CHALLENGING THE SYSTEM

SCIENCE

8

GRADE 8

This guide links the *Challenging the System* unit to the Texas Essential Knowledge and Skills (TEKS) for eighth graders. *Challenging the System* is a science unit that allows students to explore living and non-living systems and the roles those systems play in the environment and society. Though a science unit, *Challenging the System* also teaches students skills in the other subject areas of English language arts, mathematics, and social studies. For example, students use graphs, tables, and statistical data, which the Mathematics TEKS include, and writing and research skills, which the English Language Arts and Reading and Social Studies TEKS require. The following document includes the applicable TEKS and the details of the *Challenging the System* unit. The asterisks indicate that those TEKS are testable on the State of Texas Assessments of Academic Readiness (STAAR). The final section of this document presents the applicable Texas College and Career Readiness Standards adopted by the Texas Higher Education Coordinating Board (THECB) on January 24, 2008.

Description of Unit

Students will understand living and non-living systems and patterns found in systems. They will use technical writing and statistics to produce a scientific paper and formal presentation.

Phase I. Learning Experiences

A system is a collection of cycles, structures, and processes that interact. Students should understand a whole system in terms of its components and how these components relate to each other and to the whole. All systems have basic properties that can be described in terms of space, time, energy, and matter. Change and constancy occur in systems and can be observed and measured as patterns. These patterns help to predict what will happen next and can change over time.

Students will need prior knowledge of and experience in various science concepts:

- Systems
- The scientific process
- Analysis of existing data
- The use of data to make predictions
- Understanding of graphically-presented data
- Technical writing, as appropriate for science
- Scientific vocabulary

Opening activity. In groups, students analyze or create a system, **s**uch as a Rube Goldberg invention. Teachers should design this activity to fit the course students are taking. Each group must draw or create a model of their system. Then, each group will present to the class. Encourage students to ask questions about the necessity of each part of the system. Debrief. What are the things you know about a system (all the parts must work together, a system performs a function of some kind, systems are dependent on other systems, etc.)?

If you choose to do a Rube Goldberg invention, see these websites for examples:
http://mousetrapcontraptions.com/
http://www.riverdeep.net/current/2000/03/front.030300.rube.jhtml
http://www.rube-goldberg.com/

Phase II. Independent Research

A. Research process

1. Selecting a topic. Each student identifies a problem within a system that he/she wishes to study. The problem should be a real-world problem (heart disease in humans, the thinning of the ozone layer, erosion of beach dunes, water pollution from catfish farms, etc.). Depending on the topic the student wishes to study, the system could be biological, physical, environmental, social, or other.

2. Asking guiding questions. Once the student has selected a topic, he/she should think of three to five guiding questions to explore, such as:
   - What are the causes of this problem?
   - What factors contribute positively or negatively to the problem?
   - What are the consequences of this problem?
   - What are some solutions?
   - What are the advantages and disadvantages of each solution?
   - How could the solutions lead to new problems?

   While these examples are general, the student's questions should be specific to the chosen topic. The questions should lead him/her to form individual research-based opinions. The student should also develop a hypothesis or some possible answers to the questions.

3. Designing and submitting a research proposal. The student should include numerous components in the research proposal:
   - The real-world problem to be investigated
   - Three to five guiding questions he/she will investigate
   - Resources he/she will need to find answers to questions, such as previous studies on the topic and/or correspondence with experts on the subject
   - A process for gathering data to inform potential solutions to the problem, such as an experimental design or a survey.

   In the process of writing the research proposal, students may refine their guiding questions and research process.

4. Conducting the research. After the teacher has approved student proposals, students begin using the resources they have identified and others they may encounter. During this stage, students will need to keep a log, note cards, or resource process sheets of all the sources they use and what they learn from each one.

5. Data summary. Depending on the topic and needed data, this may be a lab report or analysis of survey results.

B. The product

The student shows what he/she has learned through **one** of the following written products:

1. A letter to a person or organization with responsibility for the problem. In the letter, the student should describe the solution that would best solve the problem and give reasons why this solution is the best of all the available solutions. Students may wish to include supplementary materials (such as graphs, tables, and/or visual depictions of the system) with the letter and should mail the letter to the appropriate person or organization. The student should also include any response from or additional communication with the person or organization.

2. An article that summarizes the results of the research. The student should use graphs, tables, or visual depictions of the system to illustrate the research process, results, and conclusions. The article should be submitted to a publication (e.g., school newspaper, community newspaper through a letter to the editor, teen magazine, online journal). The student should also include any response from or additional communication with representatives from the publication.

