OKLAHOMA SCHOOL TESTING PROGRAM

PARENT, STUDENT, AND TEACHER GUIDE

College and Career Readiness Assessment: SCIENCE CONTENT

2017-2018 GRADE 11

OKLAHOMA STATE DEPARTMENT OF EDUCATION
CHAMPION EXCELLENCE

College and Career Readiness:
Science Content Assessment
Administration Dates

Paper/Pencil Assessment Window
April 2–20, 2018

Online Assessment Window
April 2–20, 2018

Developed and published under contract with the Oklahoma State Department of Education by Measured Progress, 100 Education Way, Dover, NH 03820.

JOY HOFMEISTER
STATE SUPERINTENDENT of PUBLIC INSTRUCTION
OKLAHOMA STATE DEPARTMENT of EDUCATION

Dear Families and Educators,

Students will soon be taking the Oklahoma School Testing Program (OSTP) tests to provide a snapshot of academic performance near the end of the school year. For an overview of the tests that will be given this spring, please click on the following link: http://sde.ok.gov/sde/documents/2016-09-01/assessment-program-overview.

Families will receive online reports that include their child's test results, areas of success and areas in need of additional growth. Paper reports will be sent home by the local school district in summer 2018.

A digital version of the OSTP Parent, Student and Teacher Guide is available on the Oklahoma State Department of Education (OSDE) website at http://sde.ok.gov/sde/assessment-material. Inside this guide, you will find an explanation of what's covered in the test and sample questions to become familiar with the test format. These will help your child understand what to expect on the tests.

OSTP tests measure your child's progress in learning the Oklahoma Academic Standards for school subjects. To learn more about the standards, please visit http://sde.ok.gov/sde/oklahoma-academic-standards.

We know that all families have dreams for their children and want what is best for them. The spring tests are an opportunity for children to showcase their learning this school year. Students are most successful when schools and families work together. During the week of testing, please be sure your child gets plenty of sleep, eats a healthy breakfast and is at school on time.

If you have questions, please contact your school or the State Department of Education at (405) 521-3341 or assessments@sde.ok.gov.

Sincerely,

Joy Hofmeister

State Superintendent of Public Instruction

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THE OKLAHOMA SCHOOL TESTING PROGRAM

The Governor, state legislators, and other Oklahoma elected officials have committed themselves to ensuring that all Oklahoma students receive the opportunity to learn the skills required to obtain post-secondary success. To achieve this goal, schools must prepare every Oklahoma student for colleges, universities, and jobs that require new and different skills.

In addition, the Legislature established the standards-based assessment component of the Oklahoma School Testing Program (OSTP) to measure students' progress in mastering the Oklahoma Academic Standards. Assessments have been developed by national test publishers that specifically measure the Oklahoma Academic Standards. Teachers throughout Oklahoma have been involved in the review, revision, and approval of the questions that are included in these assessments.

In the content areas assessed by the OSTP, a student's performance is reported according to one of four performance levels: Advanced, Proficient, Limited Knowledge, or Unsatisfactory. (Note: due to standard setting, names of the performance levels may change.)

This year, students in Grade 11 will take an online assessment in Science content.

This guide provides an opportunity for families, students, and teachers to become familiar with how skills in these subject areas will be assessed. It presents general test-taking tips, lists the Oklahoma Academic Standards assessed, gives blueprints for the assessments, and provides practice questions.

TEST-TAKING TIPS

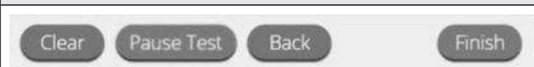
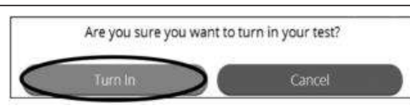
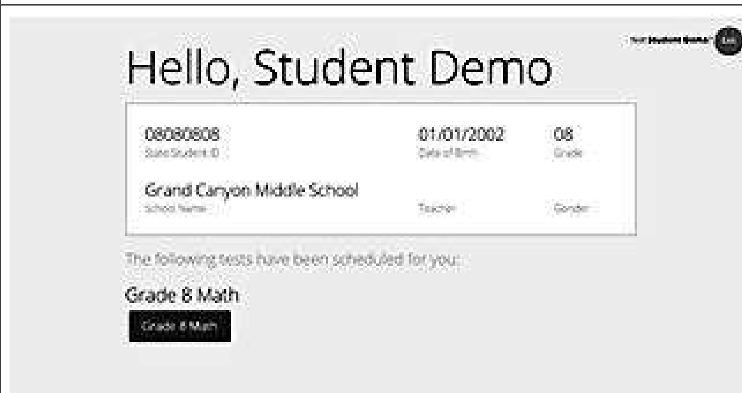
The following tips provide strategies for taking the Oklahoma School Testing Program assessments. Test-taking skills cannot replace proper preparation based on the Oklahoma Academic Standards, which serve as the foundation for these assessments.

To access the practice questions, go to the Student Log-in via browser:
https://oklahoma.measuredprogress.org/Student/login

Student Log-in: practice
Password: oklahoma

General Test-Taking Tips

- Read this guide carefully and complete the practice questions. These questions are for you to familiarize yourself with the format of the assessments and should not be used as a predictor of how you will score on the actual assessments.
- Make sure you understand all directions. If you are uncertain about any of the directions, on the day of the assessment raise your hand to ask questions before starting.
- Check your work if you finish your assessment early. Use the extra time to answer any questions that you skipped.
- Remember that if you cannot finish within the time allotted, you will be given additional time as an immediate extension to the current session to complete the assessment.
- Don't spend too much time on any one question. If a question takes too long to answer, skip it and answer the other questions. You can return to any skipped questions after you have finished all other questions.
- Don't attempt to leave the online testing system by closing the window by clicking on the X. Instead:

Steps	Button to Click
On the last item, students click **Finish**.	
On the test review screen, students click **Turn In**.	
Below the confirmation question, students click **Turn In**.	
Student returns to test section selection page and may select the next section or click **Exit** to exit the test.	

Multiple-Choice Questions

- Each multiple-choice question contains four answer choices.
- Read each question and every answer choice carefully. Choose the best answer for each question.
- Be sure that you have seen all four answer choices before making your selection. On an online assessment, this may require you to use the scroll bar on the right or left side of the question.

Technology Enhanced Questions

- Science online assessments will contain technology enhanced questions.
- There are four types of technology enhanced questions:
  - Matching – students match information from one column to another
  - Dropdown – students select the correct answer, from a dropdown menu, to complete a statement
  - Drag-and-Drop – students drag selected answers into category boxes
  - Hotspot – students highlight a box or boxes containing the correct answer(s)
- Read the directions at the start of each question carefully, as they explain how to interact with the components on the screen, and how to change your answer.
- Use the scrolling tool, if needed, to see the entire item.

Online Assessments

The Science Content Assessment is divided into separate sections. These separate sections may be administered on the same day with a break given between sections or on consecutive instructional days. Students taking an online assessment have both multiple-choice and technically enhanced questions.

Students should have enough time to complete all sections. Students may be given additional time if needed, but additional time will be given as an immediate extension of the same testing period, not at a different time.

Students who finish early need to make sure their work is complete and are encouraged to check and verify their answers prior to turning in each separate section. Students will not be allowed to log back into a section once they have clicked the turn-in buttons.

The following sections:

- list the Oklahoma Academic Standards assessed in each subject area,
- reproduce the student directions,
- present practice questions, and
- provide information about preparing for testing of the Oklahoma Academic Standards.

OKLAHOMA ACADEMIC STANDARDS

The Oklahoma School Testing Program will assess the full depth and breadth of the Oklahoma Academic Standards (OAS) in the Grade 11 Science Content Assessment. Presented below are the OAS standards for Grade 11 Science. Student performance on the assessment is reported at the domain level. Standards assessed are based on the 2014 adopted Oklahoma Academic Standards for Science.

