

An Integrated Interdisciplinary Thematic Unit based on the Conic Sections as they relate to Applied Geometry, Physics, and the Visual Arts

# WE ARE NOT THE CONEHEADS BUT WE ARE

## "Hooked on Conics"

Perry Bola Sara Cole  
Hi Perbola  
Eclipse  
STARRING

Janet Cummings and John Gerber  
Perkins High School  
3714 S. Campbell St.  
Sandusky, OH 44870

Written by

Melissa McCartney and Sarajane Steinecker  
Dixie High School  
200 S. Fuls Rd.  
New Lebanon, Ohio 45345

**Unit Title:**  
**We Are Not The Coneheads But We Are "Hooked on Conics"**

**OVERVIEW**

**I. CONTENT:**

Students will learn the similarities and differences between circles, parabolas, ellipses, and hyperbolas and how to graph each conic section. They will learn the importance of conic sections as illustrated in:  
The formulation and revision of scientific models of planetary and celestial models;  
The design and construction principles of telescopes, satellite systems, acoustical devices, and structures;  
The development and expression of artistic works such as paintings, literature, and architecture.

**II. PROCESS:**

The students will compare the physical attributes, mathematical equations, and cultural significance of each conic section. They will conduct laboratory experiments, use graphing calculators, manipulate computer simulations, and create artistic endeavors to allow them to explore and apply what they learn.

**III. PRODUCT:**

The students will:  
Utilize the graphs and equations of the conics sections to solve problems and develop models  
Discover similarities in patterns present in the physical universe and art/culture  
Understand how mathematics can influence the development of scientific models  
Understand how society can influence the development of scientific understanding  
Understand how scientific/mathematical understanding can influence the development of society  
Create and critique original artwork utilizing all four conic sections

**Unit Overview: Alignment with National/State/District  
Pupil Performance Standards**

Benchmark 1: OHIO Mathematics A.11.4.10

Students will describe the characteristics of the graphs of the conic sections.

Benchmark 2: OHIO Mathematics G.12.3.3

Students will relate graphical and algebraic representations of conic sections.

Benchmark 3: OHIO Physical Science Grade 11-12

Trace the historical development of scientific theories and ideas.

Benchmark 4: OHIO Physical Science Grade 11-12

Students will apply principles of force and motion to mathematically analyze, describe, and predict the net effects of forces and motion of objects or systems.

Benchmark 5: OHIO Science and Technology Grade 11-12

Participates in scientific investigations and actually uses the cognitive and manipulative skills associated with the formulations of scientific explanations.

Benchmark 6: OHIO Scientific Ways of Knowing Grade 11-12

Understand how scientific evidence is used to develop/revise scientific predictions, ideas, or theories.

Benchmark 7: OHIO Earth and Space Sciences Grade 11-12

Explain how technology can be used to increase our understanding of the universe.

Benchmark 8: National Standards for Physical Education

Demonstrates responsible personal and social behavior in physical activity settings.

Benchmark 9: OHIO Social Studies - Chronology Grade 11-12

Explain patterns of historical continuity and change by analyzing historical developments and hypothesizing the influence of the past on the present in a way that challenges arguments of historical inevitability.

Benchmark 10: Dixie High School Art II and III

Develop or co-develop with others in one or more of the arts, grounding its artistic merit within historical, social, cultural, critical, and aesthetic parameters, and taking into account the merit of the arts form or arts concept in an in-depth manner.

### **I-SEARCH INDEPENDENT RESEARCH PROJECTS FOR GIFTED AND TALENTED STUDENTS**

1. **PARADOXES:**

Since a circle is thought to have no beginning or end, it has become a universal symbol. For example, some cultures use a wedding ring to represent unending love and many cultures have a belief system that life is unending. Write a newspaper editorial to illustrate how various religions/cultures use the symbolism of the circle.

2. **ATTRIBUTES:**

As we move towards a global economy, corporate logos are becoming international. Research the logos of five multi-national corporations. By means of multimedia presentation, show how these logos are adapted or altered for presentation in different cultures.

3. **ANALOGIES:**

Visit local art museum and examine artworks for the use of conic sections. Organize these works in categories of your choice artistic style, time period, medium, etc. Make a power point presentation and showing which particular category used the most conic sections.

4. **DISCREPANCIES:**

Research a structural failure of a historic building to determine what was the “Missing link” that caused the building to fail. Reconstruct working model of the building.

