

SOFIA, EXES, and MJ



MJ Tykoski
email: mjtykoski@aus.txed.net



Question #1:

What are SOFIA and
EXES?

Question #2:

What have I
learned from this project?

Question #3:

How have I and my classroom
benefited?

SOFIA



Stratospheric
Observatory
For
Infrared
Astronomy

SOFIA

*Built by NASA and
DLR

*2.5 m telescope in
rear of 747-SP

*Fly in 2003



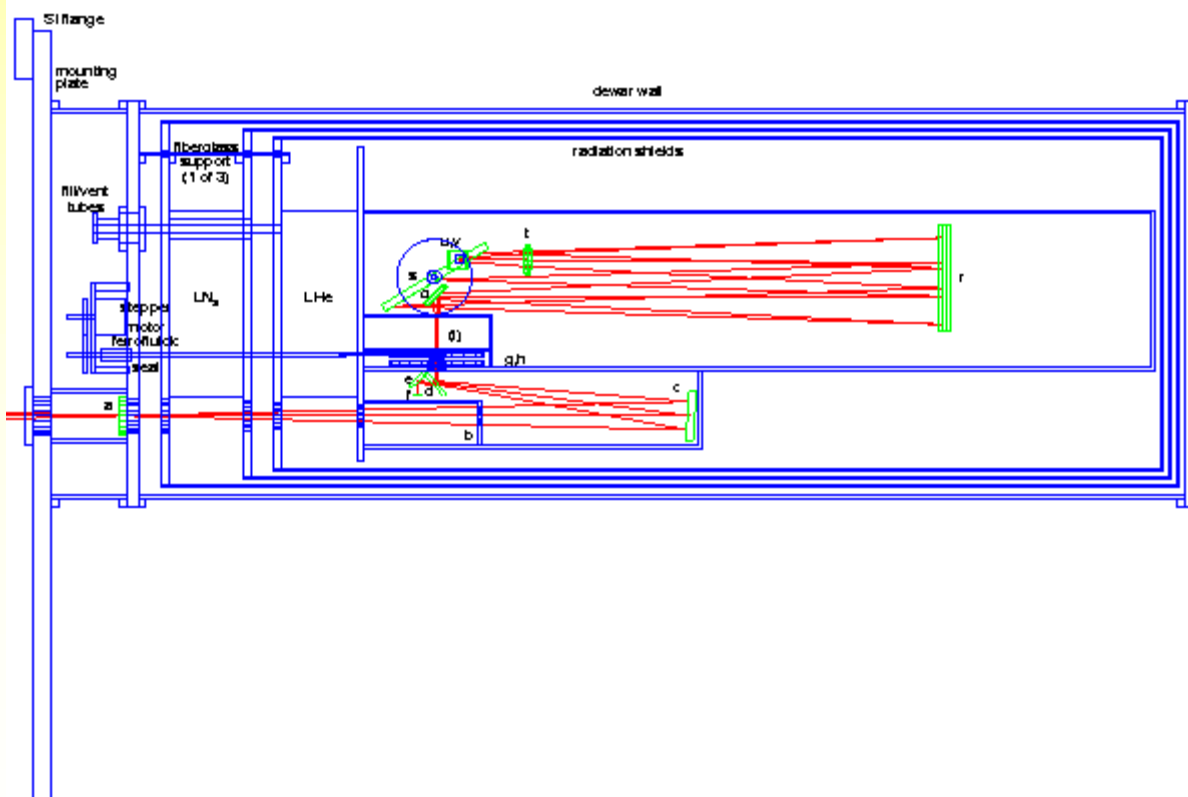
EXES

Echelon

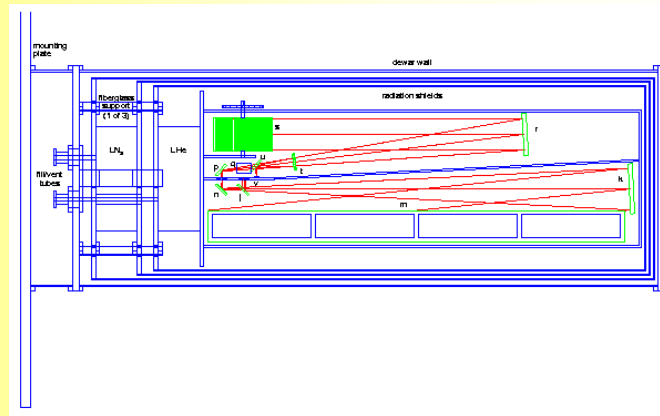
X Cross

Echelle

Spectrometer



EXES



*Built by the University
of Texas-Austin

*5-28 microns

*Collaborators

*Dr. John Lacy

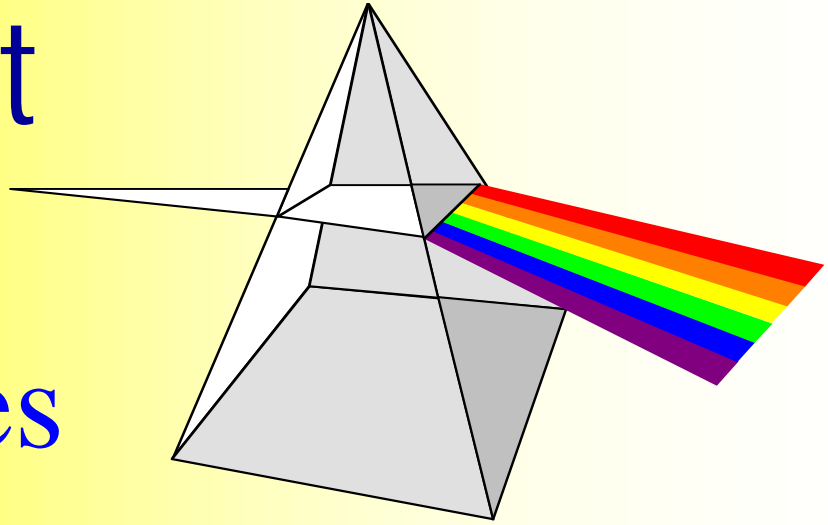
*Dr. Dan Jaffe

*Dr. Mary Kay Hemenway

*Dr. Matt Richter

*Tommy Greathouse

Light



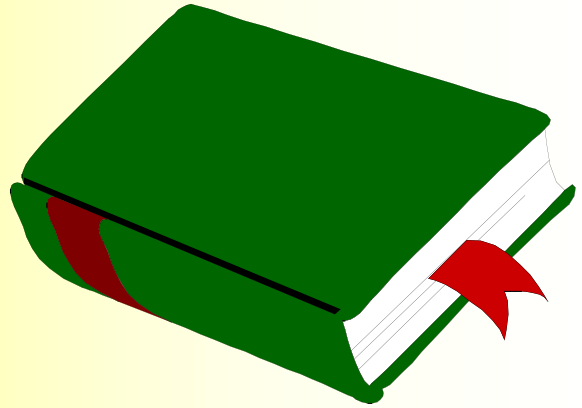
*Lenses

*Mirrors

*Infrared and the
Electromagnetic
Spectrum

*Gratings and
Spectroscopy

Skills Addressed



*TAAS

*Math: 3, 4, 11

*Reading: 1, 2, 3, 4, 5, 6

*Writing: 1, 2, 5, 6

*ICP TEKS

*1, 2, 3, 5B, 5C, 7C

*Astronomy TEKS

*1, 2, 3, 7E

Math TAAS

- 3. The student will demonstrate an understanding of geometric properties and relationships.
- 4. The student will demonstrate an understanding of measurement concepts using metric and customary units.
- 11. The student will determine solution strategies and will analyze or solve problems.

Reading TAAS

- 1. The student will determine the meaning of words in a variety of written texts.
- 2. The student will identify supporting ideas in a variety of written texts.
- 3. The student will summarize a variety of written texts.
- 4. The student will perceive relationships and recognize outcomes in a variety of written texts.
- 5. The student will analyze information in a variety of written texts in order to make inferences and generalizations.
- 6. The student will recognize points of view, propaganda, and/or statements of fact and opinion in a variety of written texts.

