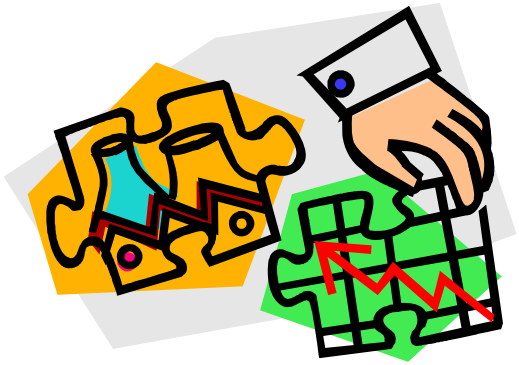

TEXAS PERFORMANCE STANDARDS PROJECT
Grade 4 Science Unit
Enigmas

This guide links the *Enigmas* unit to the Texas Essential Knowledge and Skills (TEKS) for fourth graders. *Enigmas* is a science unit that allows students to study a naturally occurring enigma, using scientific research methods. Though a science unit, *Enigmas* also leads students to practice skills in the other subject areas of English language arts, mathematics, and social studies. For example, students use deductive reasoning and logic, which the Mathematics TEKS include, and writing and research skills, which the English Language Arts and Social Studies TEKS address. The following document includes the applicable TEKS and the details of the *Enigmas* unit. The asterisks indicate that those TEKS are testable on the Texas Assessment of Knowledge and Skills (TAKS). The final section of this document presents the applicable Texas College Readiness Standards adopted by the Texas Higher Education Coordinating Board (THECB) on January 24, 2008.

Texas Essential Knowledge and Skills
This unit may address the following TEKS:

English Language Arts:
4.1 Reads grade-level text with fluency and comprehension
4.2 Understands new vocabulary and uses it when reading and writing
4.9 Reads independently for sustained periods of time and produces evidence of their reading
4.10 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
4.11 Analyzes, makes inferences, and draws conclusions about expository text and provides evidence from text to support their understanding
4.14 Uses comprehension skills to analyze how words, images, graphics, and sounds work together in various forms to impact meaning
4.15 Uses elements of the writing process (planning, drafting, revising, editing, and publishing) to compose text
4.18 Writes expository and procedural or work-related texts to communicate ideas and information to specific audiences for specific purposes
4.20 Understands the function of and uses the conventions of academic language when speaking and writing
4.21 Writes legibly and use appropriate capitalization and punctuation conventions in their compositions
4.22 Spells correctly

4.23 Asks open-ended research questions and develops a plan for answering them
4.24 Determines, locates, and explores the full range of relevant sources addressing a research question and systematically record the information they gather
4.25 Clarifies research questions and evaluates and synthesizes collected information
4.27 Uses comprehension skills to listen attentively to others in formal and informal settings
4.28 Speaks clearly and to the point, using the conventions of language
4.29 Works productively with others in teams

Mathematics:
4.7 Uses organizational structures to analyze and describe patterns and relationships* (Testable on the Grade 4 Mathematics TAKS, Objective 2)
4.8 Identifies and describes lines, shapes, and solids using formal geometric language* (Testable on the Grade 4 Mathematics TAKS, Objective 3)
4.12 Applies measurement concepts* (Testable on the Grade 4 Mathematics TAKS, Objective 4)
4.13 Solves problems by collecting, organizing, displaying, and interpreting sets of data* (Testable on the Grade 4 Mathematics TAKS, Objective 5)
4.14 Solves problems connected to everyday experiences and activities in and outside of school* (Testable on the Grade 4 Mathematics TAKS, Objective 6)
4.15 Communicates about mathematics using informal language* (Testable on the Grade 4 Mathematics TAKS, Objective 3)
4.16 Uses logical reasoning to make sense of his or her world
5.2 Uses fractions in problem-solving situations* (Testable on the Grade 5 Mathematics TAKS, Objective 1)
5.5 Makes generalizations based on observed patterns and relationships* (Testable on the Grade 5 Mathematics TAKS, Objective 2)
5.6 Describes relationships mathematically and selects from and uses diagrams and number sentences to represent real-life situations* (Testable on the Grade 5 Mathematics TAKS, Objective 2)
5.12 Describes and predicts the results of a probability experiment* (Testable on the Grade 5 Mathematics TAKS, Objective 5)
5.13 Solves problems by collecting, organizing, displaying, and interpreting sets of data* (Testable on the Grade 5 Mathematics TAKS, Objective 5)