5. **PROVOCATIVE QUESTIONS:**

If we still believed that the sun revolved around the Earth, make a project cube of how our models of the universe would be different.

6. **EXAMPLES OF CHANGE:**

Our universe seems to be held together by the attractive force of gravity. Some physicists propose that gravity was repulsive at some time in the development of the universe. By means of a tall-tale, describe how the life of a geometry teacher would be different if gravity were still repulsive.

7. **EXAMPLES OF HABIT:**

History constantly reminds us of the rigidity in society’s thinking and the persecution of scientific/mathematical figures. Most people are aware that Galileo faced house arrest and Kepler lead a life on the run. If you could be transported back in time, develop pamphlets and flyers to post outside the building in which Galileo was tried.

8. **ORGANIZED RANDOM SEARCH:**

After determining the plane figures that result from slicing a geometric solid other than a cone, design a wallpaper pattern that incorporates these figures.

9. **SKILLS OF SEARCH:**

Since the beginning of last century, we have seen the headlight evolve from gas lamp into incandescent bulbs into halogen bulbs. Based on Internet research, design the headlight system for future modes of transportation.

10. **TOLERANCE FOR AMBIGUITY:**

Read “A Brief History of Time” by Steven Hawking and his explanation on the structure of black holes and nature of matter. Put together a series of films clips illustrating the idea of going into the light where conic sections transport objects into other dimensions

11. **INTUITIVE EXPRESSION:**

Interview a professional who has just completed a major project utilizing math equations, science, art, or literature. Make a sculpture to represent this person’s feelings/emotions upon the completion of the project.

12. **ADJUSTMENT TO DEVELOPMENT:**

Choose the most boring/toughest math/science class you have struggled through or the toughest test you every had to take. Based on your experiences in striving to pass this class/test, create a collage of magazine images depicting changes that occurred in your study habits.

13. **STUDY CREATIVE PEOPLE AND PROCESS:**

Investigate the life of a famous mathematician/scientist/artist by focusing on the schooling, geographical location, family situation, and real life experiences. By means of a reflective journal, compare/contrast this person’s life with that of a personal hero.

14. **EVALUATE SITUATIONS:**

Your best friend is considering dropping out of geometry class but has future plans of becoming a physicist or physician. Write a persuasive letter to encourage him/her to stay in class.

15. **CREATIVE READING SKILL:**

Pick a term from the cultural literacy list and create a rebus diagram/pun that will be used as a bumper sticker.

16. **CREATIVE LISTENING SKILL:**

Interview an astronomer and artist. From interviews, create list of descriptive adjectives to describe these professions. Create a crossword puzzle with the across questions describing the astronomer and the down questions describing the artist.

17. **CREATIVE WRITING SKILL:**

Write a myth that explains the invention of the first sundial by the native inhabitants of North America.

18. **VISUALIZATION SKILL:**

After seeing the story of the Fly and/or Star Trek. Give examples of where sci-fi writers used conic sections of heat, matter and light to transport objects via deconstruction and reconstruction. Interview particles physicists to see if any of the fiction ideas are becoming reality. By means of film clip collage, illustrate your research findings.

**CRITICAL THINKING SKILLS – ACADEMIC  
ANALYZING HUMAN ACTIVITIES! (AHA!)**

Benchmark 1: OHIO Mathematics A.11.4.10

Students will describe the characteristics of the graphs of the conic sections.

Benchmark 2: OHIO Mathematics G.12.3.3

Students will relate graphical and algebraic representations of conic sections.

ESSENTIAL QUESTION: How does the Universal Theme of **Producing, Exchanging and Distributing** create mastery learning of essential concepts in this unit?

## 1. **PRODUCING, EXCHANGING, AND DISTRIBUTING** [ECONOMICS]

### KNOWLEDGE:

**Anticipatory Set:** Working in pairs, students will construct cones of clay/dough.  
**Students will:** create four conic sections by slicing the cone[s] by holding the floss vertically, horizontally, or diagonally. [E.g. circles, ellipses, parabola, hyperbola, point, line, intersecting lines]

### COMPREHENSION:

After examining shapes constructed by others, students will classify shapes into four [to seven] conic sections and list characteristics of each conic section.  
[e.g. circle – smooth closed figure, symmetric, centered on single point & ellipse – smooth closed figure, symmetric, centered on two points]

### APPLICATION:

**Anticipatory Set:** Video on properties of conic sections to review /extend the construction of conic sections

**Students will:** In groups, produce a collage of pictures containing various conic sections.

**Class/team product:** collage

**Multicultural and/or ESL and/or Bilingual Link:** Read short article on Hypatia.

**Mathematics/Science Link and/or Humanities Link:** In depth discussion on Hypatia's damnation and eventual murder as compared to conditions in Afghanistan.