Writing TAAS

- ❧ 1. The student will respond appropriately in a written composition to the purpose/audience specified in a given topic.
- ❧ 2. The student will organize ideas in a written composition on a given topic.
- ❧ 5. The student will recognize appropriate sentence construction within the context of a written passage.
- ❧ 6. The student will recognize appropriate English usage within the context of a written passage.

Astronomy TEKS

- (1) 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; and
 - (B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
- (2) 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.

Astronomy

(3) The student uses critical thinking and scientific problem solving skills 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;

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

(C) evaluate the impact of research on scientific thought, society, and the environment;

(D) describe the connection between astronomy and future careers; and

(E) research and describe the history of astronomy and contributions of scientists.

Astronomy

(7) The student knows how mathematical models, computer simulations, and exploration can be used to study the universe.

(E) The student is expected to:
analyze the impact of the space program on the collection of data about the Earth and the universe.

ICP TEKS

- (1) 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 investigations; and
 - (B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
- (2) 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.

ICP continued

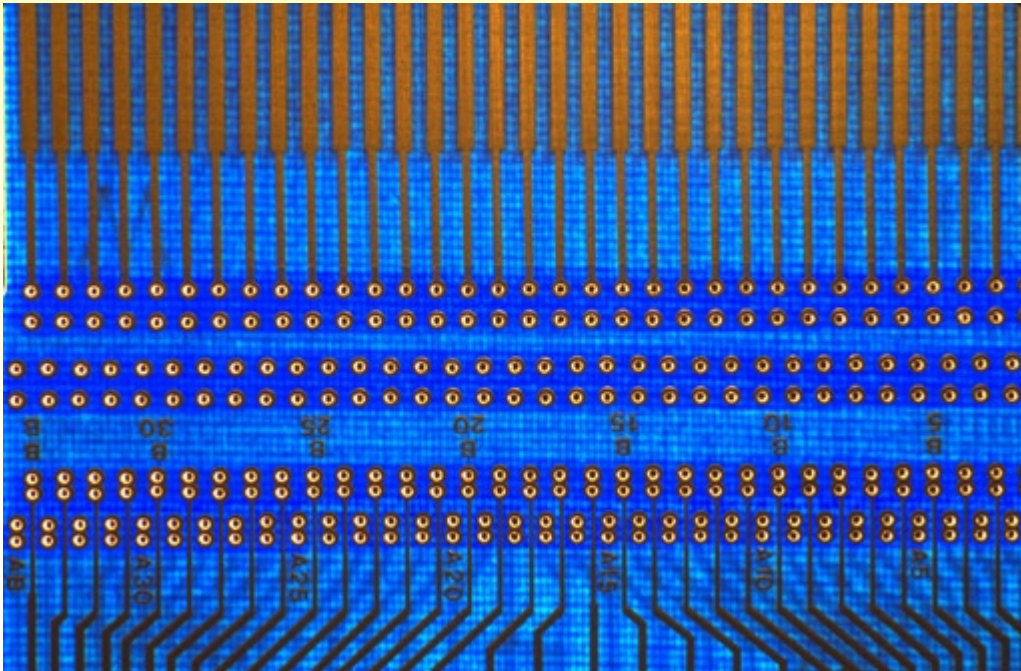
- (3) The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
- (A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
 - (B) draw inferences based on data related to promotional materials for products and services;
 - (C) evaluate the impact of research on scientific thought, society, and the environment;
 - (D) describe connections between physics and chemistry, and future careers; and
 - (E) research and describe the history of physics, chemistry, and contributions of scientists.

ICP continued

- (5) The student knows the effects of waves on everyday life. The student is expected to:
- (B) demonstrate wave interactions including interference, polarization, reflection, refraction, and resonance within various materials;
 - (C) identify uses of electromagnetic waves in various technological applications such as fiber optics, optical scanners, and microwaves; and
- (7) The student knows relationships exist between properties of matter and its components. The student is expected to:
- (C) identify constituents of various materials or objects such as metal salts, light sources, fireworks displays, and stars using spectral-analysis techniques.