   Whatever product is chosen, the student must complete a Reference List/Works Cited Page that includes at least ten references.

C. Communication

The student demonstrates what he/she has learned through **one** of the following types of presentations, to last no more than fifteen minutes:

1. A formal presentation to a panel of experts. In the class, form panels of "experts"—groups of students or adults—who will read the student's letter or article, listen to his/her presentation, and ask questions. The student may provide some questions to the panel, but others should be generated by the panel members.

2. An informal class presentation in which the student presents his/her expertise to the class. A question-and-answer session should follow the presentation.

D. Submission

a. The cover sheet
b. A research proposal
c. A log, note cards, or resource process sheets
d. A data summary
e. The letter or article
f. A Works Cited Page with at least ten references
g. An audiotape or videotape of presentation, including the Q&A session
h. A response to the student letter or article, if received

Texas Essential Knowledge and Skills

The unit may address the following TEKS:

English Language Arts and Reading:	
8.1	Reads grade-level text with fluency and comprehension
8.2	Understands new vocabulary and use it when reading and writing* (Testable on the Grade 8 Reading STAAR, Reporting Category 1)
8.3	Analyzes, makes inferences, and draws conclusions about theme and genre in different cultural, historical, and contemporary contexts and provides evidence from the text to support their understanding* (Testable on the Grade 8 Reading STAAR, Reporting Category 1, Reporting Category 2)
8.9	Analyzes, makes inferences, and draws conclusions about the author's purpose in cultural, historical, and contemporary contexts and provides evidence from the text to support their understanding* (Testable on the Grade 8 Reading STAAR, Reporting Category 1)
8.10	Analyzes, makes inferences, and draws conclusions about expository text and provides evidence from text to support their understanding* (Testable on the Grade 8 Reading STAAR, Reporting Category 3)
8.13	Uses comprehension skills to analyze how words, images, graphics, and sounds work together in various forms to impact meaning* (Testable on the Grade 8 Reading STAAR, Reporting Category 2, Reporting Category 3)
8.14	Uses elements of the writing process (planning, drafting, revising, editing, and publishing) to compose text

8.19	Understands the function of and uses the conventions of academic language when speaking and writing
8.20	Writes legibly and uses appropriate capitalization and punctuation conventions in their compositions
8.21	Spells correctly
8.22	Asks open-ended research questions and develops a plan for answering them
8.23	Determines, locates, and explores the full range of relevant sources addressing a research question and systematically record the information they gather
8.26	Uses comprehension skills to listen attentively to others in formal and informal settings
8.27	Speaks clearly and to the point, using the conventions of language
Mathematics:	
8.1	Uses mathematical processes to acquire and demonstrate mathematical understanding
8.2	Applies mathematical process standards to represent and use real numbers in a variety of forms
8.5	Applies mathematical process standards to use proportional and non- proportional relationships to develop foundational concepts of functions
8.6	Applies mathematical process standards to develop mathematical relationships and make connections to geometric formulas
8.8	Applies mathematical process standards to use one-variable equations or inequalities in problem situations
8.11	Applies mathematical process standards to use statistical procedures to describe data
8.12	Applies mathematical process standards to develop an economic way of thinking and problem solving useful in one's life as a knowledgeable consumer and investor
Science:	
8.1	For at least 40% of instructional time, conducts laboratory and field investigations following safety procedures and environmentally appropriate and ethical practices* (Testable on the Grade 8 Science STAAR)
8.2	Uses scientific inquiry methods during laboratory and field investigations* (Testable on the Grade 8 Science STAAR)
8.3	Uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists* (Testable on the Grade 8 Science STAAR)
8.4	Knows how to use a variety of tools and safety equipment to conduct science inquiry* (Testable on the Grade 8 Science STAAR)
8.5	Knows that matter is composed of atoms and has chemical and physical properties* (Testable on the Grade 8 Science STAAR, Reporting Category 1)
8.6	Knows that there is a relationship between force, motion, and energy* (Testable on the Grade 8 Science STAAR, Reporting Category 2)
8.7	Knows the effects resulting from cyclical movements of the Sun, Earth, and Moon* (Testable on the Grade 8 Science STAAR, Reporting Category 3)

