INTRODUCTION

The Texas Assessment of Knowledge and Skills (TAKS) is a completely reconceived testing program. It assesses more of the Texas Essential Knowledge and Skills (TEKS) than the Texas Assessment of Academic Skills (TAAS) did and asks questions in more authentic ways. TAKS has been developed to better reflect good instructional practice and more accurately measure student learning. We hope that every teacher will see the connection between what we test on this new state assessment and what our students should know and be able to do to be academically successful. To provide you with a better understanding of TAKS and its connection to the TEKS and to classroom teaching, the Texas Education Agency (TEA) has developed this newly revised edition of the TAKS information booklet. The information booklets were originally published in January 2002, before the first TAKS field test. Now, after several years of field tests and live administrations, we are able to provide an even more comprehensive picture of the testing program. We have clarified some of the existing material and, in some cases, provided new sample items and/or more explanations of certain item types. However, it is important to remember that these clarifications do not signify any change in the TAKS testing program. The objectives and TEKS student expectations assessed on TAKS remain unchanged. We hope this revised version of the TAKS information booklet will serve as a user-friendly resource to help you understand that the best preparation for TAKS is to be an equitable and accurate measure of learning for all Texas public school students.

BACKGROUND INFORMATION

The development of the TAKS program included extensive public scrutiny and input from Texas teachers, administrators, parents, members of the business community, professional education organizations, faculty and staff at Texas colleges and universities, and national content-area experts. The agency took these steps to involve as many stakeholders as possible because we believed that the development of TAKS was a responsibility that had to be shared if this new assessment was to be an equitable and accurate measure of learning for all Texas public school students.

The three-year test-development process, which began in summer 1999, included a series of carefully conceived activities. First, committees of Texas educators identified those TEKS student expectations for each grade and subject area assessed that should be tested on a statewide assessment. Then a committee of TEA Student Assessment and Curriculum staff incorporated these selected TEKS student expectations, along with draft objectives for each subject area, into eleventh-grade exit level surveys. These surveys were sent to Texas educators at the middle school and secondary levels for their review. Based on input we received from more than 27,000 survey responses, we developed a second draft of the objectives and TEKS student expectations. In addition, we used this input during the development of draft objectives and student expectations for grades 3 through 10 to ensure that the TAKS program, like the TEKS curriculum, would be vertically aligned. This vertical alignment was a critical step in ensuring that the TAKS tests would become more rigorous as students moved from grade to grade. For example, the fifth grade tests would be more rigorous than the fourth grade tests, which would be more rigorous than the third grade tests. Texas educators felt that this increase in rigor from grade to grade was both appropriate and logical since each subject-area test was closely aligned to the TEKS curriculum at that grade level.
In fall 2000 TEA distributed the second draft of the objectives and TEKS student expectations for eleventh grade exit level and the first draft of the objectives and student expectations for grades 3 through 10 for review at the campus level. These documents were also posted on the Student Assessment Division’s website to encourage input from the public. Each draft document focused on two central issues: first, whether the objectives included in the draft were essential to measure on a statewide assessment; and, second, whether students would have received enough instruction on the TEKS student expectations included under each objective to be adequately prepared to demonstrate mastery of that objective in the spring of the school year. We received more than 57,000 campus-consensus survey responses. We used these responses, along with feedback from national experts, to finalize the TAKS objectives and student expectations. Because the state assessment was necessarily limited to a “snapshot” of student performance, broad-based input was important to ensure that TAKS assessed the parts of the TEKS curriculum most critical to students’ academic learning and progress.

In the thorough test-development process that we use for the TAKS program, we rely on educator input to develop items that are appropriate and valid measures of the objectives and TEKS student expectations the items are designed to assess. This input includes an annual educator review and revision of all proposed test items before field-testing and a second annual educator review of data and items after field-testing. In addition, each year a panel of recognized experts in the fields of English language arts (ELA), mathematics, science, and social studies meet in Austin to critically review the content of each of the high school level TAKS assessments to be administered that year. This critical review is referred to as a content validation review and is one of the final activities in a series of quality-control steps to ensure that each high school test is of the highest quality possible. A content validation review is considered necessary at the high school grades (9, 10, and 11) because of the advanced level of content being assessed.

ORGANIZATION OF THE TAKS TESTS

TAKS is divided into test objectives. It is important to remember that the objective statements are not found in the TEKS curriculum. Rather, the objectives are “umbrella statements” that serve as headings under which student expectations from the TEKS can be meaningfully grouped. Objectives are broad statements that “break up” knowledge and skills to be tested into meaningful subsets around which a test can be organized into reporting units that help campuses, districts, parents, and the general public understand the performance of our students and schools. Test objectives are not intended to be “translations” or “reworodings” of the TEKS. Instead, the objectives are designed to be identical across grade levels rather than grade specific. Generally, the objectives are the same for third grade through eighth grade (an elementary/middle school system) and for ninth grade through eleventh grade (a high school system). In addition, certain TEKS student expectations may logically be grouped under more than one test objective; however, it is important for you to understand that this is not meaningless repetition—sometimes the organization of the objectives requires such groupings. For example, on the TAKS writing tests for fourth and seventh grades, some of the same student expectations addressing the conventions of standard English usage are listed under both Objective 2 and Objective 6. In this case, the expectations listed under Objective 2 are assessed through the overall strength of a student’s use of language conventions on the written composition portion of the test; these same expectations under Objective 6 are assessed through multiple-choice items attached to a series of revising and editing passages.
ORGANIZATION OF THE INFORMATION BOOKLETS

The purpose of the information booklets is to help Texas educators, students, parents, and other stakeholders understand more about the TAKS tests. These booklets are not intended to replace the teaching of the TEKS curriculum, provide the basis for the isolated teaching of skills in the form of narrow test preparation, or serve as the single information source about every aspect of the TAKS program. However, we believe that the booklets provide helpful explanations as well as show enough sample items, reading and writing selections, and prompts to give educators a good sense of the assessment.

Each grade within a subject area is presented as a separate booklet. However, it is still important that teachers review the information booklets for the grades both above and below the grade they teach. For example, eighth grade mathematics teachers who review the seventh grade information booklet as well as the ninth grade information booklet are able to develop a broader perspective of the mathematics assessment than if they study only the eighth grade information booklet.