Electronics

- *Ohm's Law
- *Capacitance
- *Schematics
- *Assembly



Skills Addressed

*TAAS

*Math: 6, 7, 8, 9

*Reading: 1, 2

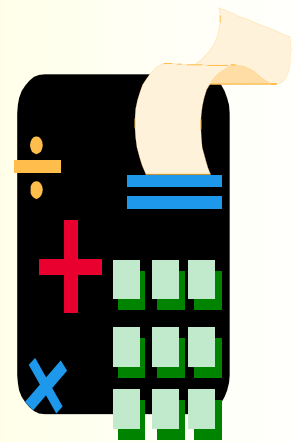
*Writing: 1, 2

*ICP TEKS

*1, 2, 3, 6E, 6F

*Astronomy TEKS

*1, 2, 3, 7E



Math TAAS

- 6. The student will use the operation of addition to solve problems.
- 7. The student will use the operation of subtraction to solve problems.
- 8. The student will use the operation of multiplication to solve problems.
- 9. The student will use the operation of division to solve problems.

Reading TAAS

- 1. The student will determine the meaning of words in a variety of written texts.
- 2. The student will identify supporting ideas in a variety of written texts.

Writing TAAS

- 1. The student will respond appropriately in a written composition to the purpose/audience specified in a given topic.
- 2. The student will organize ideas in a written composition on a given topic.

Astronomy TEKS

- (1) 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; and
 - (B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
- (2) 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.

Astronomy

(3) The student uses critical thinking and scientific problem solving skills 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;

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

(C) evaluate the impact of research on scientific thought, society, and the environment;

(D) describe the connection between astronomy and future careers; and

(E) research and describe the history of astronomy and contributions of scientists.

Astronomy

(7) The student knows how mathematical models, computer simulations, and exploration can be used to study the universe.

(E) The student is expected to analyze the impact of the space program on the collection of data about the Earth and the universe.

ICP TEKS

- (1) 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 investigations; and
 - (B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
- (2) 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.

ICP continued

- (3) 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;
 - (B) draw inferences based on data related to promotional materials for products and services;
 - (C) evaluate the impact of research on scientific thought, society, and the environment;
 - (D) describe connections between physics and chemistry, and future careers; and
 - (E) research and describe the history of physics, chemistry, and contributions of scientists.

ICP continued

(6) The student knows the impact of energy transformations in everyday life. The student is expected to:

(E) measure the thermal and electrical conductivity of various materials and explain results;

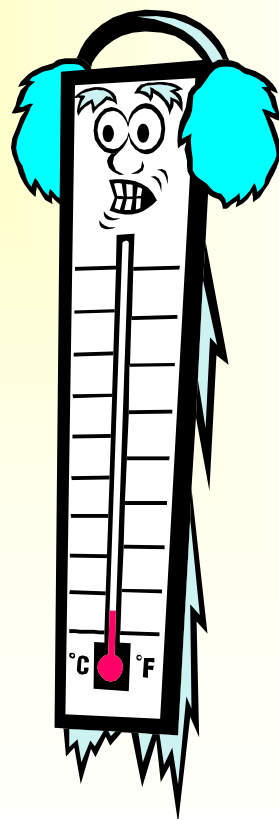
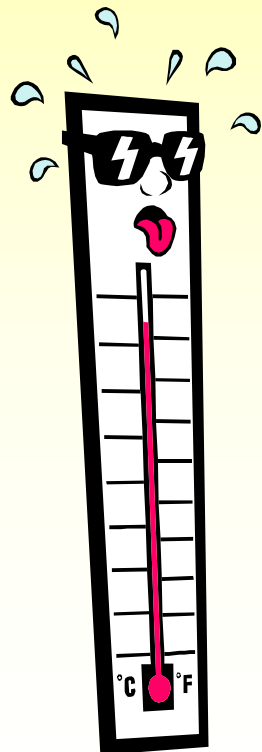
(F) investigate and compare series and parallel circuits.

