute to species survival, adaptation, and extinction.

18. Relate biodiversity to the stability of ecosystems within biomes.

Explain why a forest is more stable than a corn field when a plant disease occurs

Students should have a basic understanding of how diversity (number and variety of species) affects the stability of ecosystems within biomes. This includes the issue of species interactions.

ADDITIONAL INFORMATION

- The questions will be grouped into two types:

  1) a reading selection (passage) that may contain tables, charts, figures, or a combination of prose and graphic materials followed by a series of related questions. This type of question will comprise 80% of the test questions.

  2) questions that can be answered without referring to a reading selection. The stand-alone questions will comprise 20% of the test questions.

- Each test item will have four answer choices, but only one answer will be correct. There will not be a penalty for choosing an incorrect answer.

- While most questions will require students to interpret/analyze and apply information given to them, some questions may require students to recall specific information. Some questions will require simple calculations.

- Students may use certain acceptable calculators on the twelfth-grade science test. See page 10 for details. No other devices or tools may be used.

- The symbol × is used to signify multiplication, but not to indicate a variable. Other letters will be used to indicate variables in equations.

- Students will have a maximum of two and one-half hours to finish the test. Most students will be able to complete the test within an hour.

- Charts, maps, and other materials in the classroom that could assist students with the test questions will need to be covered or removed during test administration.

ITEM DISTRIBUTION

The test questions will be distributed over four strands as follows:

Strands	Learning Outcomes
Life Science	6, 14, 16, 17, and 18
Physical Science	1, 2, and 3
Earth/Space Science	9, 10, and 11
Nature of Science	4, 5, 7, 8, 12, 13, and 15

Each operational form of the science test will consist of 45 multiple-choice questions (5 of which are embedded field test questions and will not be counted in the student's score). Most learning outcomes will be assessed on each form of the test. The following table shows the possible numbers of questions in each area.

Strands	Acquiring Scientific Knowledge	Processing Scientific Knowledge	Extending Scientific Knowledge	Totals	Approximate % of Test
Life Science	2 - 4	3 - 5	2 - 4	9 - 11	25%
Physical Science	2 - 4	3 - 5	2 - 4	9 - 11	25%
Earth/Space Science	2 - 4	3 - 5	2 - 4	9 - 11	25%
Nature of Science	2 - 4	3 - 5	2 - 4	9 - 11	25%
Totals	10 - 14	14 - 18	10 - 14	40	100%
Approximate % of Test	30%	40%	30%	100%	

FACTS FROM THE TWELFTH-GRADE PROFICIENCY *FIELD TEST*

Test questions based on the science learning outcomes were field tested in January 1995. While the number of students responding to each test item was limited, some general observations regarding student achievement can be made.

- Student performance was highest on questions measuring outcomes 7, 9, 13, and 14.
- Student performance was lowest on questions measuring outcomes 1, 3, 4, 8, and 17.

CALCULATOR GUIDELINES

- Students will be permitted to use certain non-programmable calculators on the twelfth-grade science and twelfth-grade mathematics tests. **Graphing calculators and calculators with certain capabilities are not allowed for test security reasons.**

- Calculators with the following devices and capabilities **CANNOT** be used:

    - Dictionary or thesaurus
    - Electronic reference, organizers, personal planners, or travel organizers
    - Graphing capabilities
    - Language usage, foreign language translation, word input or storage
    - Laptop, palmtop (and other) computers
    - Large (100 steps) programmable
    - Spelling/spell checkers
    - Spreadsheet managers
    - Tape or paper outputs
    - Telephone dialers
    - Word processors

*The following are examples of **ACCEPTABLE** calculators:*

Casio	Sharp	Texas Instruments	Radio Shack	Hewlett Packard
FX-82 series	EL-509	TI-25	EC-4008	HP20S
FX-115 series	EL-520	TI-30		
FX-250D series	EL-531	TI-34		
FX-300 series	EL-546	TI-35		
FX-570 series		TI-60		
FX-991 series				

*The following are examples of **UNACCEPTABLE** calculators:*

Casio	Sharp	Texas Instruments	Radio Shack	Hewlett Packard
FX-4500 series	EL-506	TI-81	EC-4031	HP48G
FX-5000 series		TI-82	EC-4032	
FX-6000 series		TI-85		
FX-7000 series				

NOTES

Ohio Department of Education
Division of Assessment and Evaluation
Assessment Center, Room 207
65 South Front Street
Columbus, Ohio 43215-4183
614-466-0223

U.S. DEPARTMENT OF EDUCATION
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