The information booklets for each subject area contain some information unique to that subject. For example, the mathematics chart that students use on TAKS is included for each grade at which mathematics is assessed. However, all booklets include the following information, which we consider critical for every subject-area TAKS test:

- an overview of the subject within the context of TAKS
- a blueprint of the test—the number of items under each objective and the number of items on the test as a whole
- information that clarifies how to read the TEKS
- the reasons each objective and its TEKS student expectations are critical to student learning and success
- the objectives and TEKS student expectations that will be included on TAKS
- additional information about each objective that will help educators understand how it is assessed on TAKS
- sample items that show some of the ways objectives are assessed
What Every Teacher Needs to Know About the TAKS Science Tests

Why do we test science?
As teachers and parents, we are preparing our children to be the next generation of educated and concerned citizens. An understanding of science will help our children be better informed and more capable of making decisions that will affect their lives and the environment. Being scientifically literate cannot be defined as simply having the ability to remember scientific facts; scientific literacy involves much more than that. It means that our students will not only understand important science concepts but also be able to apply what they know to the health, safety, and environmental issues that are at the center of our everyday lives. Science assessments play a critical role in determining whether our students are mastering the science knowledge and skills they need in order to be scientifically literate and academically successful.

What is the science TAKS based on?
The TAKS is based on the state-mandated science curriculum, the Texas Essential Knowledge and Skills (TEKS). All four science assessments were developed using selected knowledge and skills statements and student expectations from the science TEKS. The elementary science test was based on eligible science TEKS from grades 2–5. The middle school science test will be based on selected science TEKS from grades 6–8. The grade 10 and the exit level TAKS tests are based on selected TEKS for Integrated Physics and Chemistry (IPC) and Biology.

The TEKS were created to align closely with the National Science Standards, Benchmarks for Science Literacy, and Science for All Americans. These books are an excellent resource for guidance in finding grade-appropriate strategies for teaching many science concepts.

How were the TEKS chosen to be on TAKS?
The science TEKS knowledge and skills statements and student expectations eligible for assessment were determined to be appropriate for TAKS by educator review committees; feedback from over 74,000 surveys completed by Texas educators in 2000 and 2001 and input from national reviewers further refined the objectives. Because of the constraints of a single statewide assessment, not all science TEKS can be addressed.

Although some student expectations within the TEKS are not assessed, it is important that educators teach all of the science curriculum so that students can develop a complete understanding of critical science concepts.
How are the TEKS organized within the TAKS?

The knowledge and skills statements, with their associated student expectations, are organized under objectives on the TAKS. These objectives group the eligible student expectations into categories with similar content and are used for score-reporting purposes. The elementary test has four objectives. The middle school, grade 10, and exit level tests have five objectives.

How do the knowledge and skills statements relate to items on the TAKS science tests?

Every item developed for the TAKS is grounded in the knowledge and skills statements. For example, in IPC (8)(C), students “investigate and identify the law of conservation of mass.” This concept will be assessed within the framework of the overarching knowledge and skills statement, which reads, “The student knows that changes in matter affect everyday life.”

Where does middle school fit in?

In 2003 the state legislature in Senate Bill 1108 mandated a middle school science test to be given at grade 8 no later than the 2006–2007 school year. The middle school science test will have five objectives that will include science TEKS from grades 6–8.

All educators should work together to align the curriculum across all grade levels so that unifying themes (strands) of learning are reinforced. TEKS instruction throughout elementary and middle school will lay the foundation for biology, chemistry, physics, and earth science concepts taught in high school.

What are “unifying themes”?

The science TEKS contain unifying themes, or conceptual strands, that are developed across grade levels in a grade-appropriate progression. To ensure proper teaching of the TEKS, educators should ensure that learning is connected throughout the grade levels and that there are varied opportunities for students to learn the concepts within a strand.

An example of a “systems” strand is given below:

(2.9) **Science concepts.** The student knows that living organisms have basic needs. The student is expected to

(B) compare and give examples of the ways living organisms depend on each other and on their environments. (Tested at grade 5)

(7.12) **Science concepts.** The student knows that there is a relationship between organisms and the environment. The student is expected to

(B) observe and describe how organisms, including producers, consumers, and decomposers, live together in an environment and use existing resources. (Tested at grade 8)
**Biology (12) Science concepts.** The student knows that interdependence and interactions occur within an ecosystem. The student is expected to

(E) investigate and explain the interactions in an ecosystem including food chains, food webs, and food pyramids. (Tested at grade 10)

**Biology (9) Science concepts.** The student knows metabolic processes and energy transfers that occur in living organisms. The student is expected to

(D) analyze the flow of matter and energy through different trophic levels and between organisms and the physical environment. (Tested at exit level)

**How are science integrations and interdisciplinary issues handled on the TAKS science tests?**

It is essential for teachers to expose students to science content in a variety of ways. Teachers must also help students make connections among the science disciplines by showing the natural integrations among the life, earth, and physical sciences. An example of this might be when students study different soil types (earth science) and learn how nutrients (chemistry) in the soil affect the types of plants (biology) that grow there.

Teachers should emphasize to students that science is not isolated from the other academic disciplines. The development of reading, writing, and mathematical skills will help students understand and communicate scientific ideas.

**Is there a State-Developed Alternative Assessment (SDAA II) for the TAKS science tests?**

Currently, there is not an SDAA II for TAKS science at any grade. Therefore, the Admission, Review, and Dismissal (ARD) committee can recommend that a student take the grades 5, 8, 10, and exit level science assessment, if appropriate. If the ARD committee determines that the TAKS science tests are not an appropriate assessment for a specific student, then the student may be exempt. However, if a student is exempted, the ARD committee must determine the type of Locally Developed Alternative Assessment (LDAA) the student must take. An LDAA can be a portfolio, a modified released test, or any other locally developed assessment that the ARD committee deems appropriate.

**What is the format of the TAKS science tests?**

Most items will be in a multiple-choice format with four options. Some multiple-choice items will be written as part of a cluster. A cluster will have a stimulus, which may be a diagram, a brief passage, a chart, or a combination of these, followed by a series of items that will involve the application of prior knowledge and analysis of the given information. Cluster items will appear together on the TAKS test, but items may not always appear on facing pages.

A limited number of items will be griddable, requiring students to bubble responses on grids that are the same as those used in the TAKS mathematics tests. The griddable format is intended to give students the opportunity to solve a problem or measure with precision and then determine an appropriate answer independently. The level of precision necessary for an item will be given to the student in the item. For instance, an item may direct the student to measure an object to the nearest millimeter.
A three-column grid will be the only type of grid for the Elementary Science—Grade 5 TAKS test. The same grid format is used in the grade 5 TAKS Mathematics test. Answers must be recorded in the column of the correct place value. See the following examples:

The decimal on the grid defines the place values of the columns that precede it. Students must record their answer on the grid using the correct place values.

A seven-column grid will be the only type of grid for the grade 10 and exit level TAKS Science tests. The same grid format is used in the grade 10 and exit level TAKS Mathematics tests.

The decimal on the grid defines the place values of the columns that precede it. Students must record their answer on the grid using the correct place values. If an answer is a whole number, students may add zeros after the decimal, or if the answer is fractional, students may add a zero in front of the decimal.
Will any of the TAKS science tests be performance based?

