

**CERTIFICATION EXAMINATIONS
FOR OKLAHOMA EDUCATORS (CEOE™)**

OKLAHOMA SUBJECT AREA TESTS (OSAT™)

FIELD 08: EARTH SCIENCE

TEST FRAMEWORK

June 1998

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Foundations of Scientific Inquiry
Space Systems
Atmospheric Systems
Geological Systems
Water Systems

SUBAREA I—FOUNDATIONS OF SCIENTIFIC INQUIRY

Competency 0001

Understand the relationships and common themes that connect mathematics, science, and technology.

The following topics are examples of content that may be covered under this competency.

Analyze similarities between systems in mathematics, science, and technology (e.g., magnitude and scale, equilibrium and stability, optimization).

Apply concepts and theories from mathematics, biology, chemistry, and physics to an earth science system.

Analyze the use of mathematics (including statistics) and other sciences in the design of a technological solution to a given problem.

Use a variety of software (e.g., spreadsheets, graphing utilities, statistical packages, simulations) and information technologies to model and solve problems in mathematics, science, and technology.

Competency 0002

Understand the historical and contemporary contexts of the earth/space sciences and their application to everyday life.

The following topics are examples of content that may be covered under this competency.

Analyze the significance of key events in the history of the earth/space sciences (e.g., the discovery of a galactic universe, the development of the plate tectonics model).

Assess the societal implications of earth/space science phenomena (e.g., earthquakes, erosion, rising sea levels).

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Competency 0003

Understand the process of scientific inquiry and the role of observation and experimentation in explaining natural phenomena.

The following topics are examples of content that may be covered under this competency.

Analyze processes by which new scientific knowledge and hypotheses are generated.

Analyze ethical issues related to the process of scientific research (e.g., accurately reporting experimental results).

Assess the appropriateness of a specified experimental design to test a given hypothesis.

Assess the role of communication among scientists in promoting scientific progress.

Competency 0004

Understand the processes of gathering, organizing, reporting, and interpreting scientific data; and apply this understanding in the context of earth/space science investigations.

The following topics are examples of content that may be covered under this competency.

Evaluate the appropriateness of a given method or procedure for collecting data for a specified purpose.

Select an appropriate and effective graphic representation (e.g., graph, table, diagram) for organizing, analyzing, and reporting given experimental data.

Apply procedures and criteria for formally reporting experimental procedures and data to the scientific community.

Analyze relationships between factors (e.g., inverse, direct, linear) as indicated by experimental data.

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Competency 0005

Understand types and uses of natural resources, the effects of human activities on the environment, and the need for stewardship to preserve the environmental integrity of the earth's ecosystems.

The following topics are examples of content that may be covered under this competency.

Demonstrate an understanding of the classification, uses, and importance of natural resources and methods of locating and obtaining natural resources.

Assess the positive and negative effects of human activities on the earth's environment (e.g., reclamation of strip mines, ocean dumping).

Evaluate strategies for dealing with environmental problems.

Competency 0006

Understand how to create, use, and interpret physical and mathematical models (e.g., maps, charts, graphs, diagrams) commonly used in earth/space science.

The following topics are examples of content that may be covered under this competency.

Evaluate the appropriateness of alternative models for conveying given information from earth/space science.

Demonstrate an understanding of the methods by which given physical and graphic models are created.

Classify different types of maps (e.g., topographic, geologic) used in earth/space science and analyze the information conveyed by each type of map.

Interpret diagrams relating to earth/space science.

Competency 0007

Understand equipment and materials used in earth/space science investigations, and apply procedures for their proper and safe use.

The following topics are examples of content that may be covered under this competency.

Analyze the principles upon which given instruments are based (e.g., microscope, telescope).

Demonstrate knowledge and applications of basic safety procedures in a laboratory situation.

Apply proper procedures for dealing with given accidents and injuries in the laboratory or in the field.

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SUBAREA II—SPACE SYSTEMS

Competency 0008

Understand the structure, composition, and features of the earth, moon, and sun and the role of technology and exploration in obtaining knowledge about the earth, moon, and sun system.

The following topics are examples of content that may be covered under this competency.

Demonstrate an understanding of the physical characteristics of the earth (e.g., diameter, tilt of axis, distance from the sun) and how they can be determined.

Analyze methods by which the sun's diameter, surface temperature, chemical composition, and energy source are determined.

Relate surface features (e.g., maria, craters, mountains) of the earth's moon to events in the history of the moon.

Demonstrate an understanding of how space exploration has contributed to our knowledge of the earth, moon, and sun system.