Science:
4.1 Conducts field and laboratory investigations following home and school safety procedures and environmentally appropriate and ethical practices* (Testable on the Grade 4 Science TAKS, Objective 1)
4.2 Uses scientific inquiry methods during field and laboratory investigations* (Testable on the Grade 4 Science TAKS, Objective 1)
4.3 Uses critical thinking and scientific problem solving to make informed decisions* (Testable on the Grade 4 Science TAKS, Objective 1)
4.4 Knows how to use a variety of tools and methods to conduct science inquiry* (Testable on the Grade 4 Science TAKS, Objective 1)
4.5 Knows that complex systems may not work if some parts are removed
4.10 Knows that certain past events affect present and future events* (Testable on the Grade 4 Science TAKS, Objective 4)
6.6 Knows that there is a relationship between force and motion
6.7 Knows that substances have physical and chemical properties
6.8 Knows that complex interactions occur between matter and energy
6.9 Knows that obtaining, transforming, and distributing energy affects the environment

Social Studies:
4.21 Understands the impact of science and technology on life in Texas
4.22 Applies critical-thinking skills to organize and use information acquired from a variety of sources, including electronic technology
4.23 Communicates in written, oral, and visual forms
4.24 Uses problem-solving and decision-making skills, working independently and with others, in a variety of settings

Description of Unit
Students will investigate a naturally occurring enigma, an unsolved mystery. Each student will have an opportunity to explore in depth an enigma and hypothesize possible solutions. In their explorations, students will use scientific research processes.

Goals
Students will meet these goals in their explorations:

- Develop the essential skills of logical thinking, creative problem solving, intellectual risk taking, and communicating
- Make connections across disciplines
- Identify an enigma and how it manifests itself
- Investigate theories about the cause of the enigma
- Hypothesize the cause of the enigma
- Design an experiment to test the hypothesis
- Carry out the experiment
- Keep records and document progress
- Draw conclusions and refine hypotheses
- Share results

Phase I. Learning Experiences

1. Use the example The Marfa Lights, (Attachment #1), to introduce the concept of enigmas and how scientists in different branches of science explain an enigma in different ways. Discuss the following examples:
   - How do the different scientists explain the Marfa Lights?
   - How are the viewpoints the same? What are the differences?
   - How can ideas from across the disciplines contribute to our understanding of the Marfa Lights?
   - What dilemmas or controversies are involved in understanding the phenomena of the Marfa Lights?
   - What viewpoints can be identified that reflect bias, prejudice, and discrimination?

2. Divide the students into groups. Each group will review the handout of the eight enigmas (Attachment #2—Possible Enigmas for Study) and will focus on one enigma. In small groups, students will research and discuss the following:
   - What is the meaning of the word "enigma"?
   - What is still not understood about the enigma?
   - In what ways is the information incomplete or lacking explanation?

   The class listens to each group's report and then develops an agreed-upon, informal definition of an enigma (e.g., an unsolved, age-old mystery).

You may wish to use these resources in this unit:

- An enigmas Webquest, http://projects.edtech.sandi.net/grant/enigmas/
- The Museum of Unnatural Mystery, http://www.unmuseum.org/unmain.htm
- Hadingham, Evan. *Lines to the Mountain Gods: Nazca and the Mysteries of Peru*. University of Oklahoma Press, 1998.
- Hawking, Stephen. *The Illustrated A Brief History of Time*. Bantam Books, 1996.
- Spaeth, Frank, Ed. *Mysteries of the Deep*. Llewellyn Publications, 1998.
- Yorke, Malcolm. *Beastly Tales: Yeti, Bigfoot, and the Loch Ness Monster*, Econo-Clad Books, 1998.

Phase II. Independent Research

A. Research process

1. Selecting a topic. Each student will choose an enigma for an in-depth investigation. (The enigma may be one of those shown on Attachment #2 or another enigma.)

2. Asking guiding questions. Once each student has selected a topic, he/she should think of three to five guiding questions to explore, such as:
   - How would you describe the enigma?
   - How long have people known about it?
   - How do scientists from different fields explain the enigma?
   - How are the viewpoints the same? What are their differences?
   - How do ideas from across the disciplines contribute to our understanding of the enigma?
   - What dilemmas or controversies are involved in this enigma?
   - What viewpoints can be identified that reflect bias, prejudice, and discrimination?
   - How has understanding of the enigma changed over time?