Science

OAS Science—Grade 11

<table>
<tr><td colspan="3">From Molecules to Organisms: Structure and Processes: HS-LS1-1
Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.</td></tr>
<tr><td colspan="3">Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.</td></tr>
<tr><td>Science & Engineering Practice:

Constructing Explanations and Designing Solutions
• Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</td><td>Disciplinary Core Idea:

Structure and Function
• Systems of specialized cells within organisms help them perform the essential functions of life.
• All cells contain genetic information in the form of DNA molecules.
• Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.</td><td>Crosscutting Concept:

Structure and Function
• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</td></tr>
</table>

<table>
<tr><td colspan="3">From Molecules to Organisms: Structure and Processes: HS-LS1-2
Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.</td></tr>
<tr><td colspan="3">Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical level.</td></tr>
<tr><td>Science & Engineering Practice:

Developing and Using Models
• Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.</td><td>Disciplinary Core Idea:

Structure and Function
• Multicellular organisms have a hierarchical structural organization in which any one system is made up of numerous parts and is itself a component of the next level.</td><td>Crosscutting Concept:

Systems and System Models
• Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.</td></tr>
</table>

From Molecules to Organisms: Structure and Processes: HS-LS1-3

Plan and conduct an investigation to provide evidence of the importance of maintaining homeostasis in living organisms.

Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Planning and Carrying Out Investigations • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	**Structure and Function** • Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Outside that range (e.g., at too high or too low external temperature, with too little food or water available) the organism cannot survive.	**Stability and Change** • Feedback (negative or positive) can stabilize or destabilize a system.

From Molecules to Organisms: Structure and Processes: HS-LS1-4

Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Developing and Using Models • Use a model based on evidence to illustrate the relationships between systems or between components of a system.	**Growth and Development of Organisms** • In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. • The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. • Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.	**Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows— within and between systems at different scales.

From Molecules to Organisms: Structure and Processes: HS-LS1-5

Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

Assessment Boundary: The assessment should provide evidence of students' abilities to describe the inputs and outputs of photosynthesis, not the specific biochemical steps (e.g., photosystems, electron transport, and Calvin cycle).

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Developing and Using Models • Use a model based on evidence to illustrate the relationships between systems or between components of a system.	**Organization for Matter and Energy Flow in Organisms** • The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.	**Energy and Matter** • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

From Molecules to Organisms: Structure and Processes: HS-LS1-6

Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

Assessment Boundary: Assessment does not include the use of atomic masses or intermolecular forces.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Constructing Explanations and Designing Solutions • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**Organization for Matter and Energy Flow in Organisms** • The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.	**Energy and Matter** • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

From Molecules to Organisms: Structure and Processes: HS-LS1-7

Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration (e.g., glycolysis and Kreb's Cycle).

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Developing and Using Models • Use a model based on evidence to illustrate the relationships between systems or between components of a system.	**Organization for Matter and Energy Flow in Organisms** • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. • As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. • Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. • Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.	**Energy and Matter** • Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.

Ecosystems: Interactions, Energy, and Dynamics: HS-LS2-1

Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Using Mathematics and Computational Thinking • Use mathematical OR computational representations of phenomena or design solutions to support explanations.	**Interdependent Relationships in Ecosystems** • Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from challenges such as predation, competition, and disease. • Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.	**Scale, Proportion, and Quantity** • The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

Ecosystems: Interactions, Energy, and Dynamics: HS-LS2-2

Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Assessment Boundary: Assessment is limited to the provided data.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Using Mathematics and Computational Thinking • Use mathematical representations of phenomena or design solutions to support and revise explanations.	**Interdependent Relationships in Ecosystems** • Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from challenges such as predation, competition, and disease. • Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. **Ecosystem Dynamics, Functioning, and Resilience** • A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. • If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. • Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.	**Scale, Proportion, and Quantity** • Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.

Ecosystems: Interactions, Energy, and Dynamics: HS-LS2-3

Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Constructing Explanations and Designing Solutions • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**Cycles of Matter and Energy Transfer in Ecosystems** • Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.	**Energy and Matter** • Energy drives the cycling of matter within and between systems.

Ecosystems: Interactions, Energy, and Dynamics: HS-LS2-4

Use a mathematical representation to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

Assessment Boundary: The assessment should provide evidence of students' abilities to develop and use energy pyramids, food chains, food webs, and other models from data sets.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Using Mathematics and Computational Thinking • Use mathematical representations of phenomena or design solutions to support claims.	**Cycles of Matter and Energy Transfer in Ecosystems** • Plants or algae form the lowest level of the food web. • At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. • Given this inefficiency, there are generally fewer organisms at higher levels of a food web. • Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. • The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. • At each link in an ecosystem, matter and energy are conserved.	**Energy and Matter** • Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.

Ecosystems: Interactions, Energy, and Dynamics: HS-LS2-5

Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Developing and Using Models • Develop a model based on evidence to illustrate the relationships between systems or components of a system.	**Cycles of Matter and Energy Transfer in Ecosystems** • Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. **Energy in Chemical Processes** • The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. (secondary to HS-LS2-5)	**Systems and System Models** • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Ecosystems: Interactions, Energy, and Dynamics: HS-LS2-6

Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

Assessment Boundary: The assessment should provide evidence of students' abilities to derive trends from graphical representations of population trends. Assessments should focus on describing drivers of ecosystem stability and change, not on the organismal mechanisms of responses and interactions.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Engaging in Argument from Evidence • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	**Ecosystem Dynamics, Functioning, and Resilience** • A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. • If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. • Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.	**Stability and Change** • Much of science deals with constructing explanations of how things change and how they remain stable.

Ecosystems: Interactions, Energy, and Dynamics: HS-LS2-8

Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Assessment Boundary: The assessment should provide evidence of students' abilities to: (1) distinguish between group versus individual behavior, (2) identify evidence supporting the outcomes of group behavior, and (3) develop logical and reasonable arguments based on evidence.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Engaging in Argument from Evidence • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.	**Social Interactions and Group Behavior** • Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Heredity: Inheritance and Variation of Traits: HS-LS3-1

Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

Assessment Boundary: Assessments may include codominance, incomplete dominance, and sex-linked traits, but should not include dihybrid crosses.

Science & Engineering Practice:

Asking Questions and Defining Problems

- Ask questions that arise from examining models or a theory to clarify relationships.

Disciplinary Core Idea:

Inheritance of Traits

- Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA.
- The instructions for forming species' characteristics are carried in DNA.
- All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways.
- Not all DNA codes for protein, some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.

Structure and Function

- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (secondary to HS-LS3-1)

Crosscutting Concept:

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Heredity: Inheritance and Variation of Traits: HS-LS3-2

Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanisms of specific steps in the process.

Science & Engineering Practice:

Engaging in Argument from Evidence

- Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.

Disciplinary Core Idea:

Variation of Traits

- In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation.
- Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited.
- Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in the population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.

Crosscutting Concept:

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Heredity: Inheritance and Variation of Traits: HS-LS3-3

Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Assessment Boundary: The assessment should provide evidence of students' abilities to use mathematical reasoning to explain the variation observed in a population as a combination of genetic and environmental factors. Hardy-Weinberg calculations are beyond the intent.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Analyzing and Interpreting Data • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	**Variation of Traits** • Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in the population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.	**Scale, Proportion, and Quantity** • Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Biological Unity and Diversity: HS-LS4-1

Analyze and evaluate how evidence such as similarities in DNA sequences, anatomical structures, and order of appearance of structures during embryological development contribute to the scientific explanation of biological diversity.

Assessment Boundary: The assessment should provide evidence of students' abilities to evaluate and analyze evidence (e.g., cladograms, analogous/homologous structures, and fossil records).

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Analyzing and Interpreting Data • Analyze and interpret data to determine similarities and differences in findings.	**Evidence of Common Ancestry and Diversity** • Genetic information provides evidence of common ancestry and diversity. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.	**Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Biological Unity and Diversity: HS-LS4-2

Construct an explanation based on evidence that biological diversity is influenced by (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

Assessment Boundary: Assessment does not include genetic drift, gene flow through migration, and co-evolution.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Constructing Explanations and Designing Solutions • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**Natural Selection** • Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals.	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Biological Unity and Diversity: HS-LS4-3

Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

Assessment Boundary: The assessment should provide evidence of students' abilities to analyze shifts in numerical distribution of traits as evidence to support explanations. Analysis is limited to basic statistical and graphical analysis, not gene frequency calculations.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Analyzing and Interpreting Data • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	**Natural Selection** • Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. • The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. **Adaptation** • Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. • Adaptation also means that the distribution of traits in a population can change when conditions change.	**Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations and phenomena.