Competency 0009

Understand the interactions among the components of the earth, moon, and sun system (including energy transmission and absorption).

The following topics are examples of content that may be covered under this competency.

Demonstrate an understanding of the consequences of the earth's relative position and motion with respect to the sun (e.g., length of day, change of seasons, length of year).

Analyze the consequences of the relative positions and motions of the earth, moon, and sun (e.g., phases of the moon, tides, eclipses).

Demonstrate an understanding of the solar surface as the immediate source of energy for the earth's surface.

Analyze the sunspot cycle and its possible effects on the earth's climate.

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Competency 0010

Understand the scale and organization of the solar system, the role of gravity in the solar system, characteristics of the bodies within the solar system, and physical and mathematical models that describe these objects and their real and apparent motions.

The following topics are examples of content that may be covered under this competency.

Analyze characteristics (e.g., size, density, surface temperature) of the planets.

Analyze the apparent motion of celestial objects to infer solar system models (i.e., geocentric and heliocentric).

Apply Newton's and Kepler's laws to describe and predict the motions of the planets.

Competency 0011

Understand stars, their motions and life cycles, and the methods and technology used to study them.

The following topics are examples of content that may be covered under this competency.

Compare types of telescopes (e.g., optical, radio, infrared, ultraviolet) and the ways in which they are used to acquire information on star characteristics.

Compare types of stars (e.g., pulsars, Cepheid variables) and their characteristics.

Use the H-R diagram to analyze the life cycle of stars.

Analyze stellar life cycles to understand the formation and initial development of the solar system.

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Competency 0012

Understand evidence regarding the size, structure, scale, and motions of the universe, the Milky Way galaxy, and the solar system.

The following topics are examples of content that may be covered under this competency.

Analyze evidence regarding the location of the solar system within the Milky Way galaxy.

Analyze historical methods of inferring the size, structure, and motions of the galaxy and the solar system (e.g., star observations and counts).

Analyze the evidence for current theories of the origin of the earth, the solar system, and the universe.

Analyze types of evidence used to infer scales of the solar system, the Milky Way galaxy, and the universe (e.g., in relation to relative size and distance).

SUBAREA III—ATMOSPHERIC SYSTEMS

Competency 0013

Understand the composition, structure, and properties of the earth's atmosphere and the mechanisms and effects of energy transfer involving the earth-atmosphere system.

The following topics are examples of content that may be covered under this competency.

Compare and contrast properties (e.g., density, composition, temperature) of the atmosphere from the earth's surface through the thermosphere, and understand the significance of changes in these properties.

Analyze how various wavelengths of solar radiation (e.g., ultraviolet, visible light, infrared) are affected as the radiation enters and passes through the atmosphere and is absorbed and radiated from the earth's surface.

Analyze the processes by which energy is transferred to and within the atmosphere (e.g., radiation, convection, conduction).

Analyze global wind patterns in terms of latitudinal variations in insolation and the Coriolis effect.

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Competency 0014

Understand the properties of water, conditions in the atmosphere that favor phase changes, and the energy relationships among phase changes, cloud formation, and precipitation.

The following topics are examples of content that may be covered under this competency.

Relate the physical properties of water (e.g., high specific heat, surface tension) to the chemical structure and properties of water molecules.

Analyze energy changes involved in the transition between phases of water (e.g., latent heat).

Analyze atmospheric conditions under which fog and clouds with various characteristics form (e.g., adiabatic temperature changes, dew point, atmospheric stability).

Understand conditions under which precipitation forms, and predict the type of precipitation that will fall to the earth's surface under given conditions.

Competency 0015

Understand characteristics of broad-scale weather systems and local weather, the relationship between them, and the methods and instruments used to collect and display weather data.

The following topics are examples of content that may be covered under this competency.

Interpret symbols used on weather maps, and analyze the methods used to generate weather maps (e.g., computer models).

Analyze types and characteristics of air masses, their movements, and the kinds of fronts that form between air masses.

Analyze the horizontal and vertical movements of air in high- and low-pressure areas.

Demonstrate an understanding of the use of weather instruments (e.g., thermometer, psychrometer) for collecting given types of weather data.

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Competency 0016

Understand the principles and technology of weather forecasting and the impact of weather on humans.

The following topics are examples of content that may be covered under this competency.

Analyze the use of weather models in forecasting.

Predict weather in a given location based on one or more weather maps.

Evaluate the role of computers and satellite photographs in generating weather forecasts.

Analyze types of hazardous weather to determine appropriate precautions, and demonstrate an understanding of the role of the National Weather Service in issuing weather alerts.