8.8	Knows characteristics of the universe* (Testable on the Grade 8 Science STAAR, Reporting Category 3)
8.9	Knows that natural events can impact Earth systems* (Testable on the Grade 8 Science STAAR, Reporting Category 3)
8.10	Knows that climatic interactions exist among Earth, ocean, and weather systems* (Testable on the Grade 8 Science STAAR, Reporting Category 3)
8.11	Knows that interdependence occurs among living systems and the environment and that human activities can affect these systems* (Testable on the Grade 8 Science STAAR, Reporting Category 4)
B.4	Knows that cells are the basic structure of all living things with specialized parts that perform specific functions and that viruses are different from cells* (Testable on the Biology STAAR, Reporting Category 1)
B.5	Knows how an organism grows and the importance of cell differentiation* (Testable on the Biology STAAR, Reporting Category 1)
B.6	Knows the mechanisms of genetics, including the role of nucleic acids and the principals of Mendelian Genetics* (Testable on the Biology STAAR, Reporting Category 2)
B.7	Knows the evolutionary theory is a scientific explanation for the unity and diversity of life* (Testable on the Biology STAAR, Reporting Category 3)
B.9	Knows the significance of various molecules involved in metabolic processes and energy conversions that occur in living organisms* (Testable on the Biology STAAR, Reporting Category 4)
B.10	Knows that biological systems are composed of multiple levels* (Testable on the Biology STAAR, Reporting Category 4)
B.11	Knows that biological systems work to achieve and maintain balance* (Testable on the Biology STAAR, Reporting Category 4)
B.12	Knows that interdependence and interactions occur within an environmental system* (Testable on the Biology STAAR, Reporting Category 5)

**Whether or not the activity covers these TEKS depends on the projects the students choose.

Social Studies:

8.23	Understands the relationships between and among people from various groups, including racial, ethnic, and religious groups, during the 17th, 18th, and 19th centuries* (Testable on the Grade 8 Social Studies STAAR, Reporting Category 2)
8.24	Understands the major reform movements of the 19th century* (Testable on the Grade 8 Social Studies STAAR, Reporting Category 2)
8.26	Understands the relationship between the arts and the times during which they were created* (Testable on the Grade 8 Social Studies STAAR, Reporting Category 2)
8.27	Understands the impact of science and technology on the economic development of the United States* (Testable on the Grade 8 Social Studies STAAR, Reporting Category 4)
8.28	Understands the impact of scientific discoveries and technological innovations on daily life in the United States* (Testable on the Grade 8 Social Studies STAAR, Reporting Category 4)

8.29	Applies critical-thinking skills to organize and use information acquired through established research methodologies from a variety of valid sources, including electronic technology* (Testable on the Grade 8 Social Studies STAAR)
8.30	Communicates in written, oral, and visual forms* (Testable on the Grade 8 Social Studies STAAR)
8.31	Uses problem-solving and decision-making skills, working independently and with others, in a variety of settings

Texas College and Career Readiness Standards

This unit may address the following Texas College and Career Readiness Standards:

English Language Arts:	
I.A.2	Generates ideas and gathers information relevant to the topic and purpose, keeping careful records of outside sources
I.A.3	Evaluates relevance, quality, sufficiency, and depth of preliminary ideas and information, organize material generated, and formulate thesis
I.A.4	Recognizes the importance of revision as the key to effective writing
I.A.5	Edits writing for proper voice, tense, and syntax, assuring that it conforms to standard English, when appropriate
II.A.1	Uses effective reading strategies to determine a written work's purpose and intended audience
II.A.2	Uses text features and graphics to form an overview of informational texts and to determine where to locate information
II.A.4	Draws and supports complex inferences from text to summarize, draw conclusions, and distinguish facts from simple assertions and opinions
II.A.5	Analyzes the presentation of information and the strength and quality of evidence used by the author, and judges the coherence and logic of the presentation and the credibility of an argument
II.A.8	Compares and analyzes how generic features are used across texts
II.A.9	Identifies and analyzes the audience, purpose, and message of an informational or persuasive text
II.B.1	Identifies new words and concepts acquired through study of their relationships to other words and concepts
II.B.2	Applies knowledge of roots and affixes to infer the meanings of new words
II.B.3	Uses reference guides to confirm the meanings of new words or concepts
III.A.1	Understands how style and content of spoken language varies in different contexts and influences the listener's understanding
III.A.2	Adjusts presentation (delivery, vocabulary, length) to particular audiences and purposes
III.B.1	Participates actively and effectively in one-on-one oral communication situations

III.B.2	Participates actively and effectively in group discussions
III.B.3	Plans and delivers focused and coherent presentations that convey clear and distinct perspectives and demonstrates solid reasoning
IV.A.1	Analyzes and evaluates the effectiveness of a public presentation
IV.A.2	Interprets a speaker's message; identifies the position taken and the evidence in support of that position
IV.A.3	Uses a variety of strategies to enhance listening comprehension
IV.B.1	Listens critically and responds appropriately to presentations
IV.B.2	Listens actively and effectively in one-on-one communication situations
IV.B.3	Listens actively and effectively in group discussions
V.A.1	Formulates research questions
V.A.2	Explores a research topic
V.A.3	Refines research topic and devises a timeline for completing work
V.B.1	Gathers relevant sources
V.B.2	Evaluates the validity and reliability of sources
V.B.3	Synthesizes and organizes information effectively
V.B.4	Uses source material ethically
V.C.1	Designs and presents an effective product