Biological Unity and Diversity: HS-LS4-4

Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

Assessment Boundary: The assessment should measure students' abilities to differentiate types of evidence used in explanations.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Constructing Explanations and Designing Solutions • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**Adaptation** • Natural selection leads to adaptation; that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. • That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. • Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species.	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Biological Unity and Diversity: HS-LS4-5

Synthesize, communicate, and evaluate the information that describes how changes in environmental conditions can affect the distribution of traits in a population causing: 1) increases in the number of individuals of some species, 2) the emergence of new species over time, and 3) the extinction of other species.

Assessment Boundary: The assessment should provide evidence of students' abilities to explain the cause and effect for how changes to the environment affect distribution or disappearance of traits in species.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Engaging in Argument from Evidence • Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments.	**Adaptation** • Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. • Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' adaptation over time is lost.	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Matter and Its Interactions: HS-PS1-1

Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Developing and Using Models • Use a model to predict the relationships between systems or between components of a system.	**Structure and Properties of Matter** • Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. • The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.	**Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Matter and Its Interactions: HS-PS1-2

Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, knowledge of the patterns of chemical properties, and formation of compounds.

Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Constructing Explanations and Designing Solutions • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**Structure and Properties of Matter** • The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. **Chemical Reactions** • The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	**Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Matter and Its Interactions: HS-PS1-5

Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature and concentration.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Constructing Explanations and Designing Solutions • Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.	**Chemical Reactions** • Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.	**Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Matter and Its Interactions: HS-PS1-7

Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Assessment Boundary: Assessment does not include complex chemical reactions.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Using Mathematics and Computational Thinking • Use mathematical representations of phenomena to support claims.	**Chemical Reactions** • The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.	**Energy and Matter** • The total amount of energy and matter in closed systems is conserved.

Motion and Stability: Forces and Interactions: HS-PS2-5

Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

Assessment Boundary: Assessment is limited to designing and conducting investigations with provided materials and tools.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Planning and Carrying Out Investigations • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	**Types of Interactions** • Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. • Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. **Definitions of Energy** • “Electrical energy” may mean energy stored in a battery or energy transmitted by electric currents.	**Cause and Effect** • Systems can be designed to cause a desired effect.

Energy: HS-PS3-1

Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

Assessment Boundary: Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and potential energy.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Using Mathematics and Computational Thinking • Create a computational model or simulation of a phenomenon, designed device, process, or system.	**Definitions of Energy** • Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system’s total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. **Conservation of Energy and Energy Transfer** • Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. • Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. • Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g., relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. • The availability of energy limits what can occur in any system.	**Systems and System Models** • Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.

Energy: HS-PS3-2

Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.

Assessment Boundary: Assessment does not include quantitative calculations.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Developing and Using Models • Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	**Definitions of Energy** • Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. • At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. • These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.	**Energy and Matter** • Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.

Energy: HS-PS3-3

Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Constructing Explanations and Designing Solutions • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.	**Definitions of Energy** • At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. **Defining and Delimiting Engineering Problems** • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. **Interdependence of Science, Engineering, and Technology** • Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.	**Energy and Matter** • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

Energy: HS-PS3-4

Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Planning and Carrying Out Investigations • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.	**Conservation of Energy and Energy Transfer** • Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. • Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down).	**Systems and System Models** • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

Waves and Their Applications in Technologies for Information Transfer: HS-PS4-1

Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Using Mathematics and Computational Thinking • Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations.	**Wave Properties** • The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.	**Cause and Effect** • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Waves and Their Applications in Technologies for Information Transfer: HS-PS4-4

Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

Assessment Boundary: Assessment is limited to qualitative descriptions.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Obtaining, Evaluating, and Communicating Information • Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible.	**Electromagnetic Radiation** • When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). • Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. • Photoelectric materials emit electrons when they absorb light of a high-enough frequency.	**Cause and Effect** • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

OKLAHOMA SCHOOL TESTING PROGRAM

TEST BLUEPRINT SCIENCE 2017–2018 GRADE 11

The blueprint describes the content and structure of the operational test and defines the target number of test items by reporting category for the CCR Science Content Assessment.

REPORTING CATEGORIES[1] (OKLAHOMA ACADEMIC STANDARDS FOR SCIENCE)	TARGET NUMBER OF MC ITEMS	TARGET NUMBER OF TE ITEMS[2]	TARGET RANGE OF SCORE POINTS[3] (PERCENTAGE OF TOTAL)	TARGET NUMBER OF CLUSTERS[4]
LIFE SCIENCES HS-LS1-1, HS-LS1-2, HS-LS1-3, HS-LS1-4, HS-LS1-5, HS-LS1-6, HS-LS1-7, HS-LS2-1, HS-LS2-2, HS-LS2-3, HS-LS2-4, HS-LS2-5, HS-LS2-6, HS-LS2-8, HS-LS3-1, HS-LS3-2, HS-LS3-3, HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5	29	1	31 (50%)	10
PHYSICAL SCIENCES HS-PS1-1, HS-PS1-2, HS-PS1-5, HS-PS1-7, HS-PS2-5, HS-PS3-1, HS-PS3-2, HS-PS3-3, HS-PS3-4, HS-PS4-1, HS-PS4-4	29	1	31 (50%)	10
TOTAL OPERATIONAL TEST	58	2	100% (62 TOTAL SCORE POINTS)	20

(Please note this blueprint does not include items that may be field-tested.)

[1] Reporting category names are taken from the content domain names in the OAS-Science.

[2] Technology-enhanced items (TE items/TEIs) may be used to more authentically address some aspects of the performance expectations (PEs). Each TEI will have a value of two score points. At this time, it is expected that each reporting category will include one TEI. More TEIs may possibly be introduced in future operational cycles. For a paper accommodation, the TEIs will be replaced by paired MC items (two linked multiple-choice questions), also worth two score points.

[3] A minimum of 12 points is required to report results for a reporting category for the CCR Science Content Assessment.

[4] Performance expectations will be assessed using a cluster-based format: a set of three multiple-choice items linked with a common stimulus or a set of two multiple-choice items and a technology-enhanced item linked with a common stimulus. Each cluster will align to a single performance expectation. The CCR Science Content operational test will contain a total of 20 clusters.

Oklahoma School Testing Program

Calculator Policy

Effective beginning 2017–18 School Year

Purpose

- The items on the Grade 6–8 Math, Grade 8 Science, and CCRA Science Content assessments are designed so that all tasks can be solved without the use of a calculator. However, certain tasks are more difficult if a calculator is not available.

- Before the first day of the test, students using a calculator for any Mathematics and Science assessment should be familiar with the use of the specific calculator that can be utilized. Students should be consistently instructed throughout the school year in the use of calculators; otherwise it may hinder students' performance on the assessment.

Grade-Specific Requirements

Grades 3–5 Mathematics:

Calculators are only allowed as an approved accommodation for students on an IEP or 504 Plan, and only basic four-function calculators with square root and percent keys are allowed.

Grades 6–7 Mathematics:

Basic four-function calculators that include square root and percent keys but do not include +/- keys are allowed, (Calculators with memory keys, including M+ and M-, are acceptable).

Grade 8 Mathematics and Science:

Scientific calculators meeting general requirements are allowed.

Grade 11 CCRA Mathematics and Science:

For part 1, please see the policy of the assessment your district has chosen.

ACT: http://www.act.org/content/dam/act/unsecured/documents/ACT-calculator-policy.pdf
SAT: https://collegereadiness.collegeboard.org/sat/taking-the-test/calculator-policy

For part 2 Science Content

Graphing calculators and/or scientific calculators meeting general requirements are allowed.

General Requirements

- Calculators are permitted but are not required.
- Calculator capabilities described for a specific subject give the maximum capabilities allowed; calculators with less capability are acceptable.
- Students may not share calculators.
- Students may use their own calculators or those provided by the school.
- Calculators that make noise must have the sound feature turned off.
- Calculators that have paper tape must have the tape removed.
- Programs, applications, or documents must be removed or disabled prior to the test session.
- ***All calculators must have the memory cleared or reset before and after the test session***.
    - See the manufacturer's website or user guide for clearing procedures.