**School-to-Career/Tech Prep Link:** Collect corporate logos that incorporate any of the conic sections.

### HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory Set:** Examine collage of corporate logos collected by students.

**Students will:** Working in groups of four, construct team logo that contains each conic section.

**Class/team/individual product:** T-shirt with team logo

### INDIVIDUAL JOURNAL ASSIGNMENT:

Respond to questions presented at end of Hypanthia article.

### HOMELINK:

Involve family members in scavenger hunt to find common household objects that represent each conic section.

---

Benchmark 1: OHIO Mathematics A.11.4.10

Students will describe the characteristics of the graphs of the conic sections.

Benchmark 2: OHIO Mathematics G.12.3.3

Students will relate graphical and algebraic representations of conic sections.

ESSENTIAL QUESTION: How does the Universal Theme of **Transportation** create mastery learning of essential concepts in this unit?

## 2. **TRANSPORTATION**

### KNOWLEDGE:

**Anticipatory Set:** Sing 'Wheels on the Bus'

**Students will:** Identify 10 components on a bus that are circular. [e.g. – steering wheel, various dials]

### COMPREHENSION:

Student will: use and pencil to construct a perfect circle. [from a point, measure 2 inches, repeat – connect points to form circle]

APPLICATION:

**Anticipatory Set:** Pose problem – how does the right triangle relate to the circle?

**Students will:** Derive equation for a circle in terms of the Pythagorean Theorem.

**Class/team product:** Equation:  $x^2 + y^2 = r^2$

**Multicultural and/or ESL and/or Bilingual Link:** Research word for circle or wheel in 10 different languages.

**Mathematics/Science Link and/or Humanities Link:** Research first culture to develop wheel/circle. [show short clip from Ben Hur on slave girl about to be crushed]

**School-to-Career/Tech Prep Link:** Show video clip on development of a bike with square wheels.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** Show short clip of Flintstones – focusing on wheels

**Students will:** Generate and revise hypotheses to describe how a circle's equation is affected by its location in the Cartesian plane.

**Class/team/individual product:** Standard form equation for circle  $[(x - h)^2 + (y - k)^2 = r^2]$

INDIVIDUAL JOURNAL ASSIGNMENT:

Reflection of individual hypotheses in comparison to class conclusions.

HOMELINK:

How important is the circle in transportation? How would your life be different if the wheel was not invented?

---

Benchmark 1: OHIO Mathematics A.11.4.10

Students will describe the characteristics of the graphs of the conic sections.

Benchmark 2: OHIO Mathematics G.12.3.3

Students will relate graphical and algebraic representations of conic sections.

ESSENTIAL QUESTION: How does the Universal Theme of **Communications** create mastery learning of essential concepts in this unit?

3. COMMUNICATIONS

KNOWLEDGE:

**Anticipatory Set:** Show short video clip from CONTACT – Jodie Foster focusing antenna array

**Students will:** Identify that shape a radio antenna is being that of a conic section [parabolic].

COMPREHENSION:

Using a ripple tank, teacher demonstration / student experiment on finding the focus of parabola. Explain how focus relates to shape of parabola. [point to which all things are reflected]

APPLICATION:

Changes, computes, demonstrates, discovers, manipulates, modifies, operates, predicts, prepares, produces, relates, shows, solves, uses.

**Anticipatory Set:** Waxed paper folding activity. See p 578 in Algebra 2 text [Holt, Rhinehart, Winston].

**Students will:** Compare parabolas with peers. Formulate conjecture on how to make narrower/wider parabola. Explain how definition of parabola is related to folded parabola.

**Class/team product:** Definition of parabola, directrix, and focus as based on group discussion.

**Multicultural and/or ESL and/or Bilingual Link:** Distance learning field-trip to another country. Explain how parabolic dishes make this cultural/technologic experience possible.

**Mathematics/Science Link and/or Humanities Link:** Research how living conditions can be improved in developing nations by the use of satellite/communication technology.

**School-to-Career/Tech Prep Link:** NASA guest speaker on radio antenna /satellite design

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** Pose problem of designing headlight light with maximum illumination for a set of parameters.