Mathematics:

I.A.1	Compares real numbers
I.B.1	Performs computations with real and complex numbers
IV.A.1	Selects or uses the appropriate type of unit for the attribute being measured
IV.D.1	Computes and uses measures of center and spread to describe data
VI.A.1	Plans a study
VI.B.1	Determines types of data
VI.B.2	Selects and applies appropriate visual representations of data
VI.B.4	Describes patterns and departure from patterns in a set of data
VI.C.2	Analyzes data sets, using graphs and summary statistics
VI.C.3	Analyzes relationships between paired data, using spreadsheets, graphing calculators, or statistical software
VI.C.4	Recognizes reliability of statistical results.
VIII.A.1	Analyzes given information
VIII.A.2	Formulates a plan or strategy
VIII.A.3	Determines a solution
VIII.A.4	Justifies the solution
VIII.A.5	Evaluates the problem-solving process
VIII.B.1	Develops and evaluate convincing arguments
VIII.B.2	Uses various types of reasoning

VIII.C.1	Formulates a solution to a real-world situation based on the solution to a mathematics problem
VIII.C.3	Evaluates the problem-solving process
IX.A.1	Uses mathematical symbols, terminology, and notation to represent given and unknown information in a problem
IX.A.2	Uses mathematical language to represent and communicate the mathematical concepts in a problem
IX.C.1	Communicates mathematical ideas, reasoning, and their implications using symbols, diagrams, graphs, and words
IX.C.2	Creates and uses representations to organize, record, and communicate mathematical ideas
IX.C.3	Explains, displays, or justifies mathematical ideas and arguments, using precise mathematical language in written or oral communications
X.A.1	Connects and uses multiple strands of mathematics in situations and problems.
X.A.2	Connects mathematics to the study of other disciplines
X.B.1	Uses multiple representations to demonstrate links between mathematical and real-world situations
X.B.2	Understands and uses appropriate mathematical models in the natural, physical, and social sciences
Science:	
I.A.1	Utilizes skepticism, logic, and professional ethics in science
I.A.2	Uses creativity and insight to recognize and describe patterns in natural phenomena
I.A.3	Formulates appropriate questions to test understanding of natural phenomena
I.A.4	Relies on reproducible observations of empirical evidence when constructing, analyzing, and evaluating explanations of natural events and processes
I.B.1	Designs and conducts scientific investigations in which hypotheses are formulated and tested.
I.C.1	Collaborates on joint projects
I.E.1	Uses several modes of expression to describe or characterize natural patterns and phenomena. These modes of expression include narrative, numerical, graphical, pictorial, symbolic, and kinesthetic
I.E.2	Uses essential vocabulary of the discipline being studied
II.A.1	Understands the real number system and its properties
II.A.7	Uses calculators, spreadsheets, computers, etc., in data analysis
II.F.1	Selects appropriate Standard International (SI) units and prefixes to express measurements for real-world problems
II.E.1	Understands descriptive statistics
III.B.1	Reads technical and scientific articles to gain understanding of interpretations, apparatuses, techniques or procedures, and data
III.B.2	Sets up apparatuses, carries out procedures, and collects specified data from a given set of appropriate instructions