Temperature

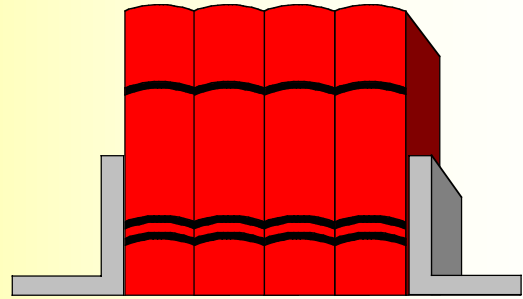
*Scales

*Cryogenics

*Expansion and
Contraction



Skills Addressed



*TAAS

*Math: 4, 6, 7, 8, 9

*Reading: 1, 2, 4, 5, 6,

*Writing: 1, 2, 5, 6

*ICP TEKS

*1, 2, 3, 6B, 6E

*Astronomy TEKS

*1, 2, 3, 6B, 6C

Math TAAS

- 4. The student will demonstrate an understanding of measurement concepts using metric and customary units.
- 6. The student will use the operation of addition to solve problems
- 7. The student will use the operation of subtraction to solve problems..
- 8. The student will use the operation of multiplication to solve problems.
- 9. The student will use the operation of division to solve problems.

Reading TAAS

- 1. The student will determine the meaning of words in a variety of written texts.
- 2. The student will identify supporting ideas in a variety of written texts.
- 4. The student will perceive relationships and recognize outcomes in a variety of written texts.
- 5. The student will analyze information in a variety of written texts in order to make inferences and generalizations.
- 6. The student will recognize points of view, propaganda, and/or statements of fact and opinion in a variety of written texts.

Writing TAAS

- 1. The student will respond appropriately in a written composition to the purpose/audience specified in a given topic.
- 2. The student will organize ideas in a written composition on a given topic.
- 5. The student will recognize appropriate sentence construction within the context of a written passage.
- 6. The student will recognize appropriate English usage within the context of a written passage.

Astronomy TEKS

- (1) 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; and
 - (B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
- (2) 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.

Astronomy

(3) The student uses critical thinking and scientific problem solving skills 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;

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

(C) evaluate the impact of research on scientific thought, society, and the environment;

(D) describe the connection between astronomy and future careers; and

(E) research and describe the history of astronomy and contributions of scientists.

Astronomy

(6) The student knows the characteristics and life cycle of stars. The student is expected to

(B) Identify the characteristics of stars such as temperature, age, relative size, composition, and radial velocity using spectral analysis

(C) Identify the stages in the life cycle of stars by examining the Hertzsprung-Russell diagram.

ICP TEKS

- (1) 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 investigations; and
 - (B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
- (2) 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.

ICP continued

- (3) 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;
 - (B) draw inferences based on data related to promotional materials for products and services;
 - (C) evaluate the impact of research on scientific thought, society, and the environment;
 - (D) describe connections between physics and chemistry, and future careers; and
 - (E) research and describe the history of physics, chemistry, and contributions of scientists.

ICP continued

- (6) The student knows the impact of energy transformations in everyday life. The student is expected to:
- (B) investigate and demonstrate the movement of heat through solids, liquids, and gases by convection, conduction, and radiation;
 - (E) measure the thermal and electrical conductivity of various materials and explain results.