ExamCalc Online Testing Calculator

For grades 6–8 Math and Science and CCRA Part 2 Science content, each test administered online will be equipped with an ExamCalc within the testing interface. Students may use a handheld calculator meeting their grade-specific requirements, the ExamCalc or both. The calculators provided in ExamCalc are:

Grades 6–7	TI-108 with the +/- key disabled
Grade 8	TI-30XS Multiview
CCRA Science Content	TI-84 Plus

Prohibited Calculators

- Pocket organizers
- Handheld or laptop computers
- Electronic writing pads or pen-input devices
- Calculators built into cellular phones, smart watches, tablets, or other electronic communication devices
- Calculators with a typewriter keypad (QWERTY format)
- Calculators with programs or applications that cannot be removed or disabled (e.g., Polynomial Root-Finders and Simultaneous Equation Solvers)
- Calculators that provide Internet access or Bluetooth

Deleting or Disabling Programs, Applications, and Documents on Graphing Calculators

Texas Instruments

See the instructions for your calculator model at: www.education.ti.com/us/testprep

Casio

To reset the memory on any Casio graphing calculator, use the following steps:
[menu], go to system, [exe], [F5] to reset, [F2] for main memory, [F1] for yes, [exit]

For all other calculators, please refer to the manufacturer's website or user guide.

Test Security and Validity

Using a calculator that does not meet the above requirements invalidates the test results and is a violation of test security and test validity. Any violation will be reported to the State Superintendent and may result in revocation of teaching and/or administrative certificates.

MULTIPLE-CHOICE PRACTICE QUESTIONS

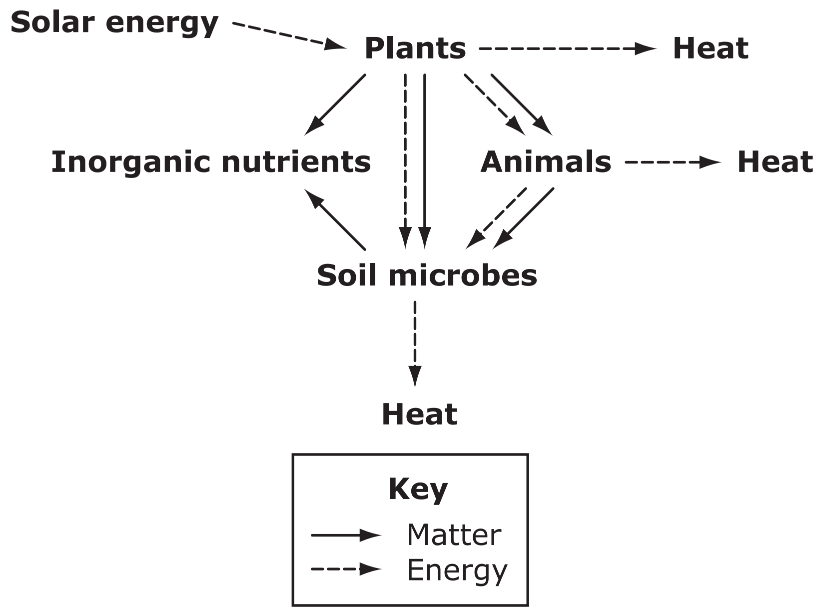
To access the practice questions, go to the Student Log-in via browser:
https://oklahoma.measuredprogress.org/Student/login

Student Log-in: practice Password: oklahoma

Study the information. Then answer questions 1–4.

A group of students studied a grassland ecosystem. The students learned that biomass is a measure of the amount of matter in an ecosystem. They also learned that energy is primarily transferred through an ecosystem in the form of food. The students created a diagram to show what they learned.

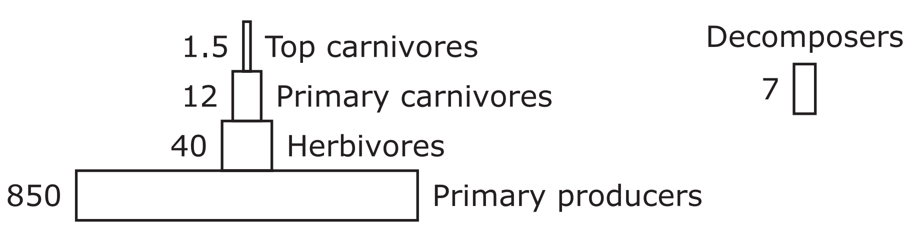
Matter and Energy Flow in a Grassland Ecosystem



After the students created the diagram, their teacher asked them to answer this question: *How is biomass related to energy flow in the grassland ecosystem?*

To help them answer the question, the students found biomass data. They created this second diagram to illustrate the data.

Pyramid of Biomass (g/m^2)



GO ON ▶

1 A student makes a claim about how the heat energy shown in the diagram "Matter and Energy Flow in a Grassland Ecosystem" helps explain the amounts of biomass shown in the diagram "Pyramid of Biomass."

> **Claim:** As heat energy is released by consumers, less heat is available to organisms at the next level. Therefore the higher pyramid levels contain less biomass.

Which statement best analyzes the student's claim?

A The claim is supported; organisms store heat energy in food to produce biomass, and the available heat energy decreases at the higher levels.

B The claim is supported; the amount of biomass stored at higher levels is very small, and small amounts of biomass show that energy and matter are lost from a system.

C The claim is rejected; heat energy flows in all directions among the levels, and this allows food energy to be stored within biomass at all levels.

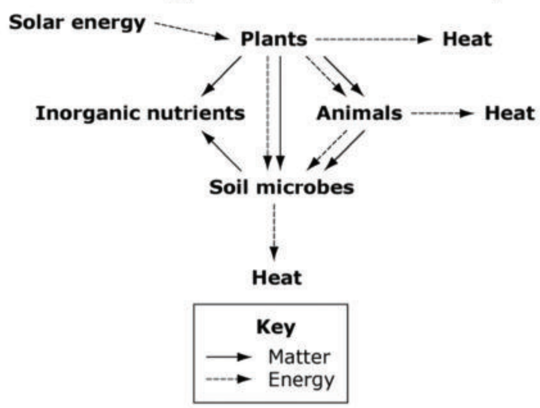
D The claim is rejected; energy from food is used to produce biomass, and the conversion of some of this energy to heat in each level reduces energy to be stored in biomass.

GO ON ▶

2

A group of students studied a grassland ecosystem. The students learned that biomass is a measure of the amount of matter in an ecosystem. They also learned that energy is primarily transferred through an ecosystem in the form of food. The students created a diagram to show what they learned.

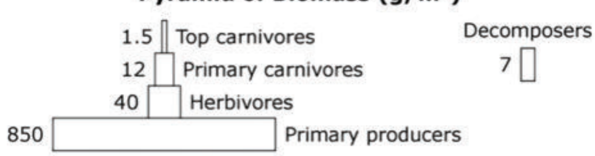
Matter and Energy Flow in a Grassland Ecosystem



After the students created the diagram, their teacher asked them to answer this question: *How is biomass related to energy flow in the grassland ecosystem?*

To help them answer the question, the students found biomass data. They created this second diagram to illustrate the data.

Pyramid of Biomass (g/m^2)



Three claims about energy flow in the ecosystem are listed. Some of the claims are supported by the information in the diagrams, while other claims are not supported. **Identify whether each claim is "supported" or "not supported" based on the reasoning provided.** Use the drop-down menu next to each claim to select your responses. To select an answer click the menu and then click the desired answer.

Claim	Supported or Not Supported?
The plants receive food energy from other organisms and from sunlight.	-Select an Answer- ▼
The amount of stored energy changes as it flows between different trophic levels.	-Select an Answer- ▼
The energy available to animals and microbes is limited by photosynthesis in plants.	-Select an Answer- ▼

GO ON ▶

Claim	Supported or Not Supported?
The plants receive food energy from other organisms and from sunlight.	-Select an Answer- Supported: the food web shows a solid arrow from inorganic nutrients to plants Not Supported: the food web shows a single dashed arrow from the sun to the plants
The amount of stored energy changes as it flows between different trophic levels.	
The energy available to animals and microbes is limited by photosynthesis in plants.	-Select an Answer-

Claim	Supported or Not Supported?
The plants receive food energy from other organisms and from sunlight.	-Select an Answer-
The amount of stored energy changes as it flows between different trophic levels.	-Select an Answer- Supported: the food web shows arrows between the organisms and heat Not Supported: the food web shows that both heat and energy move through the ecosystem
The energy available to animals and microbes is limited by photosynthesis in plants.	