The only performance testing that will occur on the TAKS science tests is using a ruler to measure with precision. Some items will require students to physically use a ruler to measure a drawing of an object in centimeters or millimeters.

Remember that when the 20-centimeter paper ruler or measurement item that accompanies the TAKS science test is photocopied, the image may be distorted and improper measurements can result.

What is the purpose of the highlights that appear after each objective?

The highlights that appear after each objective are meant to clarify some of the student expectations in the TEKS. These highlights focus attention on some of the important aspects of certain student expectations and explain how these expectations might be assessed on the TAKS science tests. The highlights came from comments and concerns expressed on teacher surveys and in educator meetings.
Introduction to the Grade 10 and the Exit Level Science TAKS

Who will be required to take the grade 10 and the exit level TAKS Science tests?

As mandated by Senate Bill 103, all tenth and eleventh grade students will be required to take the high school TAKS science test unless exempted by an admission, review, and dismissal (ARD) committee. All students who are exempted from the science TAKS by an ARD committee must take a Locally Developed Alternative Assessment (LDAA) for that grade as set by the ARD committee. Limited English proficient (LEP) students can be exempted from the grade 10 science test. But LEP students can receive only a one-time postponement from the exit level science test. For more information about ARD and LPAC committees, refer to ARD Committee Decision-Making Process for the Texas Assessment Program and LPAC Decision-Making Process for the Texas Assessment Programs (Grades 3–10).

How should the TEKS be approached at the high school level?

Students learn science by doing science. At the high school level, science must be more than the memorization of facts. Students should be provided with multiple opportunities to experience science directly, thereby giving them the tools and skills necessary to understand the methods scientists use to investigate the world. High school students must be able to examine concrete examples of science phenomena in order to understand and apply abstract science concepts.

How will the TAKS affect course and curriculum options?

The new testing requirements in science have an impact on both course selection and curriculum decisions at the high school level. Schools should take into account the state recommendations for graduation plans and the TAKS science tests when considering options involving science instruction. Biology and Integrated Physics and Chemistry (IPC) are the courses designated in the legislation to be tested on the TAKS. High school students are now required to have one credit of biology. Students who choose to take IPC will be exposed to the IPC TEKS assessed on the TAKS science tests. However, those who take separate chemistry and physics courses should be equally or better prepared to be successful on this assessment. Beginning in the 2004–2005 school year, all students will be required to complete three science courses in order to graduate. For more information on the science requirements for graduation, refer to the TEA website.

Where does the middle school science program fit in?

In 2003 the state legislature in Senate Bill 1108 mandated a middle school science test to be given at grade 8 no later than the 2006–2007 school year. The middle school science test will have five objectives that will include science TEKS from grades 6, 7, and 8.

What is the difference between the grade 10 and the exit level TAKS Science tests?

The high school TAKS tests at both grades 10 and 11 are based on TEKS from Biology and IPC. The TEKS tested at tenth grade are quite similar to those tested at eleventh grade. However, there are some differences between the grade levels. The differences are based on the expectation that eleventh grade students will have had more science instruction and therefore more opportunities to develop critical-
thinking skills. For example, the TAKS tests at both grade levels require students to examine interactions in food chains, food webs, and food pyramids [Bio (12)(E)]. However, at grade 11 students are also required to analyze the flow of matter and energy through the various trophic levels [Bio (9)(D)].

Student expectations found only in the grade 10 test include the following:

Objective 2—Biology (6)(D); Objective 4—IPC (7)(E); Objective 5—IPC (5)(A) and IPC (6)(F)

Student expectations found only in the Exit Level test include the following:

Objective 2—Biology (6)(B) and Biology (10)(B); Objective 3—Biology (7)(A) and Biology (9)(D); Objective 4—IPC (7)(D) and IPC (9)(B); Objective 5—IPC (4)(D), IPC (5)(B), and IPC (6)(D)

What is the role of the untested TEKS in the grade 10 and exit level TAKS Science?

Because of the constraints of a single statewide assessment, not all TEKS can be addressed.

Although some student expectations within the TEKS are not assessed, it is important that educators teach all of the science curriculum so that students can develop a complete understanding of critical science concepts.

For example, student expectation IPC (4)(C), “analyze the effects caused by changing force or distance in simple machines as demonstrated in household devices, the human body, and vehicles,” is not included in a TAKS objective. However, in order to fully comprehend the student expectation IPC 4(D), which is listed in Exit Level Objective 5, the student must recognize how changes in a force can affect work, power, momentum, acceleration, and efficiency, which are assessed.

What is the purpose of the grade 10 Science test?

The grade 10 TAKS Science test should serve as an indicator of students’ science knowledge and skills. If a student does not pass the grade 10 test, it will be necessary for the student to receive some supplemental science instruction. However, just because a student passes the grade 10 test, it cannot be assumed that the student will pass the exit level test. Students will need to maintain their science knowledge and will most likely need additional instruction on the TEKS that are tested at eleventh grade but not at tenth grade.

What tools will be available to students during the TAKS science tests?

Students will be provided with a 20-centimeter ruler, a periodic table, and a formula chart. (Remember that when the 20-centimeter paper ruler or measurement items are photocopied, the image may be distorted and improper measurements can result.)
Because calculations may involve multiple steps and realistic data, each student must have access to a calculator for use during the grade 10 and exit level TAKS Science tests. A four-function calculator, scientific calculator, or graphing calculator may be used. Any kind of graphing calculator may be used except one with a typewriter-style keypad (known as QWERTY) or one that includes a computer algebra system (CAS). Handheld minicomputers, personal digital assistants, and laptop computers may not be used. All types of memory, including standard memory, ROM, and flash ROM, must be cleared to factory default both before and after testing. In addition, any programs or applications must be removed prior to the test administration.

Students need to have classroom experience using a calculator in their science classes so that they are comfortable using it on the day of the test. There should be a minimum of one calculator for every five students in the testing situation. If graphing calculators are shared among students, the test administrator must erase all memory between student uses.

**What is on the formula chart?**

The formula chart has two sides (see pages 16–17). One side has a periodic table, and the other side has a list of many commonly used formulas and a 20 cm ruler. Even though these formulas may not be directly addressed in the TEKS, they are important for a complete understanding of many chemistry and physics concepts, such as density, momentum, force, and waves.

**What about significant figures and scientific notation?**

Items will be developed so that answer choices will take into account significant figures, as appropriate. There may be some items whose answers are not in correct significant-figure format, because it would cause confusion for students who are not familiar with the format, such as those in IPC. Though the significant-figure format will not be assessed, it is still recommended that students learn the proper use of significant figures in courses where significant figures are appropriate, such as in chemistry and physics. Griddable items will always give the level of precision in the stem.