III.B.3	Recognizes scientific and technical vocabulary in the field of study and uses this vocabulary to enhance clarity of communication
III.B.4	Lists, uses, and gives examples of specific strategies before, during, and after reading to improve comprehension
III.C.1	Prepares and represents scientific/technical information in appropriate formats for various audiences
III.D.1	Uses search engines, databases, and other digital electronic tools effectively to locate information
III.D.2	Evaluates quality, accuracy, completeness, reliability, and currency of information from any source
IV.A.1	Recognizes how scientific discoveries are connected to technological innovations
IV.B.1	Understands how scientific research and technology have an impact on ethical and legal practices
IV.B.2	Understands how commonly-held ethical beliefs impact scientific research
IV.C.1	Understands the historical development of major theories in science
IV.C.2	Recognizes the role of people in important contributions to scientific knowledge
V.C.1	Recognizes patterns of change
V.E.1	Uses models to make predictions
Social Studies:	
I.F.1	Uses a variety of research and analytical tools to explore questions or issues thoroughly and fairly
I.F.2	Analyzes ethical issues in historical, cultural, and social contexts
IV.A.1	Identifies and analyzes the main idea(s) and point(s) of view in sources
IV.A.2	Situates an informational source in its appropriate contexts
IV.A.3	Evaluates sources from multiple perspectives
IV.A.4	Understands the differences between a primary and secondary source and use each appropriately to conduct research and construct arguments
IV.A.5	Reads narrative texts critically
IV.A.6	Reads research data critically
IV.B.1	Uses established research methodologies
IV.B.3	Gathers, organizes, and displays the results of data and research
IV.B.4	Identifies and collects sources
IV.C.1	Understands/interprets presentations critically
IV.D.1	Constructs a thesis that is supported by evidence
IV.D.2	Recognizes and evaluates counter-arguments
V.A.1	Uses appropriate oral communication techniques, depending on the context or nature of the interaction
V.A.2	Uses conventions of standard written English
V.B.1	Attributes ideas and information to source materials and authors

Cross-Disciplinary Standards:

I.A.1	Engages in scholarly inquiry and dialogue
I.A.2	Accepts constructive criticism and revises personal views when valid evidence warrants
I.B.1	Considers arguments and conclusions of self and others
I.B.2	Constructs well-reasoned arguments to explain phenomena, validate conjectures, or support positions
I.B.3	Gathers evidence to support arguments, findings, or lines of reasoning
I.B.4	Supports or modifies claims based on the results of an inquiry
I.C.1	Analyzes a situation to identify a problem to be solved
I.C.2	Develops and applies multiple strategies to solving a problem
I.C.3	Collects evidence and data systematically and directly relate to solving a problem
I.D.1	Self-monitors learning needs and seek assistance when needed
I.D.2	Uses study habits necessary to manage academic pursuits and requirements
I.D.3	Strives for accuracy and precision
I.D.4	Perseveres to complete and master tasks
I.E.1	Works independently
I.E.2	Works collaboratively
I.F.1	Attributes ideas and information to source materials and people
I.F.2	Evaluates sources for quality of content, validity, credibility, and relevance
I.F.3	Includes the ideas of others and the complexities of the debate, issue, or problem
I.F.4	Understands and adheres to ethical codes of conduct
II.A.1	Uses effective prereading strategies
II.A.2	Uses a variety of strategies to understand the meanings of new words
II.A.3	Identifies the intended purpose and audience of the text
II.A.4	Identifies the key information and supporting details
II.A.5	Analyzes textual information critically
II.A.6	Annotates, summarizes, paraphrases, and outlines texts when appropriate
II.A.7	Adapts reading strategies according to structure of texts
II.A.8	Connects reading to historical and current events and personal interest
II.B.1	Writes clearly and coherently, using standard writing conventions
II.B.2	Writes in a variety of forms for various audiences and purposes
II.B.3	Composes and revises drafts
II.C.1	Understands which topics or questions are to be investigated
II.C.2	Explores a research topic
II.C.3	Refines research topic based on preliminary research and devise a timeline for completing work
II.C.4	Evaluates the validity and reliability of sources
II.C.5	Synthesizes and organizes information effectively

II.C.6	Designs and presents an effective product
II.C.7	Integrates source material
II.C.8	Presents final product
II.D.1	Identifies patterns or departures from patterns among data
II.D.2	Uses statistical and probabilistic skills necessary for planning an investigation, and collecting, analyzing, and interpreting data
II.D.3	Presents analyzed data and communicate findings in a variety of formats
II.E.1	Uses technology to gather information
II.E.2	Uses technology to organize, manage, and analyze information
II.E.3	Uses technology to communicate and display findings in a clear and coherent manner
II.E.4	Uses technology appropriately

COVER SHEET

Name: _____

District: _____ School: _____

Project I.D. Number: _____ Topic: *Challenging the System*

Items submitted:
_____ Cover sheet

Research process:
_____ Research proposal
_____ Research evidence (log, note cards, or resource process sheets)
_____ Research-data summary

Product:
_____ Product, including ten references (select **one** of the following)
    _____ Letter
    _____ Article

Communication:
_____ Videotape or audiotape (select **one** of the following)
    _____ Formal presentation, including the Q&A session
    _____ Informal presentation, including the Q&A session
_____ A response to the student's letter or article submission, if received

For the Student:
I certify that all work submitted is totally my work and that I have credited others for their contributions.

Student Signature: _____ **Date:** _____

For the Teacher:
I certify that all the work submitted is totally that of this student.

Teacher Signature: _____ **Date:** _____