   While these examples are general, the student's questions should be specific to the chosen enigma. 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. Developing a hypothesis. The student should create his/her own theory of the cause of the enigma and identify a way to test the theory.

4. Designing a research proposal. (See Attachment #4—Enigmas Proposal.) Each student should carry out a scientific research process:
   - Identify the enigma he/she will study
   - List the guiding questions to be investigated
   - Describe his/her hypothesis
   - Identify an experimental design to test the hypothesis

5. Testing the hypothesis. Each student will design and carry out an experiment or study based on a scientific concept related to the enigma. (See Attachment #6—The Scientific Process—and Attachment #7—Experiment Organizer.)

   You may wish to have your students share parts of their hypothesis with their classmates—a Hypothesis Hunch—so that you and their peers can ask questions and provide feedback. In a Hypothesis Hunch, the student stands before the class and explains what his/her hypothesis is. Students and teachers then ask questions about the hypothesis. Questions should be thoughtful and elicit complex responses. If the student does not know how to answer a

question, he/she writes it down and researches an answer at the end of the Hypothesis Hunch. (Source: Dawn Campagna, Nat Williams Elementary School, Lubbock ISD.)

6. Revising the hypothesis based on the experiment or study results. Each student should consider the following questions:
   - What did you learn from your experiment that helps you better understand the enigma?
   - What other experiments could be done that would solve the mystery?

7. Drawing conclusions. Each student should consider the following questions:
   - What do you still not understand about the enigma?
   - What do scientists still not understand about the enigma?
   - In what ways is the information incomplete or lacking in an explanation?

B. The product

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

1. The student develops a board game or a learning center based on the enigma. The game should include fair rules and accurate information about the enigma and various theories of its cause. (See Attachment #7.)

2. A grade-level-appropriate, interactive learning center to teach younger children about the enigma and theories relating to it. (See Attachment #8.)

C. Communication

Students present their game or learning center to the class. The presentation should be long enough for classmates to understand the game or learning center and should end with a question-and-answer session.

D. Submissions

a. The cover sheet
b. Attachment #4—Enigmas Proposal
c. Evidence of research (log, note cards, and/or resource process sheets)
d. Attachment #6—Experiment Organizer
e. Attachment #7 or #8, including references
f. Videotape or audiotape of presentation, including the Q&A session

THECB College Readiness Standards

This unit may address the following THECB College 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
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.3	Identifies explicit and implicit textual information, including main ideas and author's purpose

II.A.4 Draws and supports complex inferences from text to summarize, draw conclusions, and distinguish facts from simple assertions and opinions
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
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 demonstrate 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 respond 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 devise 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 present an effective product

Mathematics:
IV.D.2 Applies probabilistic measures to practical situations to make an informed decision
VI.A.1 Plans a study
VI.B.1 Determines types of data
VI.B.2 Selects and applies appropriate visual representations of data
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
IX.A.3 Uses mathematics as a language for reasoning, problem solving, making connections, and generalizing
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
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 use 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
V.C.1 Recognizes patterns of change
V.D.1 Understands that scientists categorize things according to similarities and differences
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
IV.A.3 Evaluates sources from multiple perspectives
IV.A.4 Understands the differences between a primary and secondary source and uses 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.2 Explains how historians and other social scientists develop new and competing views of past phenomena
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 revise 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.3 Collects evidence and data systematically and directly relate to solving a problem
I.D.1 Self-monitors learning needs and seeks 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.C.1 Understands which topics or questions are to be investigated
II.C.2 Explores a research topic
II.C.3 Refines a research topic based on preliminary research and devises 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

Attachment #1
The Marfa Lights

In West Texas, nine miles outside the city of Marfa, tiny ghostly lights dance in the air at night. Robert Ellison first recorded seeing the lights in 1883, and they have remained a mystery ever since. The Marfa Lights are such a phenomenon that there is a designated area for visitors to use for camping and observing. The theories and hypotheses are many, including the possibilities of unidentified flying objects (UFOs) and the Apache Indian belief that the lights are fallen stars. The following three theories are from contemporary scientists.

Meteorologist: Ball lightning is simply a form of lightning in the shape of a ball. Generally associated with thunderstorms, ball lightning is an expulsion of atmospheric electricity, along with an extremely colorful flash of light. The lightning can last anywhere from a few seconds to a few minutes. The length of the lightning strike tends to correlate with its size and brightness, so a larger, brighter ball will generally last longer than a smaller, duller ball. Sometimes the balls appear to move from one place to another or to vibrate.