Some items may have data and/or answer choices represented in scientific notation.
### Grade 10 and Exit Level TAKS Science Blueprints

The grade 10 and exit level TAKS Science blueprints will remain the same from one testing cycle to the next.

<table>
<thead>
<tr>
<th>TAKS Objectives</th>
<th>Number of Items Grade 10</th>
<th>Number of Items Grade 11</th>
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<td><strong>Total items on test</strong></td>
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A Key to Understanding the TEKS
Included on the Grade 10 TAKS Science

Example from Objective 2

**Bio (6) Science Concepts.** The student knows the structures and functions of nucleic acids in the mechanisms of genetics. The student is expected to

(C) identify and illustrate how changes in DNA cause mutations [and evaluate the significance of these changes].

**KEY**

A. **Knowledge and Skills Statement**
This broad statement describes what students should know and be able to do for Biology. The number preceding the statement identifies the number of the knowledge and skills statement. It is important to read the knowledge and skills statement along with the student expectations associated with it for a full understanding of the concept.

B. **Student Expectation**
This specific statement describes what students should be able to do to demonstrate proficiency in what is described in the knowledge and skills statement. Students will be tested on skills outlined in the student expectation statement.

C. [bracketed text]
The student expectation has been presented in its entirety for two reasons: to clarify the link to the curriculum and to provide background information for test items. However, bracketed text will not be specifically tested on the TAKS.

**NOTE:** The full TEKS curriculum can be found at www.tea.state.tx.us/teks/.
TEKS STUDENT EXPECTATIONS—IMPORTANT VOCABULARY

For every subject area and grade level, two terms—such as and including—are used to help make the TEKS student expectations more concrete for teachers. However, these terms function in different ways. To help you understand the effect each of the terms has on specific student expectations, we are providing the following:

- a short definition of each term
- an example from a specific student expectation for this subject area
- a short explanation of how this term affects this student expectation

**Such as**

The term *such as* is used when the specific examples that follow it function only as representative illustrations that help define the expectation for teachers. These examples are just that—examples. Teachers may choose to use them when teaching the student expectation, but there is no requirement to do so. Other examples can be used in addition to those listed or as replacements for those listed.

Biology (4)(C) “The student is expected to compare the structures and functions of viruses to cells and describe the role of viruses in causing diseases and conditions such as acquired immune deficiency syndrome, common colds, smallpox, influenza, and warts.”

For this student expectation, students must be able to compare viruses to living cells and understand the role of viruses as pathogens. The examples listed in this student expectation are common diseases caused by viruses that most students will be familiar with and that are easy to describe in the classroom. However, there are many other examples that can be used, and the list of examples in this student expectation is not exhaustive or exclusive.

**Including**

The term *including* is used when the specific examples that follow it must be taught. However, other examples may also be used in conjunction with those listed.

IPC (9)(D) “The student is expected to demonstrate how various factors influence solubility including temperature, pressure, and nature of the solute and solvent.”

This expectation lists some of the factors that students must understand in order to properly understand how solubility works and how these factors affect it. Other factors, such as concentration of the solute and pH, can be used as well as those listed, but it is required that students be able to understand the factors listed in the student expectation.
**Remember**

For the TAKS tests, teachers should remember two things with regard to these terms.

- Any example preceded by the term *such as* in a particular student expectation may or may not provide the basis for an item assessing that expectation. Because these examples do not necessarily have to be used to teach the student expectation, it is equally likely that other examples may be used in assessment items. The rule here is that an example be used only if it is central to the knowledge, concept, or skill the item assesses.

- It is more likely that some of the examples preceded by the term *including* in a particular student expectation will provide the basis for items assessing that expectation, since these examples must be taught. However, it is important to remember that the examples that follow the term *including* do not represent all of the examples possible, so other examples may also provide the basis for an assessment item. As above, the rule here is that an example should be used only if it is central to the knowledge, concept, or skill the item assesses.
**Density** = \frac{\text{mass}}{\text{volume}}

**Speed** = \frac{\text{distance traveled}}{\text{time}}

**Acceleration** = \frac{\text{final velocity} - \text{initial velocity}}{\text{change in time}}

**Momentum** = \text{mass} \times \text{velocity}

**Force** = \text{mass} \times \text{acceleration}

**Work** = \text{force} \times \text{distance}

**Power** = \frac{\text{work}}{\text{time}}

**% efficiency** = \frac{\text{work output}}{\text{work input}} \times 100

**Kinetic energy** = \frac{1}{2} (\text{mass} \times \text{velocity}^2)

**Gravitational potential energy** = \text{mass} \times \text{acceleration due to gravity} \times \text{height}

**Energy** = \text{mass} \times (\text{speed of light})^2

**Velocity of a wave** = \text{frequency} \times \text{wavelength}

**Current** = \frac{\text{voltage}}{\text{resistance}}

**Electrical power** = \text{voltage} \times \text{current}

**Electrical energy** = \text{power} \times \text{time}

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### Constants/Conversions

- \( g \) = acceleration due to gravity = 9.8 m/s\(^2\)
- \( c \) = speed of light = 3 \times 10^8 m/s
- speed of sound = 343 m/s at sea level and 20°C
- 1 cm\(^3\) = 1 mL
- 1 wave cycle/second = 1 hertz (Hz)
- 1 calorie (cal) = 4.18 joules
- 1000 calories (cal) = 1 Calorie (Cal) = 1 kilocalorie (kcal)
- newton (N) = kgm/s\(^2\)
- joule (J) = Nm
- watt (W) = J/s = Nm/s
- volt (V) = ampere (A) = ohm (\Omega)
### Periodic Table of the Elements

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**Lanthanide Series**

- 57: Lanthanum (La)
- 58: Cerium (Ce)
- 59: Praseodymium (Pr)
- 60: Neodymium (Nd)
- 61: Promethium (Pm)
- 62: Europium (Eu)
- 63: Gadolinium (Gd)
- 64: Terbium ( Tb)
- 65: Dysprosium (Dy)
- 66: Holmium (Ho)
- 67: Erbium (Er)
- 68: Thulium (Tm)
- 69: Ytterbium (Yb)
- 70: Lutetium (Lu)

**Actinide Series**

- 89: Actinium (Ac)
- 90: Thorium (Th)
- 91: Protactinium (Pa)
- 92: Uranium (U)
- 93: Neptunium (Np)
- 94: Plutonium (Pu)
- 95: Americium (Am)
- 96: Curium (Cm)
- 97: Berkelium (Bk)
- 98: Californium (Cf)
- 99: Einsteinium (Es)
- 100: Fermium (Fm)
- 101: Mendelevium (Md)
- 102: Nobelium (No)
- 103: Lawrencium (Lr)

**Mass numbers in parentheses are those of the most stable or most common isotope.**

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*Revised October 15, 2001*
Objective 1: The student will demonstrate an understanding of the nature of science.