Competency 0017

Understand the locations and characteristics of the earth's major climatic regions, and analyze factors that affect local climate and the relationship between weather and climate.

The following topics are examples of content that may be covered under this competency.

Infer the climatic zone in which a given area is located based on temperature and precipitation data.

Analyze factors that affect the climate in a given region (e.g., insolation, wind patterns, topography).

Analyze the relationship between the climate of a region and its weather.

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Competency 0018

Understand the impact of human activities and natural processes on the atmosphere, theories about the long-range effects of human activities on global climate, and methods of controlling and minimizing these effects.

The following topics are examples of content that may be covered under this competency.

Identify common air pollutants and their sources, and demonstrate an understanding of the effects of air pollutants and atmospheric chemical reactions involving these pollutants.

Demonstrate an understanding of factors that affect local air pollutant concentrations (e.g., population density).

Analyze the theory of global warming due to increased levels of atmospheric carbon dioxide from the burning of fossil fuels.

SUBAREA IV—GEOLOGICAL SYSTEMS

Competency 0019

Understand geochemical systems, the processes of mineral and rock formation, the characteristics of different types of minerals and rocks, and the methods used to identify and classify them.

The following topics are examples of content that may be covered under this competency.

Demonstrate the ability to utilize a classification scheme (e.g., based on physical properties, crystal form, chemical composition) to identify common rock-forming minerals.

Analyze the processes by which different kinds of rocks are formed.

Classify a given rock as sedimentary, igneous, or metamorphic.

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Competency 0020

Understand the structure of the earth, the constructional forces that have shaped its surface, theories and evidence of crustal movements, and the effects of crustal movements on landscape.

The following topics are examples of content that may be covered under this competency.

Demonstrate an understanding of the use of seismic waves to infer the earth's internal structure.

Apply the theory of dynamic equilibrium (e.g., isostasy) to explain landscape development.

Analyze evidence for seafloor spreading and plate tectonics.

Apply the theory of plate tectonics to explain landscape development and geologic phenomena (e.g., volcanism, earthquakes) and to predict future movements of landmasses.

Competency 0021

Understand erosional-depositional processes that change the earth's surface (e.g., weathering, erosion) and the relationship between these processes and landscape development.

The following topics are examples of content that may be covered under this competency.

Demonstrate an understanding of the processes of mechanical, chemical, and biological weathering and factors that affect the rate at which rocks weather and soils are produced.

Demonstrate an understanding of the processes of erosion by various agents (e.g., wind, water, glaciers) and factors that affect erosion rates and patterns.

Demonstrate an understanding of the processes by which given landscape features are formed.

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Competency 0022

Understand characteristics of the major geologic time divisions and theories and supporting evidence regarding the earth's geologic history.

The following topics are examples of content that may be covered under this competency.

Compare and contrast the conditions and characteristic fossils of the various geologic periods.

Apply the laws and principles of geology (e.g., law of original horizontality, law of superposition) to interpret diagrams of rock strata.

Demonstrate an understanding of the principles, applications, and limits of radioactive dating.

Use paleontological information to infer the geologic history of a given area.

SUBAREA V—WATER SYSTEMS

Competency 0023

Understand the processes by which water moves through the hydrologic system, and use this knowledge to analyze local water budgets.

The following topics are examples of content that may be covered under this competency.

Analyze the components of the hydrologic system (e.g., evaporation, transpiration, infiltration).

Evaluate the effects of various factors (e.g., vegetation, gradient, rock strata) on components of a local water budget.

Analyze the energy transformations that occur as water moves through the hydrologic system.

Analyze the role of the hydrologic system in shaping the earth's surface.

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Competency 0024

Understand the processes by which water moves on and beneath the earth's surface.

The following topics are examples of content that may be covered under this competency.

Analyze the factors affecting the flow of water in river systems (e.g., flow velocity, sediment load, cross-sectional stream shape).

Analyze factors affecting the movement of ground water (e.g., aquifers, gradient).

Analyze a cross-sectional diagram of a water table and surrounding rock strata to predict the movement of ground water and the behavior of wells.

Analyze the interrelationship between ground water and surface water.

Competency 0025

Understand the oceanic system; the structure, composition, and properties of the earth's oceans; and the causes and properties of currents and waves.

The following topics are examples of content that may be covered under this competency.

Analyze the composition of seawater (e.g., elements, dissolved gases).

Analyze the relationship between the physical properties of ocean water (e.g., temperature, pressure, density, light) and depth.

Analyze forces affecting surface circulation in the open ocean.

Analyze the effect of waves and tides on coastline formation.