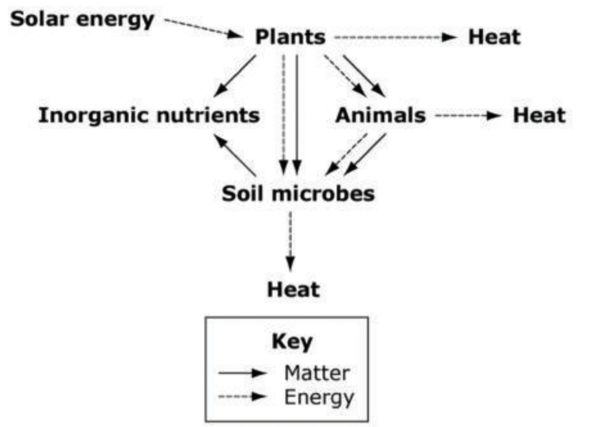
Claim	Supported or Not Supported?
The plants receive food energy from other organisms and from sunlight.	-Select an Answer-
The amount of stored energy changes as it flows between different trophic levels.	-Select an Answer-
The energy available to animals and microbes is limited by photosynthesis in plants.	-Select an Answer- Supported: the arrows trace all energy back to the use of sunlight by plants Not Supported: heat energy is present at each level of the system

GO ON ▶

3

A group of students studied a grassland ecosystem. The students learned that biomass is a measure of the amount of matter in an ecosystem. They also learned that energy is primarily transferred through an ecosystem in the form of food. The students created a diagram to show what they learned.

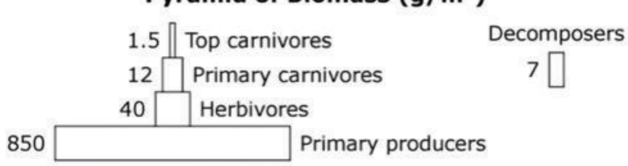
Matter and Energy Flow in a Grassland Ecosystem



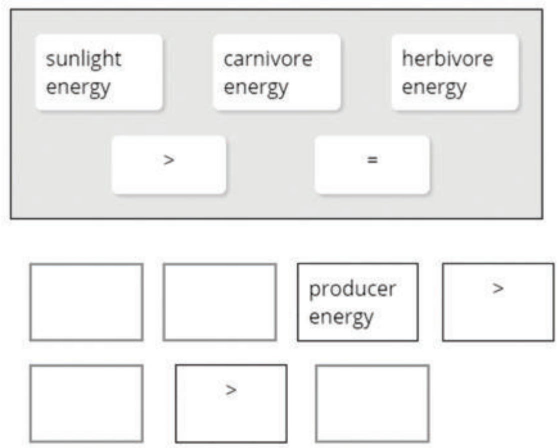
After the students created the diagram, their teacher asked them to answer this question: *How is biomass related to energy flow in the grassland ecosystem?*

To help them answer the question, the students found biomass data. They created this second diagram to illustrate the data.

Pyramid of Biomass (g/m^2)



Complete the mathematical expression to compare the amounts of energy in different levels of the ecosystem. Drag and drop the labels into the boxes to create the mathematical expression for the amounts of energy at the different levels. To drag a label, click and hold the label, and then drag it to the desired space. You may use each label once or not at all.



GO ON ▶

4 **Based on the diagrams, which mathematical expression correctly compares the amounts of energy in different parts of the ecosystem?**

F producer energy > herbivore energy

G carnivore energy > herbivore energy

H carnivore energy = herbivore energy

J producer energy = herbivore energy

Based on the diagrams, what is another mathematical expression that correctly compares the amounts of energy in parts of the ecosystem?

F microbe energy = carnivore energy

G herbivore energy > microbe energy

H microbe energy > carnivore energy

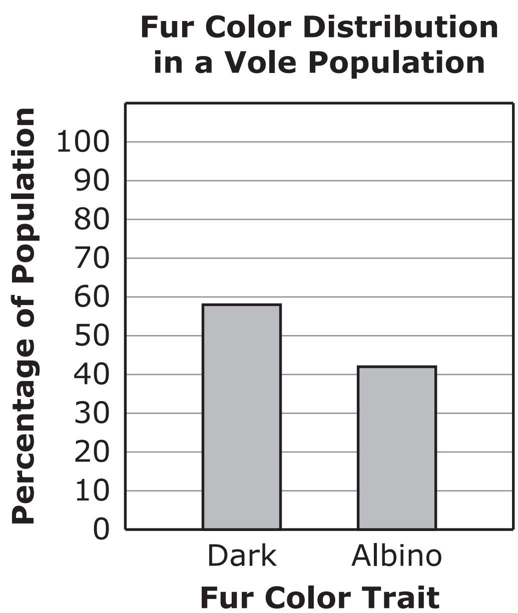
J herbivore energy = microbe energy

GO ON ▶

Study the information. Then answer questions 5–7.

Meadow voles are small rodents similar to mice that are found in grassy areas. They store food and give birth to their young in underground burrows. Meadow voles usually have dark fur, but they can sometimes have white fur. Voles with white fur are called albinos. The genetic cause of the albino phenotype is the recessive form of a gene for fur color in voles. The dominant form of the gene codes for dark fur.

Albino voles are typically rare and usually have low survival rates in the population. Scientists recorded the distribution of fur color phenotypes in a vole population in one particular habitat, as shown in the graph.



Because the data were not what the scientists expected, they decided to investigate how genetic and environmental factors affect the distribution of expressed traits in vole populations.

GO ON ▶

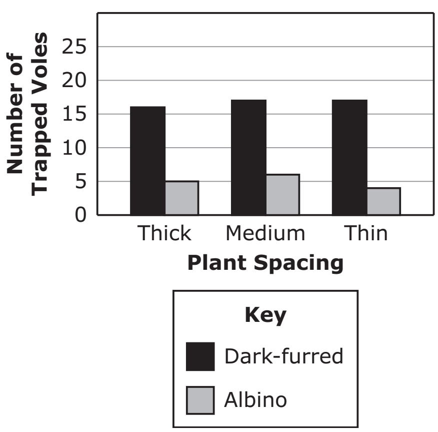
5 When thinking about environmental factors to explain the data in the graph "Fur Color Distribution in a Vole Population," scientists observed that there were many plants growing close together in the habitat. The scientists hypothesized that the thick plant cover allowed albino voles to be hidden from predators, and that this caused the fur color distribution seen in the vole population.

The scientists set up an experiment to test how the spacing of plants in an area affects the abundance of dark-furred and albino voles. In late spring, scientists released equal numbers of dark-furred and albino voles into habitats with different spacing and numbers of plants. Three months later, they set traps to capture some of the voles remaining in each area.

Which graph shows results that best support the scientists' hypothesis?