Objective 1 is focused on the student as a scientist. This objective is found in grades 5, 8, 10, and exit level. The nature of science is at the heart of all sciences, K–16. The skills developed in Objective 1 progress in sophistication and complexity as the student matures and advances academically. In order to understand scientific processes, students must perform the activities of scientists, which include making observations, collecting data, and drawing conclusions. For instance, student expectation Bio/IPC (2)(B) states that students are expected to “collect data and make measurements with precision.” Rather than just lecturing to students on how to use lab equipment, the teacher should give students the opportunity to work in a lab setting with equipment such as thermometers, balances, and graduated cylinders.

Activities related to the TEKS of Objective 1 develop students’ critical-thinking skills and problem-solving abilities. Using critical-thinking skills to apply science concepts is the primary goal of science education. To best develop these skills, scientific processes should be taught and reinforced throughout the curriculum instead of as an isolated unit.

Biology (1) and Integrated Physics and Chemistry (1) Scientific Processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to

(A) demonstrate safe practices during field and laboratory investigations.

Biology (2) and Integrated Physics and Chemistry (2) Scientific Processes. The student uses scientific methods during field and laboratory investigations. The student is expected to

(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology;

(B) collect data and make measurements with precision;

(C) organize, analyze, evaluate, make inferences, and predict trends from data; and

(D) communicate valid conclusions.
Integrated Physics and Chemistry (3) Scientific Processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to

(A) analyze, review, [and critique] scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; and

(B) draw inferences based on data related to [promotional materials for] products and services.

Highlights of Objective 1

- Scientists use many methods in their research. Students should learn a variety of methods to solve problems and make sense of the world.

- Students should be actively participating in laboratory and field activities. Classrooms, hallways, school grounds, and community resources can be used for these investigations.

- Texas Safety Standards, which can be obtained through TEA’s Office of Publications, should be referenced as students learn about and use safe practices in the classroom, laboratory, and field.

- Students need to be able to draw inferences, recognize meaningful data, and manipulate data from various sources, such as product labels, advertisements, flyers, Web pages, and brochures.

- Students may be required to interpret and evaluate graphs, charts, and maps.

- Students must be able to calculate percentages, determine probability, and use the slope of a line to make predictions.

- The use of the tools, equipment, and materials included in the middle and high school science TEKS is part of this objective. Students will be required to recognize these tools and know how to properly use them. Precise measurements will be necessary on test items.

- Students may be asked to apply basic earth/space science concepts to questions that assess scientific processes, such as testing a hypothesis, predicting trends in data, or communicating valid conclusions.
1 Which is the best estimate of the volume of solution released from the burette?

A 47.3 mL
B* 47.7 mL
C 48.3 mL
D 48.7 mL

Bio/IPC (2)(B)
This item requires students to read the volume of a liquid within a graduated device. Although students do not necessarily need to have worked with burettes to be able to answer this item correctly, they do need to have experience working with other graduated measuring devices, such as graduated cylinders or pipettes.
2. All of these procedures should be followed for lab safety except —

   A. immediately reporting all dangerous activity
   B. wearing gloves when necessary
   C. using eye protection as needed
   D.* putting used chemicals back in the original containers

**Bio/IPC (1)(A)**
This item illustrates the importance of students doing laboratory investigations. Students should be aware that returning chemicals to original containers could result in contamination as well as possible safety issues.

3. Which set of materials would be the most appropriate to use in testing the effects of stirring on the dissolving rate of a solute?

   A. Flask, petri dish, metal rod, scale, magnifying glass
   B.* Beaker, glass rod, balance, graduated cylinder, timer
   C. Test tube, filter paper, funnel, flask, ring stand
   D. Flask, Bunsen burner, ring stand, petri dish, thermometer

**Bio/IPC (2)(A)**
This item demonstrates how Objective 1 items can require students to apply content. This item requires students to understand factors that affect rate of solution and to apply that knowledge in designing a simple experiment.

4. According to the graph, what partial pressure of oxygen would saturate 67% of hemoglobin in the blood?

   A. 2.8 kPa
   B.* 5.2 kPa
   C. 8.7 kPa
   D. 12.4 kPa

**Bio/IPC (2)(C)**
This item demonstrates that students will need to be proficient with reading a graph to collect information. This is just one way the student expectation can be tested.
This diagram shows several rock formations exposed at a construction site. The job supervisor claimed that Formation T is the oldest formation. Why is he incorrect?

A  Formation S, which is sandstone, formed after Formation T, which is granite.
B  The oldest formations are always in the middle.
C* Formation T is an intrusion that cut through the other rock formations after they were formed.
D  An uplift occurred in Formation R, as happens in the oldest formations.

**IPC (3)(A)**
Students need to use their knowledge of earth science to analyze why the supervisor was incorrect. This item does not require students to have detailed knowledge of igneous intrusions or specific geological terminology, but it does require students to carefully analyze the drawing and the answer choices.
Objective 2: The student will demonstrate an understanding of the organization of living systems.

Students should understand that patterns, organized in increasingly complex levels, help define the natural world. The most important pattern in living systems is the structure of the DNA molecule. DNA orchestrates the construction of cells, which in turn form organisms, populations, and communities. As students investigate and analyze living systems, they should recognize the similarities and differences between organisms. Understanding how these systems are organized, including having a basic knowledge of genetics, will increase students’ ability to address the medical, ecological, and technological issues that have an impact on the world.

**Biology (4) Science Concepts.** The student knows that cells are the basic structures of all living things and have specialized parts that perform specific functions, and that viruses are different from cells and have different properties and functions. The student is expected to

(B) investigate and identify cellular processes including homeostasis, permeability, energy production, transportation of molecules, disposal of wastes, function of cellular parts, and synthesis of new molecules.

**Biology (6) Science Concepts.** The student knows the structures and functions of nucleic acids in the mechanisms of genetics. The student is expected to

(A) describe components of deoxyribonucleic acid (DNA), and illustrate how information for specifying the traits of an organism is carried in the DNA;

(C) identify and illustrate how changes in DNA cause mutations [and evaluate the significance of these changes]; and

(D) compare genetic variations observed in plants and animals.

**Biology (8) Science Concepts.** The student knows applications of taxonomy and can identify its limitations. The student is expected to

(C) identify characteristics of kingdoms including monerans, protists, fungi, plants, and animals. **

**Biology (10) Science Concepts.** The student knows that, at all levels of nature, living systems are found within other living systems, each with its own boundary and limits. The student is expected to

(A) interpret the functions of systems in organisms including circulatory, digestive, nervous, endocrine, reproductive, integumentary, skeletal, respiratory, muscular, excretory, and immune.