Physicist: Another theory involves the headlights of cars, either the headlights themselves or their reflection off the nearby mountains. In 1973, two scientists named Pat Kenney and Elwood Wright set out to prove that the Marfa Lights were the result of atmospheric tunneling. Atmospheric tunneling occurs when refracted light continues to follow the Earth's contours for long distances. The scientists thought that this refracted light came from the headlights of cars driving down the nearby Highway 67. To begin their study, Kenney and Wright plotted the movements of the Marfa Lights and took measurements that would allow them to compare the Lights to the headlights of cars. Problems arose for the two—the Marfa Lights would sometimes appear before there were any cars driving on the highway. The scientists gave up when they watched one light move back and forth.

Geologist: The Tectonic Strain Theory, according to its adherents, is the only theory that can be tested for explaining the UFO-like activity of the Marfa Lights. Tectonics is the study of the earth's crust and the forces that produce changes in it. According to the Tectonic Strain Theory, the ghost lights occur due to the wear and tear on the Earth's crust. In other words, the Marfa Lights are due to tectonic stress. The injection of billions of gallons of fluid into nearby oil fields in order to enhance recovery of petroleum may be a trigger for these luminous displays. In order to predict when the lights will appear, scientists must gather data on how much tectonic stress occurs, how much fluid has been injected into the Earth, and the rate of that injection.

Attachment #2
Possible Enigmas for Study

1. **The Pyramids.** How did the majestic pyramids appear in the deserts of an isolated people? Could aliens have built them, or were humans of that time actually able to compute so precisely that modern mathematicians, engineers, and architects still marvel at their handiwork?
   Internet sources:
   http://www.pbs.org/wgbh/nova/pyramid/
   http://www.si.edu/resource/faq/nmnh/pyramid.htm
   http://www.nationalgeographic.com/pyramids/pyramids.html

2. **The Bermuda Triangle.** What has caused planes and ships to disappear off the southeastern coast of the United States? Have the area's unique environmental features caused pilots and captains to make errors in navigation? Or is this a mystery not so easily explained?
   Internet sources:
   http://www.history.navy.mil/faqs/faq8-1.htm
   http://news.nationalgeographic.com/news/2002/12/1205_021205_bermudatriangle.html
   http://channel.nationalgeographic.com/channel/highspeed/2005/07/20050711news.html

3. **The Lost Colony.** Colonists settled Roanoke Island in 1585. When the leaders of the colony returned to the Old World, they instructed the settlers to leave a sign in an obvious place if they fled. A supply ship was late in arriving. The leaders came back to Roanoke Island to find it deserted.
   Internet sources:
   http://news.nationalgeographic.com/news/2005/10/1013_051013_lost_colony.html
   http://www.nps.gov/fora/search.htm
   http://oncampus.richmond.edu/academics/education/projects/webquests/roanoke/

4. **Atlantis.** A continent is lost! Where would you find it? Did this advanced civilization, first described by the Greek philosopher Plato, really exist, or was it a parable to show how the gods punish mortals? Jacques Cousteau has searched the oceans and seas for this enigma.
   Internet sources:
   http://news.nationalgeographic.com/news/2002/01/0102_020103wiratlan.html
   http://news.nationalgeographic.com/news/2004/08/0819_040819_atlantis.html

5. **Stonehenge.** From a distance, the gray stones rise abruptly from the treeless plain. Obviously, they are not a part of the natural English landscape. A closer look reveals a ring of huge, upright stones—many of them more than thirteen feet high—that appear to be deliberately placed in a large circle. Resting on top of these stones are massive

flat slabs of rock. Inside the circle are several additional upright stones topped with heavy slabs. For centuries people have looked at these stones and wondered who constructed this structure and why. Scientists have determined that this stone ring was erected 4,000 years ago, but no one knows for certain why or how it was built.

Internet sources:

http://channel.nationalgeographic.com/channel/ET/daily/20051031.html
http://www.britannia.com/history/h7.html
http://www.exn.ca/mysticplaces/stonehenge.asp

6. **The Loch Ness Monster.** Hundreds of persons have reported seeing the animal nicknamed "Nessie." Can there be a creature that lives in Loch Ness, a lake in northern Scotland?