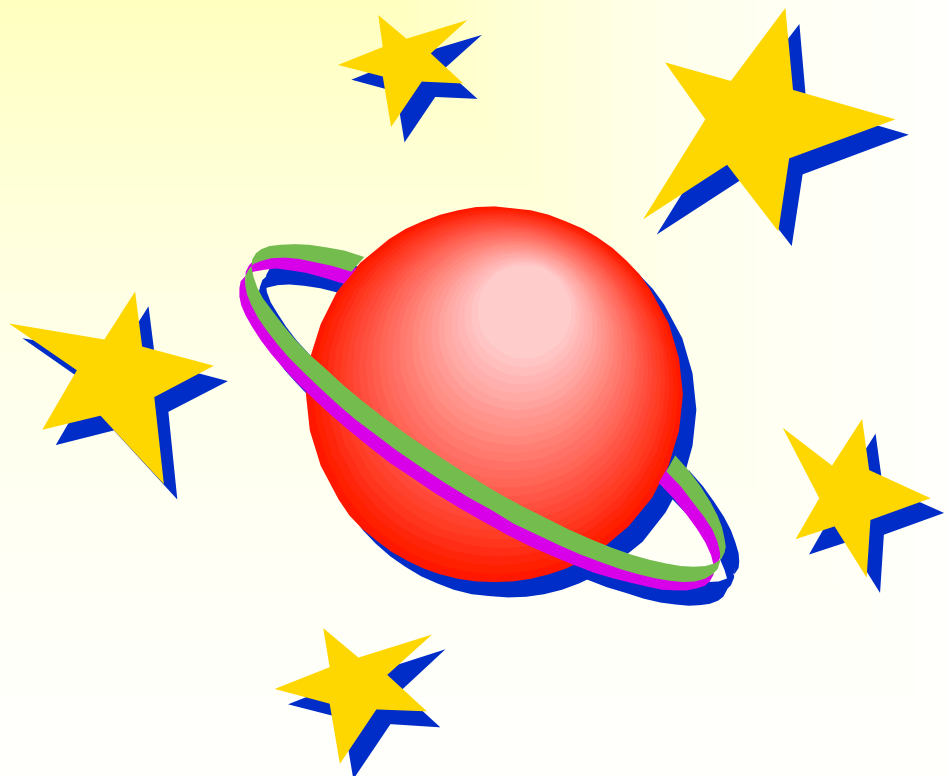
Astronomy

*Stars

*Planets

*Galaxies

*Comets



Skills Addressed



*TAAS

*Math: 6, 7, 8, 9

*Reading: 1, 2, 3, 4

*Writing: 1, 2

*ICP TEKS

*1, 2, 3

*Astronomy TEKS

*1, 2, 3, 4B, 5C, 6C, 7E

Math TAAS

- 4. The student will demonstrate an understanding of measurement concepts using metric and customary units.
- 6. The student will use the operation of addition to solve problems
- 7. The student will use the operation of subtraction to solve problems..
- 8. The student will use the operation of multiplication to solve problems.
- 9. The student will use the operation of division to solve problems.

Reading TAAS

- ❧ 1. The student will determine the meaning of words in a variety of written texts.
- ❧ 2. The student will identify supporting ideas in a variety of written texts.
- ❧ 3 The student will summarize a variety of written texts..
- ❧ 4. The student will perceive relationships and recognize outcomes in a variety of written texts.

Writing TAAS

- ✎ 1. The student will respond appropriately in a written composition to the purpose/audience specified in a given topic.
- ✎ 2. The student will organize ideas in a written composition on a given topic.

Astronomy TEKS

- (1) 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; and
 - (B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
- (2) 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.

Astronomy

(3) The student uses critical thinking and scientific problem solving skills 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;

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

(C) evaluate the impact of research on scientific thought, society, and the environment;

(D) describe the connection between astronomy and future careers; and

(E) research and describe the history of astronomy and contributions of scientists.

Astronomy

- (4) The student knows scientific information about the universe. The student is expected to:
- (B) describe characteristics of galaxies.
- (5) The student knows the scientific theories of the evolution of the universe. The student is expected to:
- (C) interpret data concerning the formation of galaxies and our solar system.
- (6) The student knows the characteristics and life cycle of stars. The student is expected to
- (C) Identify the stages in the life cycle of stars by examining the Hertzsprung - Russell diagram.
- (7) The student knows how mathematical models, computer simulations, and exploration can be used to study the universe.
- (E) The student is expected to: analyze the impact of the space program on the collection of data about the Earth and the universe.