**Students will:** Derive equation to describe parabola and develop headlight model based on the equation.

**Class/team/individual product:** Model of headlight.

INDIVIDUAL JOURNAL ASSIGNMENT:

In a third world country, a satellite crashes in your village. What is your reaction?

HOMELINK:

At home, refrain from using any technology – computer, televisions, radios, etc that utilize satellite dishes. Describe what your family experienced.

Benchmark 1: OHIO Mathematics A.11.4.10

Students will describe the characteristics of the graphs of the conic sections.

Benchmark 2: OHIO Mathematics G.12.3.3

Students will relate graphical and algebraic representations of conic sections.

ESSENTIAL QUESTION: How does the Universal Theme of **Protecting and Conserving** create mastery learning of essential concepts in this unit?

4. **PROTECTING AND CONSERVING**

KNOWLEDGE:

**Anticipatory Set:** Examine shadow of round lampshade.

**Students will:** Identify shadow as having shape of conic section [hyperbolic] shape

COMPREHENSION:

Students will infer from position of top and bottom openings of shade that these define the asymptotes and that light bulb is center

APPLICATION:

**Anticipatory Set:** Students use metal detector to locate teacher-buried items.

**NOTE:** Teacher will need to explain connection of hyperbolic image pulses and detection of metallic objects.

**Students will:** After exploring website <http://www.sensoft.ca/applications/index.html>, students will compose summary paper illustrating five uses of GPR [ground [-penetrating radar].

**Class/team product:** summary papers

**Multicultural and/or ESL and/or Bilingual Link:**

Explore various measurement unit systems used by other cultures and implications of data analysis between various cultures.

**Mathematics/Science Link and/or Humanities Link:** If GPR were available, how would Poe's "Tell-tale Heart" be changed?

**School-to-Career/Tech Prep Link:** Police officer/forensics expert to make class presentation on use of imaging equipment used to solve crimes/locate objects.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** Complete waxed paper folding activity – p 603 of Algebra 2 book

**Students will:** Formulate equation for hyperbola given the foci is on an axis and the center is at origin.

**Class/team/individual product:** Standard form equation developed by students

INDIVIDUAL JOURNAL ASSIGNMENT:

Compare and contrast the properties/equations of a parabola and a hyperbola using a Venn diagram.

HOMELINK:

Interview family members to determine if they have used a metal detector to find lost object. What was the significance of finding that object?

---

**BENCHMARK #10:** Develop or co-develop with others in one or more of the arts, grounding its artistic merit within historical, social, cultural, critical, and aesthetic parameters, and taking into account the merit of the arts form or arts concept in an in-depth manner.

**ESSENTIAL QUESTION:** How does the Universal Theme of **Providing Education** create mastery learning of essential concepts in this unit?

5. **PROVIDING EDUCATION**

KNOWLEDGE:

**Anticipatory Set:** Arch building activity

**Students will:** construct arch from set of marshmallows

COMPREHENSION:

Give examples of structures utilizing conic sections [arches] and building careers responsible for design/construction of these structures.

APPLICATION:

**Anticipatory Set:** Guidance counselor administers career aptitude test Play song “Working Nine to Five” and/or “You can take this job...”

**Students will:** Write help-wanted ad outlining the mathematical/course of study/degree requirements and starting salaries for the two careers indicated by results for career aptitude test

**Class/team product:** Help wanted page for CONIC News published by class

**Multicultural and/or ESL and/or Bilingual Link:** Email editors to determine how regional demographics influence response patterns to advertisements in national newspaper/periodicals.

**Mathematics/Science Link and/or Humanities Link:** Research how structural failure [bridge, building] has changed building codes. Share results in series of slides/transparencies depicting buildings.

**School-to-Career/Tech Prep Link:** Host career fair to explore professions in math/science/art

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** Color page from coloring book [image with conic section]

**Students will:** Collaboratively design and create a single page for a picture/cartoon coloring book containing careers/applications involving conic sections in every day life.

**Class/team/individual product:** Picture/cartoon coloring book presented to students at elementary students.

INDIVIDUAL JOURNAL ASSIGNMENT:

Reflection of what it is like to be in the role of teacher instead of student.

HOMELINK:

Engage family members in discussion on possible applications of conic sections in career choice

---

BENCHMARK # 4, 5, 6, & 7 – see benchmarks listed earlier in this unit

ESSENTIAL QUESTION: How does the Universal Theme of **Making and Using Tools and/or Technology** create mastery learning of essential concepts in this unit?