**The TAKS will use the most current classification system.**
Highlights of Objective 2

- Students should understand the importance of cellular processes and the cell parts that play a role in these processes. In addition, students should understand that cells form tissues and tissues form organs with specialized functions.

- The relationship of structure to function should be explored from the cellular level to the ecosystem level.

- Students must identify the structures of nucleic acids, such as DNA and RNA. They should know how nucleic acids are involved in the formation of the organism and the inheritance of traits. Students will need to be able to use Punnett squares and probability to find possible genotypes and phenotypes. Students may be asked to apply their knowledge of genetics to predict possible genotypes involving sex-linked traits and multiple alleles.

- Genetic principles will be applied to the understanding of ecology and evolution. For example, bacterial resistance to some antibiotics is a genetic trait passed on from generation to generation. Constant exposure to an antibiotic will kill the majority of individual bacteria in a population, but the few individuals that have a resistance to that antibiotic will live on to reproduce. Scientists predict that natural selection will cause a rise in antibiotic-resistant strains of bacteria that have been overexposed to some antibiotics.

- TAKS will use the six-kingdom system that includes Archaebacteria, Eubacteria, Protista, Fungi, Plantae, and Animalia. Increasing knowledge of the world necessitates change. Therefore, classification of organisms can change over time. Though scientific names of organisms may be used on TAKS items, students will not be expected to memorize the scientific names.

- Students need to be familiar with the functions of both plant and animal systems.

- The study of systems requires an integration of all sciences. For example, students may apply knowledge of physics concepts to the human body (the elbow as a lever or light through the lens of an eye), chemistry concepts to cellular processes (the manufacture of carbohydrates by plants or the formation of proteins within a ribosome), and earth science concepts to ecosystems (soil composition or the nitrogen cycle).

- Students will not be asked to name specific types of macromolecules, such as fructose or sucrose. However, students will be expected to be familiar with carbohydrates, fats, and proteins and their role in living systems.
Objective 2 Sample Items

6 If an organism has the genotype RrSsTtUu, what proportion of its gametes will be RSTU?

A 1/2
B 1/4
C 1/8
D* 1/16

Bio (6)(D)
This item requires students to apply their knowledge of genetics and probability (an integration of science and mathematics) to determine the proportions of possible genotypes in the offspring. Students need not construct a Punnett square for this item.

7 Which two kingdoms have members that are photosynthetic?

A Eubacteria and Fungi
B Protista and Animalia
C* Plantae and Protista
D Animalia and Fungi

Bio (8)(C)
The TAKS will assess students’ familiarity with the main characteristics of the six kingdoms and how the kingdoms relate to one another.

8 Which of these statements describes the vertebrate circulatory system and its primary function?

A A web of structures that provide support while protecting vital organs
B A series of ductless glands that secrete hormones directly into the blood
C* A network of tissues that carry nutrients and oxygen through the body
D A complex of cytoplasmic cell membranes that transport materials made by the cell

Bio (10)(A)
This item requires students to understand the functions of organ systems. This student expectation may be addressed with items about organ systems and functions in humans, other animals, and plants.
The illustration above shows a cell model with starch solutions both inside and outside the cell. In which of the following situations will the solution rise highest in the tube?

Bio (4)(B)
Students will be expected to understand the process of osmosis and diffusion, rather than simply defining hypertonic, hypotonic, and isotonic. These concepts, like many others, should be reinforced in laboratory investigations.
10 The structures marked 3 in the diagram are responsible for —

A  absorbing oxygen  
B* carrying genetic codes  
C  lining up amino acids  
D  serving as an anticodon

Bio (6)(A)  
Students will be expected to know the structure of DNA and understand the functions of its parts.
Objective 3: The student will demonstrate an understanding of the interdependence of organisms and the environment.

Organisms do not live in isolation. They rely on their environment and on other species for survival. To comprehend these relationships, students must integrate concepts from environmental science, evolution, and population genetics. Understanding interdependence will help students make informed decisions about their health, the use of resources, and the well-being of the planet on which they live.

Biology (4) Science Concepts. The student knows that cells are the basic structures of all living things and have specialized parts that perform specific functions, and that viruses are different from cells and have different properties and functions. The student is expected to

(C) compare the structures and functions of viruses to cells and describe the role of viruses in causing diseases and conditions such as acquired immune deficiency syndrome, common colds, smallpox, influenza, and warts; and

(D) identify and describe the role of bacteria in maintaining health such as in digestion and in causing diseases such as in streptococcus infections and diphtheria.

Biology (7) Science Concepts. The student knows the theory of biological evolution. The student is expected to

(B) illustrate the results of natural selection in speciation, diversity, phylogeny, adaptation, behavior, and extinction.

Biology (12) Science Concepts. The student knows that interdependence and interactions occur within an ecosystem. The student is expected to

(B) interpret interactions among organisms exhibiting predation, parasitism, commensalism, and mutualism; and

(E) investigate and explain the interactions in an ecosystem including food chains, food webs, and food pyramids.

Biology (13) Science Concepts. The student knows the significance of plants in the environment. The student is expected to

(A) evaluate the significance of structural and physiological adaptations of plants to their environments.
Highlights of Objective 3

- Students should be aware that bacteria are not always harmful. The majority of bacteria have no direct effect on humans. Many times bacteria play a beneficial role in organisms and the environment.

- Students should learn about some of the plant and animal diseases caused by bacteria and viruses. However, students are not expected to be aware of all of them. Items that address this issue will be designed to provide background information on the specific disease used in the item.

- Evolution is change over time. Students must understand natural selection as a mechanism for evolution, not as a term synonymous with evolution.

- Students should know that solar energy drives ecosystems. Food chains combine to make more complex food webs, and these webs are limited by the amount of energy that can be transferred between levels. Students need to understand the concept of biomass and relate it to food chains, webs, and pyramids. Students should know that the arrows in a food web or chain point in the direction of energy flow through the system.

- The cycling of nutrients is essential to maintaining the ecosystem. An understanding of this concept helps students realize why Earth’s resources may be limited. Students should be familiar with the water, carbon, and nitrogen cycles. They should be able to analyze how changes, caused by either humans or natural occurrences, affect the availability of these resources.

- Students should know the significance of the structures and adaptations of plants, such as the variety of leaf structures, methods of dispersing offspring, and methods of obtaining nutrients. The study of plant structures and adaptations helps students better understand the connection between plants and the survival of other life, including human life.
Objective 3 Sample Items

11 Which of these is a model of the most complete food chain?

A Primary consumer → decomposer → tertiary consumer → secondary consumer
B* Producer → primary consumer → secondary consumer → decomposer
C Decomposer → primary consumer → producer → secondary consumer
D Primary consumer → secondary consumer → decomposer → tertiary consumer

Bio (12)(E)
This item requires students to recognize the basic interactions demonstrated in a food chain. The most complete food chain begins with an autotroph (producer) such as a plant, phytoplankton, or cyanobacteria. Decomposers may not be included in a food chain or food web but are generally understood to be an important part of it.