   Internet sources:

   http://www.pbs.org/wgbh/nova/lochness/
   http://www.si.edu/resource/faq/nmnh/lochness.htm
   http://news.nationalgeographic.com/news/2003/07/0729_030729_lochness.html

7. **The Nazca Lines.** The strangest messages ever left by man are permanently marked on the flat, desolate plains in southern Peru. Drawn in lines of pebbles across the expansive wastes are huge birds, animals, and geometric figures, as if outlined by a giant's finger. From ground level, these great drawings are invisible, yet the Nazca Indians laid them across the desert 1,500 years ago, long before man could fly. What was their meaning? And who was meant to read them?

   Internet sources:

   http://www.exn.ca/mysticplaces/nazcalines.asp
   http://www.virtualperu.net/peru_arch_nazca_lines.html
   http://news.nationalgeographic.com/news/2002/10/1008_021008_wire_peruglyphs.html

Attachment #3
Branches of Science

Branch of Science	The Study of...
Anatomy	The shape and structure of organisms and their parts
Archaeology	Material remains of past human life and activity
Astronomy	Objects and matter outside the earth's atmosphere
Biochemistry	Chemical compounds and processes that occur in organisms
Biology	Living organisms and vital processes
Biophysics	The application of physical principles and methods to biological problems
Botany	Plant life
Chemistry	The composition, structure, and properties of substances and their processes
Computer science	Computable processes and structures
Entomology	Insects
Environmental science/Ecology	The interrelationship of organisms and their environments
Genetics	Heredity and the variation of organisms
Geology	The history of the earth and its life
Hydrology	The properties, distribution, and circulation of water
Immunology	The immune system
Mathematics	Numbers
Medicine	The maintenance of health and the prevention, alleviation, or cure of disease
Microbiology	Microscopic forms of life
Neuroscience	Nerves and nerve tissue
Paleontology	Past geological periods
Physical anthropology	Human evolution, variation, and classification
Physics	Matter and energy and their interactions
Virology	Viruses
Zoology	Animals

Attachment #4
Enigmas Proposal

The enigma I choose to study is _____

1. This is what I currently know about the enigma:

_____

_____

_____

_____

2. Here are some dilemmas or controversies involved in this enigma:

_____

_____

_____

_____

3. Understanding of the enigma has changed over time in the following ways:

_____

_____

_____

_____

4. Some unanswered questions about my enigma include the following:

_____

_____

5. I hope to learn…

6. Different sciences view the enigma in different ways. Some examples are:

Attachment #5
The Scientific Process

Problem	The question you are trying to answer
Hypothesis	The possible answer to the problem, which should be written as a statement
Materials	All of the supplies and equipment you need in order to conduct the experiment
Procedure	The step-by-step method you will use to test your hypothesis; what you are going to do in what order
Observation	The collection and recording of the data
Hypothesis Revision	A new or refined hypothesis based on what you have learned
Conclusion	The final results of the study

Attachment #6
Experiment Organizer

Problem:

Hypothesis:

Materials:

Procedure:

Observations:

Hypothesis Revision:
What did you learn from your experiment that helps you better understand the enigma?

What other experiments could be conducted that might help explain the mystery?

Conclusion:
What do you still not understand about the enigma?

What do scientists still not understand about the enigma?

In what ways is the information incomplete or lacking an explanation?

Attachment #7
Enigmas Board Game

Name of Game: _____

Number of Players: _____

Materials: _____

Related information, including theories of cause:

1. _____ 6. _____
2. _____ 7. _____
3. _____ 8. _____
4. _____ 9. _____
5. _____ 10. _____

Rules:

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

Sketch the design of the board.

Attachment #8
Enigmas Learning Center

Name of Learning Center: _____

Materials: _____

_____

_____

Related information, including theories of cause:

1. _____
2. _____
3. _____
4. _____

Activities and directions:

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

Sketch the design of the learning center.

COVER SHEET

Name:_____

District: _____ **School:** _____

Project I.D. Number: _____ **Topic:** *Enigmas*

Items submitted:

_____ Cover sheet

Research process:
_____ Attachment #4—Proposal

_____ Evidence of research (logs, note cards, and/or resource process sheets)

_____ Attachment #6—Experiment Organizer

Product:
Product with references (select one of the following):

_____ Attachment #7—Enigmas Board Game

_____ Attachment #8—Enigmas Learning Center

Communication:
_____ Audiotape or videotape of presentation and Q&A session

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

Student Signature: _____ **Date:** _____

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

Teacher Signature: _____ **Date:** _____