## 6. MAKING AND USING TOOLS AND/OR TECHNOLOGY

### KNOWLEDGE:

**Anticipatory Set:** Conduct lab activity investigating how concave mirrors and lens focus light of various colors.

**Students will:** State differences between ray patterns of various colors as focused by the mirrors and lens.  
[mirrors focus light by reflection and focus all wavelengths of light at same point ]  
[lens focus light by refraction and focus each wavelength at different point]

### COMPREHENSION:

After group discussion, the student will extend these observations to predict image limitations associated with mirror telescopes and lens telescopes.

Mirror telescopes – experience spherical aberration

Lens telescopes – experience chromatic aberration

### APPLICATION:

**Anticipatory Set:** Images of telescopes used by Galileo and other early astronomers. Images of earliest known microscopes.

**Students will:** Relate lens/mirror structure and image limitations of telescopes to those of microscopes

**Class/team product:** Series of labeled diagrams and learning center

**Multicultural and/or ESL and/or Bilingual Link:** Research astronomical instruments developed by Inca, Mayas, or Aztecs. Present findings in form of charts

**Mathematics/Science Link and/or Humanities Link:** Visit SETI and other websites searching for extraterrestrial life.

Prepare word scramble of latest tools/technology used.

**School-to-Career/Tech Prep Link:** Video on careers/technology in modern astronomy.

### HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** Clip from the film “Armageddon” and discussion of Earth orbit crossing asteroids.

**Students will:** justify the spending of millions of US tax dollars to build and maintain a detection and earth defense system.

**Class/team/individual product:** Public awareness pamphlet

### INDIVIDUAL JOURNAL ASSIGNMENT:

An asteroid is on collision course with Earth – you are given a 6 hour notice until impact. The emergency impact shelter has only room for twenty people. Who is allowed inside the shelter? Why?

### HOMELINK:

Survey 10 people on their thoughts on the possibility of there being extraterrestrial life.

---

BENCHMARK #10: Develop or co-develop with others in one or more of the arts, grounding its artistic merit within historical, social, cultural, critical, and aesthetic parameters, and taking into account the merit of the arts form or arts concept in an in-depth manner.

[HS Art II: Inst Obj, Goal II, b, Goal IV c and HS Art III Goal III, c]

ESSENTIAL QUESTION: How does the Universal Theme of **Providing Recreation** create mastery learning of essential concepts in this unit?

## 7. PROVIDING RECREATION

### KNOWLEDGE:

**Anticipatory Set:** video on simple animation

**Students will:** identify common types of animation and describe how each is created [eg – flipbook, Claymation]

### COMPREHENSION:

Students will select conic section and create storyboard that will show how the shape will move left to right across; bounce up and down; and bounce off the page

### APPLICATION:

**Anticipatory Set:** Short clip from “Shrek”

**Students will:** create flipbook that follows the storyboard they designed and second flip book using all four conic sections and morphs the one shape into another shape flipbook

**Multicultural and/or ESL and/or Bilingual Link:** Present animation clip from another country

**Mathematics/Science Link** : Conduct Internet scavenger hunt to find applications of computer animation and/or **Humanities Link:** as related to latest developments in mathematical theory

**School-to-Career/Tech Prep Link:** Student writes short report – including biography on creator of favorite Cartoon, video clip, and one favorite character

### HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** Clip from “Robbie the Reindeer; Houses on Fire; and Gumby ISBN 0-7907-6187-4

**Students will:** Develop storyboard to guide the creation and animation of several small 3 inch Plastic-clay figures

**Class/team/individual product:** Claymation video at least 3 minutes in length

### INDIVIDUAL JOURNAL ASSIGNMENT:

Describe one of characters from storyboard above and the importance of this character in the storyboard

### HOMELINK:

Survey three family members as to what is favorite cartoon

---

BENCHMARK # 4, 5, 6, & 7 – see benchmarks listed earlier in this unit

ESSENTIAL QUESTION: How does the Universal Theme of **Organizing and Governing** create mastery learning of essential concepts in this unit?

## 8. ORGANIZING AND GOVERNING

### KNOWLEDGE:

**Anticipatory Set:** Short video clip from “Mechanical Universe” describing accuracy and extent of the observations made by Tycho Brahe

**Students will:** Identify five heavenly bodies that were observed repeatedly by Brahe. [eg moon, Venus, etc]

### COMPREHENSION:

Students will distinguish between accuracy and scope of Tycho’s observations and those made by previous and later astronomers.