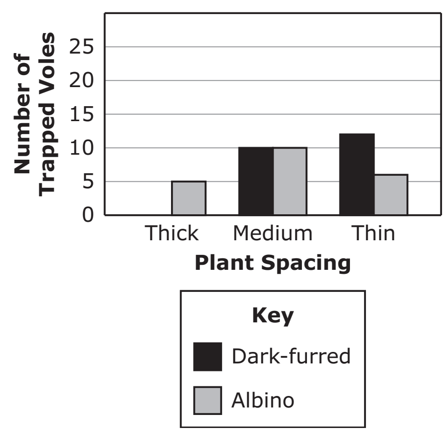
A

Effect of Plant Spacing on Vole Abundance



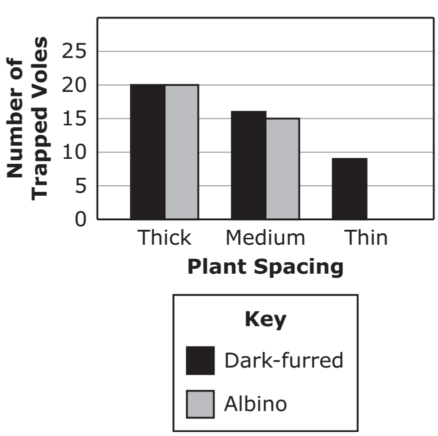
B

Effect of Plant Spacing on Vole Abundance



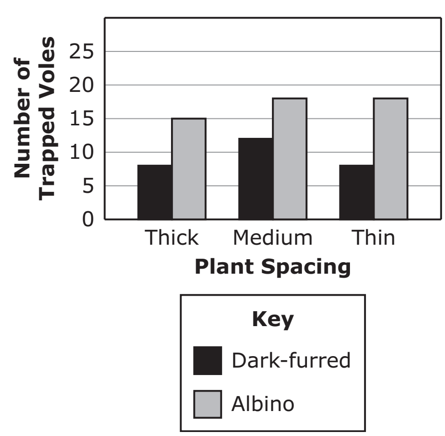
C

Effect of Plant Spacing on Vole Abundance



D

Effect of Plant Spacing on Vole Abundance



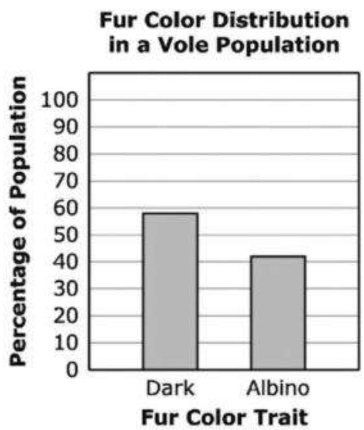
GO ON ▶

6

Study the information. Then answer the following three questions.

Meadow voles are small rodents similar to mice that are found in grassy areas. They store food and give birth to their young in underground burrows. Meadow voles usually have dark fur, but they can sometimes have white fur. Voles with white fur are called albinos. The genetic cause of the albino phenotype is the recessive form of a gene for fur color in voles. The dominant form of the gene codes for dark fur.

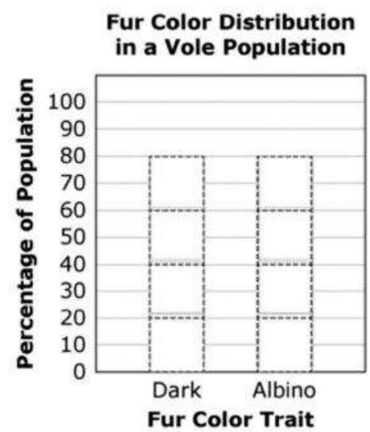
Albino voles are typically rare and usually have low survival rates in the population. Scientists recorded the distribution of fur color phenotypes in a vole population in one particular habitat, as shown in the graph.



Because the data were not what the scientists expected, they decided to investigate how genetic and environmental factors affect the distribution of expressed traits in vole populations.

Scientists also wondered how another environmental factor, snow, would affect the distribution of fur color in the vole population. They measured survival of dark-furred and albino voles in the winter, after several years with winters that had more snow than usual.

Complete the bar graph to show how the fur color distribution in a vole population would most likely change for voles captured under these conditions. Click on the boxes in the graph to create two solid-colored bars with appropriate heights. To select a box, click the box. To deselect a box, click on it again.



7

Study the information. Then answer the following three questions.

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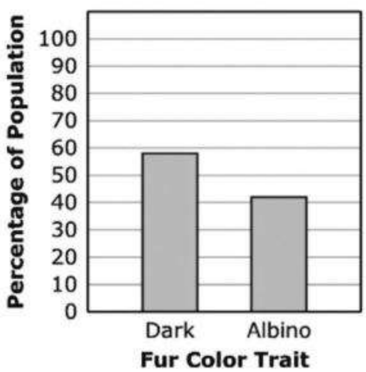
Albino voles are typically rare and usually have low survival rates in the population. Scientists recorded the distribution of fur color phenotypes in a vole population in one particular habitat, as shown in the graph.

Fur Color Distribution in a Vole Population



Because the data were not what the scientists expected, they decided to investigate how genetic and environmental factors affect the distribution of expressed traits in vole populations.

Although the environment plays a role in determining the distribution of the fur color trait in the vole population, the percentages of albino voles and voles with dark fur are also influenced by the mating patterns of the voles.

Match each vole cross to its likely outcome to show the expected percentages of offspring with each fur color. To connect a cross and outcome, click the cross and then the outcome, and a line will automatically be drawn between them. To remove a connection, hold the pointer over the line until it turns red, and then click it. You may connect each outcome to more than one vole cross.

Vole cross	Outcome
AA x AA	50% dark fur and 50% albino fur
Aa x aa	100% of offspring with dark fur
AA x aa	100% of offspring with albino fur
aa x aa	

Study the information. Then answer questions 8–10. You may refer to the periodic table found on the inside cover of the back of your booklet.

In the 1930s, the first commercial airlines carried passengers across the Atlantic Ocean. But the passengers did not travel in airplanes. Instead, they traveled in airships.

The Zeppelin Construction Company, a German company, built an airship they named "LZ-129 Hindenburg." The Hindenburg was the largest object ever flown. Most of the volume of this airship was filled with the 200,000 cubic meters of gas used to lift the ship into the air.

When designing the Hindenburg, engineers considered the density of air, which is 1.229 g/L. They considered two different gases to fill the airship, hydrogen and helium. Characteristics of those gases, plus other gases produced in the 1930s, are listed in the table. Reactivity describes how likely a substance is to gain or lose electrons.

Properties of Gases Produced in the 1930s

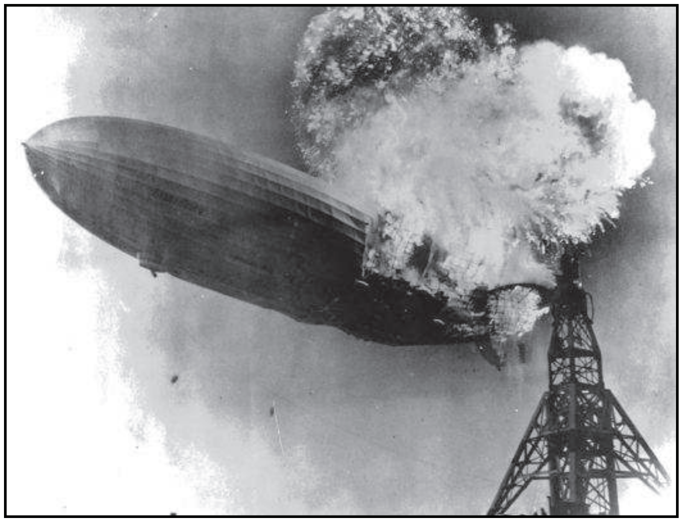
Gas	Number of Electrons in Valence Shell	Density (g\L)	Reactivity
Hydrogen	1	0.089	Highly likely
Helium	2	0.090	Not likely
Fluorine	7	1.700	Highly likely
Neon	8	0.900	Not likely
Chlorine	7	3.200	Highly likely
Argon	8	1.784	Not likely

Due to cost concerns, the Hindenburg engineers chose inexpensive hydrogen gas to fill their airship.

The Hindenburg made thirty-seven flights across the Atlantic Ocean in 1936 and 1937.

GO ON ▶

Then, on May 6, 1937, disaster struck as the ship was landing in stormy weather. Most researchers agree that a spark ignited leaking hydrogen. Within thirty-two seconds, the entire ship was engulfed in flames, taking the lives of some on board. The photograph, taken in the first few seconds of the explosion, shows the scale of the disaster.



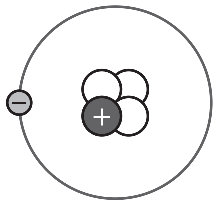
U.S. Navy

Today, airships are still used across the world. However, as a result of the Hindenburg disaster, they are no longer filled with hydrogen.

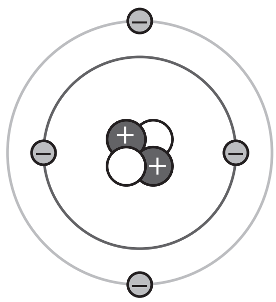
GO ON ▶

8 **Based on the information shown in the periodic table and data table, what is the subatomic structure of helium?**

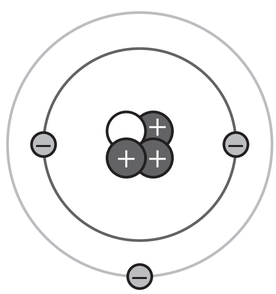
F



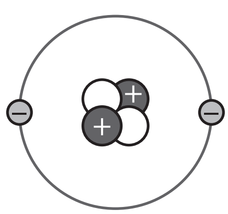
G



H



J



GO ON ▶

9 The periodic table organizes information into horizontal rows called periods and vertical columns called groups.

How does the data shown in the table relate to the organization of the periodic table?