12 Which of these would make a species most susceptible to extinction?

A Few natural predators
B* Extreme specialization
C Short growth cycles
D Extensive migration distances

Bio (7)(B)
This item requires students to apply their knowledge of natural selection to factors that can cause extinction.

13 The diagram shows a cross section of a leaf from a plant that most likely —

A grows in the desert
B* floats on a pond
C lives under trees
D climbs up walls

Bio (13)(A)
This item requires students to apply their knowledge of plant structure to a plant they may not have studied before. Since this item uses a water plant instead of a typical land plant, students must be able to apply their understanding of plant structures and how plants have evolved to function in certain environments.
14 Which of the following is an example of mutualism?

A A wasp injects its eggs inside the body of a caterpillar. The eggs hatch and eat the caterpillar.
B A bird builds a nest in a tree.
C* A human uses a dog to protect a flock of sheep. The dog is given food and shelter.
D A flower grows next to a bush.

Bio (12)(B)
Students will be expected to apply their knowledge of mutualism, commensalism, and predation to situations they may not be familiar with.

15 Which group of organisms can live in the human intestine and aid in the digestive process?

A* Bacteria
B Fungi
C Protozoa
D Viruses

Bio (4)(D)
Students should be familiar with the characteristics of different groups of organisms and the role bacteria play in digestion.
Objective 4: The student will demonstrate an understanding of the structures and properties of matter.

Knowledge of the structures and properties of matter and the ways in which matter interacts to create new substances allows students to understand the molecular structures of living organisms and nonliving objects. An understanding of basic chemistry concepts helps students understand their world and enhances their lives. For example, chemistry concepts play a part in our daily lives in the development of microchips for computers, the production of cosmetic items, and the development of pharmaceuticals.

Integrated Physics and Chemistry (7) Science Concepts. The student knows relationships exist between properties of matter and its components. The student is expected to

(A) investigate and identify properties of fluids including density, viscosity, and buoyancy; and

(E) classify samples of matter from everyday life as being elements, compounds, or mixtures.

Integrated Physics and Chemistry (8) Science Concepts. The student knows that changes in matter affect everyday life. The student is expected to

(A) distinguish between physical and chemical changes in matter such as oxidation, digestion, changes in states, and stages in the rock cycle; and

(C) investigate and identify the law of conservation of mass.

Integrated Physics and Chemistry (9) Science Concepts. The student knows how solution chemistry is a part of everyday life. The student is expected to

(A) relate the structure of water to its function [as the universal solvent]; and

(D) demonstrate how various factors influence solubility including temperature, pressure, and nature of the solute and solvent.
Highlights of Objective 4

- All organisms are composed mainly of water, and most of Earth is covered with water. It is important for students to understand the structure of water and how that structure dictates its characteristics.

- Students should be able to use the periodic table as a tool to predict patterns of chemical bonding.

- Students should be able to calculate density and apply it to different situations, such as buoyancy, density columns, and substance identification. Students should also be familiar with the factors that affect viscosity and buoyant force.

- Some items will integrate earth/space science concepts as these ideas relate to the chemical and physical concepts of IPC. For example, when ice forms in the cracks in rocks, the expansion of water aids in the weathering process and the production of soil.

- Students should be able to balance simple chemical equations. They may need to choose between different equations to find the one that is balanced, or they may have to select the correct set of coefficients.

- Students should be able to read solubility curves and be familiar with how temperature and pressure affect the solubility of both solids and gases.

- Students should be familiar with factors that affect the rate of solution.
Objective 4 Sample Items

16 The same amount of hydrogen gas is in both containers. The pressure in Container B is —

A $\frac{1}{4}$ the pressure in Container A
B $\frac{1}{2}$ the pressure in Container A
C* 2 times the pressure in Container A
D 4 times the pressure in Container A

IPC (7)(A)
This item requires students to understand that the temperature, pressure, and volume of fluids, including gases, are related. Students must understand that changes in volume and pressure are inversely proportional. Items will not require any calculations using the gas law formulas.

17 The reaction equation below shows the process of oxidizing iron. Balance the equation by calculating the coefficients.

$$\boxed{\text{Fe(s)}} + \boxed{\text{O}_2\text{(g)}} \rightarrow \boxed{\text{Fe}_2\text{O}_3\text{(s)}}$$

A 2, 3, 1
B 1, 1, 1
C* 4, 3, 2
D 4, 2, 2

IPC (8)(C)
This item gives students an unbalanced chemical equation, requiring them to determine the correct coefficients.
IPC (7)(E)
This item reinforces the idea that laboratory investigations can help students recognize the differences between elements, compounds, and mixtures. Students must understand that mixtures can be separated by physical means.

18 The experiment illustrates that iron and sulfur combine to form —
A a nonmetal
B a compound
C* a mixture
D an alloy

19 Which of these represents a physical change?
A Iron rusting
B* Ice melting
C Wood burning
D Food spoiling

IPC (8)(A)
Students must be able to distinguish between physical and chemical changes.

20 Which of these is a reason that frogs and fish are sensitive to changes in water temperature?
A* Cold water has a higher concentration of dissolved oxygen than warm water.
B Warm water has a higher range of compressibility than cold water.
C Cold water has a greater density than warm water.
D Warm water has a higher viscosity than cold water.

IPC (9)(D)
This item demonstrates how biology and IPC concepts can be integrated. Students should be able to apply concepts learned in IPC to a life science situation. This item requires students to recognize the factors that affect the solubility of a gas and how this affects aquatic organisms.
Objective 5: The student will demonstrate an understanding of motion, forces, and energy.

Students need to understand force and motion in order to comprehend the concepts of speed, wave characteristics, and energy transformations. The study of motion, forces, and energy is necessary for understanding the physical world. Whether riding in a car, turning on lights, or listening to the radio, we are continually surrounded by examples of energy transformations and Newton’s laws of motion.

Integrated Physics and Chemistry (4) Science Concepts. The student knows concepts of force and motion evident in everyday life. The student is expected to

(A) calculate speed, momentum, acceleration, work, and power in systems such as in the human body, moving toys, and machines; and

(B) investigate and describe [applications of] Newton’s laws such as in vehicle restraints, sports activities, geological processes, and satellite orbits.