ICP TEKS

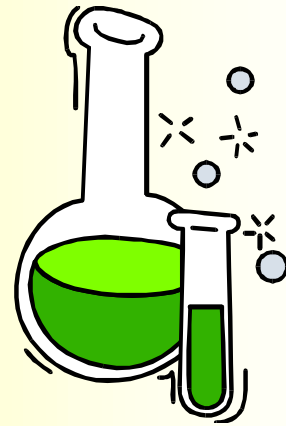
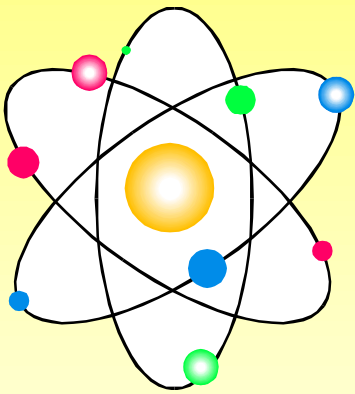
- (1) The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:
 - (A) demonstrate safe practices during investigations; and
 - (B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
- (2) 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.

ICP continued

- (3) 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;
 - (B) draw inferences based on data related to promotional materials for products and services;
 - (C) evaluate the impact of research on scientific thought, society, and the environment;
 - (D) describe connections between physics and chemistry, and future careers; and
 - (E) research and describe the history of physics, chemistry, and contributions of scientists.

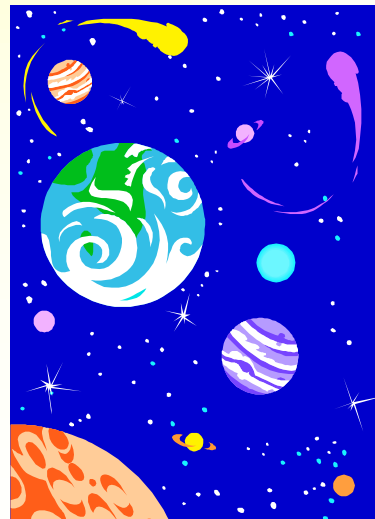
Increased Background

*Chemistry



*Physics

*Astronomy



Benefits For Students

- *New ideas
- *Equipment
- *Guest speakers



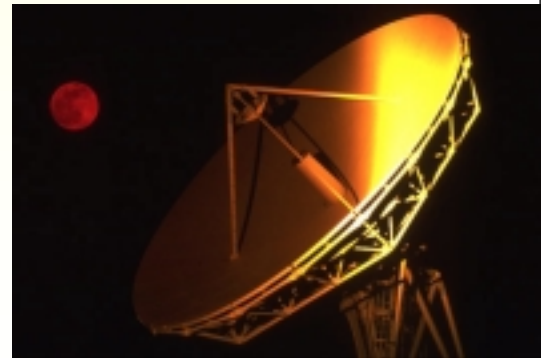
Opportunities

- *Working with other teachers
- *American Astronomical Society



Opportunities

- * American Association for Variable Star Observing
- * NASA mini-grants
- * McDonald Observatory



Opportunities

*Going to Raytheon

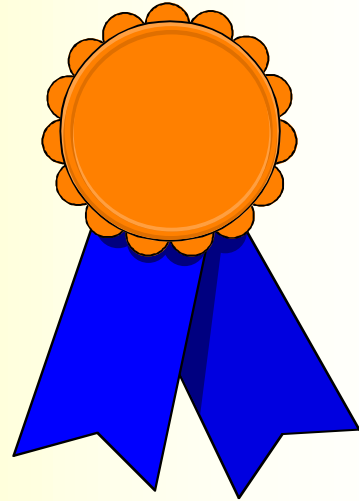


Opportunities

*Flying on SOFIA



Credits and Sources



*<http://nene.as.utexas.edu/exes/design>

*<http://sofia.arc.nasa.gov>

*Special thanks to:

*Mary Kay Hemenway

*Kathie del Hierro

*Paula King

*Ross Klein

*Ron Tykoski