A Elements with similar densities are placed into the same group.

B Elements with similar densities are placed into the same period.

C Elements with similar numbers of valence electrons are placed into the same group.

D Elements with similar numbers of valence electrons are placed into the same period.

10 **How does the observation of reactivity described in the data table and text relate to hydrogen's location on the periodic table?**

F Hydrogen's location shows that it has one free electron in its valence shell; this electron is given up freely during reactions.

G Hydrogen's location shows that it has one free electron in its valence shell; this electron reacts with other elements until it has seven other electrons to fill hydrogen's valence shell.

H Hydrogen's location shows that it has more protons than neutrons in its nucleus; hydrogen reacts with other elements until the number of protons is balanced by additional electrons.

J Hydrogen's location shows that it has more protons than neutrons in its nucleus; hydrogen reacts with other elements until the number of electrons is reduced to equal the number of neutrons.

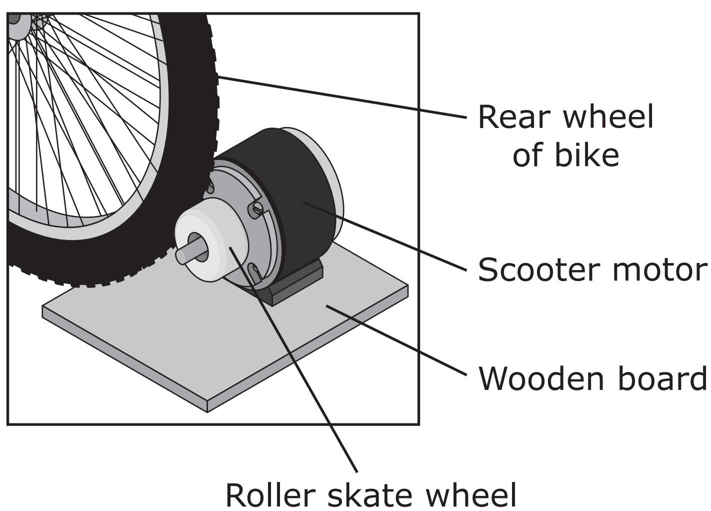
GO ON ▶

Study the information. Then answer questions 11–13.

Students in a science class were asked to build a device that would convert one form of energy into another form. The students were given the following design criteria:

- device must charge a battery to run a six-watt cell phone for seven hours (forty-two watt hours [Wh])
- device must be portable
- device must be built from recycled materials

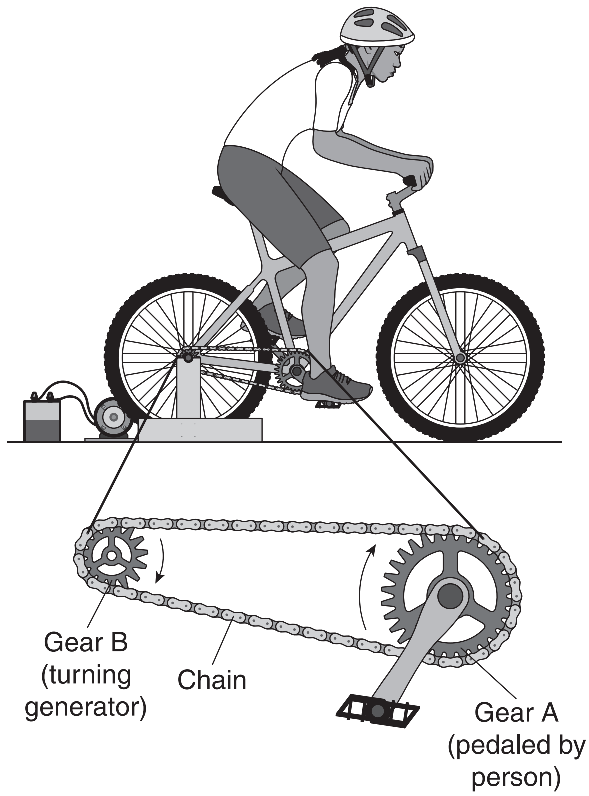
One group of students designed a bike-powered charging station. They learned that a motor run in reverse can work as an electrical generator. They built their generator by attaching a roller skate wheel to an old scooter motor. The generator was mounted to a wooden board, as shown in the first diagram.



The generator was placed behind the rear wheel of the bike with the roller skate wheel touching the bike wheel. When the bike wheel spun it caused the roller skate wheel to rotate, spinning the generator and producing electricity. Next, the students built a wooden stand to hold the bike upright. Then the students attached the generator to a rechargeable twelve-volt battery.

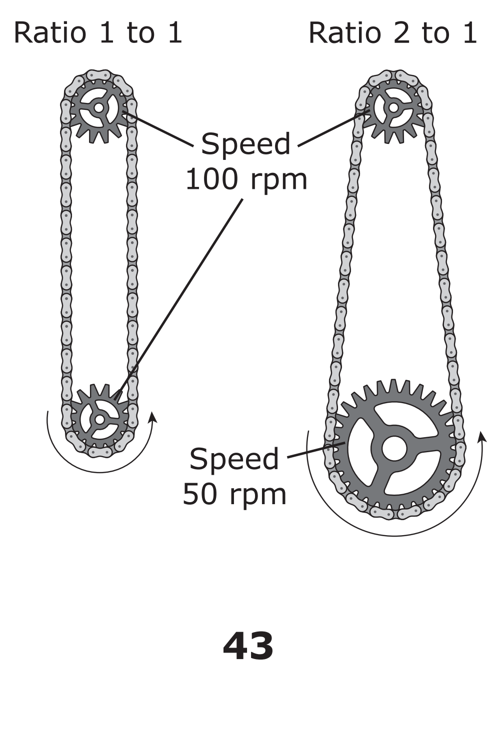
GO ON ▶

The second diagram shows the completed setup.



A person pedaled to turn Gear A, which caused the chain attached to the gear to move. This, in turn, caused Gear B and the back wheel to spin, producing electricity and charging the battery. The students noticed that Gears A and B turned at different rates. The students learned this difference in rate is called gear ratio. The third diagram shows how gear size affects gear ratio. Gear speed is measured in rpm (revolutions per minute).

Gear Ratio



GO ON ▶

The data table shows speed data the students recorded for four people using the bike generator.

Speed Testing

3–minute Test				
	Gear Speed (rpm)			
Person	**Gear A**	**Gear B**	**Charging Power (W)**	**Stored Energy (Wh)**
W	103	323	129.1	6.46
X	105	330	151	7.55
30–minute Test				
Y	102	315	105	52.5
Z	101	316	106	53

The students also learned that not all of the energy put into the battery would be available to charge the cell phone. In general, only about 70% of the energy stored in a battery can be used to charge a device.

GO ON ▶

11 **Which statement <u>best</u> describes an energy conversion in this system?**

A Mechanical energy is converted to potential energy between Gear A and the chain.

B Kinetic energy is converted to potential energy between the rear wheel and Gear B.

C Potential energy is converted to chemical energy between the generator and the battery.

D Mechanical energy is converted to thermal energy between the rear wheel and the generator.

12 **Based on the input and output data shown in the table, is the design useful?**

F Yes, because 3 minutes of pedaling will produce an average of 140 W of power, and 98 W will be available to charge the phone.

G No, because 30 minutes of pedaling will produce an average of 52.8 Wh of power, and 37 Wh will be available to charge the phone.

H Yes, because 30 minutes of pedaling will produce an average of 105.5 W of power, and 42 W are needed to run the cell phone for 7 hours.

J No, because 3 minutes of pedaling will produce an average of 7.01 Wh of power, and 42 Wh are needed to run the cell phone for 7 hours.