Integrated Physics and Chemistry (5) Science Concepts. The student knows the effects of waves on everyday life. The student is expected to

(A) demonstrate wave types and their characteristics through a variety of activities such as modeling with ropes and coils, activating tuning forks, and interpreting data on seismic waves.

Integrated Physics and Chemistry (6) Science Concepts. The student knows the impact of energy transformations in everyday life. The student is expected to

(A) describe the law of conservation of energy;

(B) investigate and demonstrate the movement of heat through solids, liquids, and gases by convection, conduction, and radiation; and

(F) investigate and compare series and parallel circuits.
Highlights of Objective 5

• Students will be expected to perform calculations related to motion, force, and energy. Calculations may involve the use of more than one formula and/or the conversion of basic SI units. For example, the item may give the force, distance, and time of a moving object, and students will be asked to calculate the power of the object. All the formulas needed for the assessment will be listed on the formula chart or in the item. Items may require the use of more than one formula or step.

• Students should understand the movement of heat energy through materials. An understanding of specific heat will be needed to calculate the amount of heat energy gained or lost by a substance. Some items may not require calculations but instead will ask students to apply the ideas of specific heat, heat transfer, and phase changes.

• Students may be required to demonstrate their understanding of the characteristics of waves. Students should be able to identify relationships between wavelength, frequency, and amplitude. These concepts may be applied to transverse, longitudinal/compression, and electromagnetic waves. Students should also be familiar with how temperature and density can affect wave behavior. The technological applications of different types of waves (for example, radios, microwave ovens, and X-rays) should be explored as well.

• The integration of biological and earth/space science concepts with the study of forces, motion, and energy may be seen in items that address ideas such as osmosis, blood pressure, muscle activity, weather, and plate tectonics.

• Students should be able to interpret simple circuit diagrams. Items will not require students to perform calculations that are specific to parallel and series circuits.
Objective 5 Sample Items

21 The circuit above can be made into a closed-series circuit that will light both bulbs by touching the loose wire to Point —

A Q
B* R
C S
D U

IPC (6)(F)
Students should be given the opportunity to construct series and parallel circuits.

NOTE: IPC (6)(F) is tested only at tenth grade.

22 What is the average speed of a jet plane that flies 8000 kilometers in 8.5 hours?

A 471 km/h
B* 941 km/h
C 8009 km/h
D 68,000 km/h

IPC (4)(A)
Students will be expected to perform basic mathematical calculations on some items. Notice that items of this nature do not require the application of the rules for significant figures.

23 Safety restraints in cars help prevent passenger injuries that would otherwise occur as a result of passengers remaining in motion during a car's abrupt stop. Which of these laws predicts that an unrestrained moving body will continue to move?

A* Law of inertia
B Law of reflection
C Law of universal gravitation
D Law of conservation of momentum

IPC (4)(B)
Students must have a strong conceptual understanding of Newton's laws of force and motion as well as be able to perform calculations.
24 Which of these best explains why skin is warmed by radiant energy?

A* Sunlight absorbed by the skin increases the skin’s thermal energy.

B High-frequency radiant energy is composed of waves with short wavelengths.

C Uneven heating produces convection currents within the skin.

D Atoms with loosely held electrons transmit heat by conduction.

IPC (6)(B)
Students must understand and recognize examples of the movement of energy rather than simply define convection, conduction, and radiation.

25 What would be the wavelength in centimeters of this wave if its frequency were doubled? Record and bubble in your answer on the answer document.

IPC (5)(A)
This item requires students to understand the relationship between wavelength and frequency. Students will need to know how to apply the wave formula.
Cluster Example

Use the information below and your knowledge of science to answer questions 26–28.

The Texas Horned Lizard

From the 1950s to the 1970s, the Texas horned lizard population decreased dramatically. Three possible reasons have been given for this decline. First, Texas horned lizards became popular pets in Texas and Oklahoma and were overharvested. Second, expansion of Texas and Oklahoma cities led to the loss of the lizard’s habitat. Third, there was a decline in the number of harvester ants, the horned lizard’s main food source.

The decline of the harvester ants is due in part to the arrival of fire ant populations into the United States from South America in the early 1900s. The aggressive, omnivorous fire ants migrated west and harmed many native populations in their path, including harvester ants. As the harvester ant population decreased, it became more difficult for the Texas horned lizard to find adequate food.

The Texas horned lizard does not feed on fire ants. It is possible that the Texas horned lizard does not recognize the fire ants as a food source. Fire ants do not provide the nutrients that the native harvester ants provide. The Texas horned lizard requires formic acid from harvester ants to help neutralize a base that the horned lizard produces.
26 According to this food web, the relationship between Texas horned lizards and other lizards would be described best as —

A* competitive  
B predatory  
C parasitic  
D mutualistic

27 Like most invasive species, fire ants have successfully migrated into new territories because of —

A genetic drift  
B advantageous coloration  
C* lack of population control  
D mutation of genes

28 In this food web, how many organisms are in kingdom Animalia?

A 8  
B 7  
C* 6  
D 5

29 Texas horned lizards must eat a large number of harvester ants each day. The formic acid in the harvester ants helps neutralize a base that the lizard produces. The products from this reaction would be —

A an acid and a base  
B* a salt and water  
C an acid and water  
D a salt and a base

Bio (12)(B), (12)(E), (8)(C), and IPC (8)(A)  
Clusters will often address more than one objective and integrate content areas. This cluster is an example of how biological information can be a stimulus for an item on chemistry. The answers to the items in a cluster may not be directly found in the stimulus. Instead, the stimulus is used to focus students so that they can analyze and apply information.
Appendix: Science Educator Resources

Texas Education Agency (TEA) Websites
TEA website: www.tea.state.tx.us
Graduation Requirements for Science: www.tea.state.tx.us/curriculum/side1.doc
Certification Requirements and PD Provider Number: www.sbec.state.tx.us

Resources for Teaching Science
Texas Science Center at Region IV: www.texassciencecenter.org
Science Safety: www.tenet.edu/teks/science/stacks/safety/safetymain.html
Texas Regional Collaboratives for Excellence in Science Teaching: http://regcol.edb.utexas.edu
Charles A. Dana Center: www.tenet.edu/teks/science
Benchmarks for Science Literacy: www.project2061.org/tools/benchol/bolintro.htm
Science for All Americans: www.project2061.org/tools/sfaaol/sfaatoc.htm
National Science Education Standards: www.nap.edu/readingroom/books/nses/html/

Resources from Organizations
Science Teachers Association of Texas: www.statweb.org
National Science Teachers Association: www.nsta.org
National Association of Biology Teachers: www.nabt.org
American Association of Physics Teachers: www.aapt.org
American Chemical Society: www.acs.org
National Earth Science Teachers Association: www.nestanet.org

If you need any help in the area of science curriculum or assessment, please feel free to contact:

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