13 **Which change will decrease the amount of time it takes to transfer energy to the battery, assuming the cyclist continues pedaling at approximately 100 rpm?**

A replace Gears A and B with two larger gears

B replace Gears A and B with two smaller gears

C replace Gear A with a larger gear and Gear B with a smaller gear

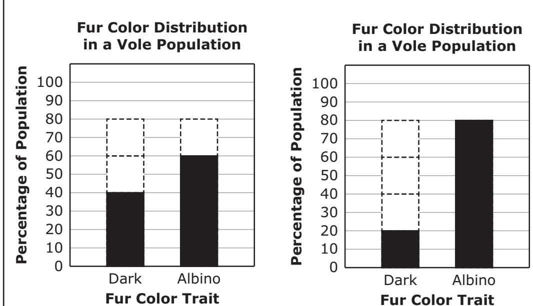
D replace Gear A with a smaller gear and Gear B with a larger gear

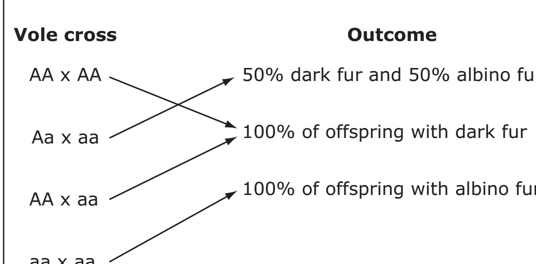
STOP

Blank

Science		
Number	**Answer**	**OAS Objective**
1	D	HS.LS2.4
2	See below.	HS.LS2.4
3	See below.	HS.LS2.4
4	F, G	HS.LS2.4
5	C	HS.LS3.3
6	See below.	HS.LS3.3
7	See below.	HS.LS3.3
8	J	HS.PS1.1
9	C	HS.PS1.1
10	F	HS.PS1.1
11	D	HS.PS3.3
12	G	HS.PS3.3
13	C	HS.PS3.3

<table>
<tr><th colspan="4">Science–TEI Sample Responses</th></tr>
<tr><th>Number</th><th>Answer</th><th>Number</th><th>Answer</th></tr>
<tr><td>2</td><td>
Statement
The plants receive food energy from other organisms and from sunlight.
The amount of stored energy changes as it flows between different trophic levels.
The energy available to animals and microbes is limited by photosynthesis in plants.

Supported or Not Supported?
Not Supported: the food web shows a single dashed arrow from the sun to the plants
Supported: the food web shows arrows between the organisms and heat
Supported: the arrows trace all energy back to the use of sunlight by plants.
</td><td>6</td><td>


</td></tr>
<tr><td>3</td><td>
sunlight energy | > | producer energy | >
herbivore energy | > | carnivore energy
</td><td>7</td><td>


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ANSWER SHEET

USE NO.2 PENCIL ONLY

SCIENCE				
1	Ⓐ	Ⓑ	Ⓒ	Ⓓ
2	TEI			
3	TEI			
4	Ⓕ	Ⓖ	Ⓗ	Ⓙ
	Ⓕ	Ⓖ	Ⓗ	Ⓙ
5	Ⓐ	Ⓑ	Ⓒ	Ⓓ
6	TEI			
7	TEI			
8	Ⓕ	Ⓖ	Ⓗ	Ⓙ
9	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10	Ⓕ	Ⓖ	Ⓗ	Ⓙ
11	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12	Ⓕ	Ⓖ	Ⓗ	Ⓙ
13	Ⓐ	Ⓑ	Ⓒ	Ⓓ

STOP

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PERIODIC TABLE OF THE ELEMENTS

Key

Name **Atomic Number** **Symbol** Average Atomic Mass

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Hydrogen 1 **H** 1.008																	Helium 2 **He** 4.003
2	Lithium 3 **Li** 6.941	Beryllium 4 **Be** 9.012											Boron 5 **B** 10.811	Carbon 6 **C** 12.011	Nitrogen 7 **N** 14.007	Oxygen 8 **O** 15.999	Fluorine 9 **F** 18.998	Neon 10 **Ne** 20.180
3	Sodium 11 **Na** 22.990	Magnesium 12 **Mg** 24.305											Aluminum 13 **Al** 26.982	Silicon 14 **Si** 28.086	Phosphorus 15 **P** 30.974	Sulfur 16 **S** 32.066	Chlorine 17 **Cl** 35.453	Argon 18 **Ar** 39.948
4	Potassium 19 **K** 39.098	Calcium 20 **Ca** 40.078	Scandium 21 **Sc** 44.956	Titanium 22 **Ti** 47.88	Vanadium 23 **V** 50.942	Chromium 24 **Cr** 51.996	Manganese 25 **Mn** 54.938	Iron 26 **Fe** 55.847	Cobalt 27 **Co** 58.933	Nickel 28 **Ni** 58.693	Copper 29 **Cu** 63.546	Zinc 30 **Zn** 65.39	Gallium 31 **Ga** 69.723	Germanium 32 **Ge** 72.61	Arsenic 33 **As** 74.922	Selenium 34 **Se** 78.96	Bromine 35 **Br** 79.904	Krypton 36 **Kr** 83.80
5	Rubidium 37 **Rb** 85.468	Strontium 38 **Sr** 87.62	Yttrium 39 **Y** 88.906	Zirconium 40 **Zr** 91.224	Niobium 41 **Nb** 92.906	Molybdenum 42 **Mo** 95.94	Technetium 43 **Tc** 97.907	Ruthenium 44 **Ru** 101.07	Rhodium 45 **Rh** 102.906	Palladium 46 **Pd** 106.42	Silver 47 **Ag** 107.868	Cadmium 48 **Cd** 112.411	Indium 49 **In** 114.82	Tin 50 **Sn** 118.710	Antimony 51 **Sb** 121.757	Tellurium 52 **Te** 127.60	Iodine 53 **I** 126.904	Xenon 54 **Xe** 131.290
6	Cesium 55 **Cs** 132.905	Barium 56 **Ba** 137.327	Lanthanum 57 **La** 138.906	Hafnium 72 **Hf** 178.49	Tantalum 73 **Ta** 180.948	Tungsten 74 **W** 183.84	Rhenium 75 **Re** 186.207	Osmium 76 **Os** 190.2	Iridium 77 **Ir** 192.22	Platinum 78 **Pt** 195.08	Gold 79 **Au** 196.967	Mercury 80 **Hg** 200.59	Thallium 81 **Tl** 204.383	Lead 82 **Pb** 207.2	Bismuth 83 **Bi** 208.980	Polonium 84 **Po** 208.982	Astatine 85 **At** 209.978	Radon 86 **Rn** 222.018
7	Francium 87 **Fr** 223.020	Radium 88 **Ra** 226.025	Actinium 89 **Ac** 227.028	Rutherfordium 104 **Rf** (261)	Dubnium 105 **Db** (262)	Seaborgium 106 **Sg** (263)	Bohrium 107 **Bh** (262)	Hassium 108 **Hs** (265)	Meitnerium 109 **Mt** (266)									

Lanthanide Series	Cerium 58 **Ce** 140.115	Praseodymium 59 **Pr** 140.908	Neodymium 60 **Nd** 144.24	Promethium 61 **Pm** 144.913	Samarium 62 **Sm** 150.36	Europium 63 **Eu** 151.965	Gadolinium 64 **Gd** 157.25	Terbium 65 **Tb** 158.925	Dysprosium 66 **Dy** 162.50	Holmium 67 **Ho** 164.930	Erbium 68 **Er** 167.26	Thulium 69 **Tm** 168.934	Ytterbium 70 **Yb** 173.04	Lutetium 71 **Lu** 174.967
Actinide Series	Thorium 90 **Th** 232.038	Protactinium 91 **Pa** 231.038	Uranium 92 **U** 238.029	Neptunium 93 **Np** 237.048	Plutonium 94 **Pu** 244.064	Americium 95 **Am** 243.061	Curium 96 **Cm** 247.070	Berkelium 97 **Bk** 247.070	Californium 98 **Cf** 251.080	Einsteinium 99 **Es** 252.083	Fermium 100 **Fm** 257.095	Mendelevium 101 **Md** 258.099	Nobelium 102 **No** 259.101	Lawrencium 103 **Lr** 260.105

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