### APPLICATION:

**Anticipatory Set:** Video clip on process by which Kepler verified his first law of planetary motion [planets orbit sun in elliptical orbits]

**Students will:** Predict how Kepler’s work would change view of the universe during his life time and how this would affect future generations.

**Class/team product:** Skit

**Multicultural and/or ESL and/or Bilingual Link:** Research early Chinese and Japanese models of solar system - construct models of these systems.

**Mathematics/Science Link and/or Humanities Link:** Write letter to state representative or senator asking for his/her opinion on need for policies to keep certain space technology/info secret.

**School-to-Career/Tech Prep Link:** Write editorial for local newspaper defending/refuting the need for government involvement/policy making in space tourism.

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** “Mechanical Universe” video describing Kepler’s work to understand the laws of physics that govern planetary motion.

**Students will:** Complete waxed paper folding activity on ellipses p 594 of Algebra 2 text [H,R,W]  
Formulate equation for ellipse.

**Class/team/individual product:** Standard form equation developed by students

$$(x - h)^2 / a^2 + (y - k)^2 / b^2 = 1$$
$$(y - k)^2 / a^2 + (x - h)^2 / b^2 = 1$$

INDIVIDUAL JOURNAL ASSIGNMENT:

Compare and contrast the properties/equations of a circle and an ellipse by means of Venn diagram.

HOMELINK:

Ask three adults to describe how solar system is arranged and what laws of physics govern its motion.

---

BENCHMARK # 4, 5, 6, & 7 – see benchmarks listed earlier in this unit

ESSENTIAL QUESTION: How does the Universal Theme of **Moral, Ethical and Spiritual Behavior** creates mastery learning of essential concepts in this unit?

9. **MORAL, ETHICAL AND SPIRITUAL BEHAVIOR**

KNOWLEDGE:

**Anticipatory Set:** Quote from Newton/Einstein – “if I seem to have reached farther than others, it is because I stand on the shoulders of giants.”

**Students will:** In terms of the progression of science, students will state the meaning of this quote. [one scientist’s break through results for work of previous scientists]

COMPREHENSION:

After brief discussion on erroneous scientific ideas that are accepted as fact in popular culture, the student will write an editorial to defend such a fact. [eq – man has never set foot on the moon]

APPLICATION:

**Anticipatory Set:** Short video from “Mechanical Universe” showing the tension between Brahe and Kepler. Discussion on importance and acceptance of a scientist using another’s work to further the overall advancement of science.

**Students will:** write prosecution or defense case of Kepler – as he stands accused of stealing Brahe’s work to advance his own career.

**Class/team product:** Mock trial of Kepler

**Multicultural and/or ESL and/or Bilingual Link:** Construct map depicting Einstein’s various locations as he discovered or reached or published significant events/papers/actions

**Mathematics/Science Link and/or Humanities Link:** Find other quotes from other famous scientists/mathematicians who describe progress in their fields and how their work has challenged/changed society

**School-to-Career/Tech Prep Link:** Examine how politicians influence modern scientific research in political cartoon

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** From "Mechanical Universe" - short clip depicting Galileo on trial during Inquisition

**Students will:** Criticize the logic that Galileo used in writing his little book that got him in so much trouble

**Class/team/individual product:** Mock radio talk show – where students call in to voice criticisms

INDIVIDUAL JOURNAL ASSIGNMENT:

As Galileo you have been sentenced to house arrest the remaining years of your life. Write a letter that will be read after two hundred years on the anniversary of your death.

HOMELINK:

Relate story of Galileo's trial, convictions, and punishment. Ask people to name other people who experienced similar experiences.

---

Benchmark 2: OHIO Mathematics G.12.3.3

Students will relate graphical and algebraic representations of conic sections.

Benchmark 5: OHIO Science and Technology Grade 11-12 Participates in scientific investigations and actually uses the cognitive and manipulative skills associated with the formulations of scientific explanations.

ESSENTIAL QUESTION: How does the Universal Theme of Aesthetic Needs create mastery learning of essential concepts in this unit?

10. AESTHETIC NEEDS

KNOWLEDGE:

**Anticipatory Set:** Examine images of famous fountains from across the world

**Students will:** Describe trajectories of water and note similarities

COMPREHENSION:

Students will discuss how changing shape of fountain changes cross section of parabola  
[Ex – if pointed up, parabola becomes narrower]

APPLICATION:

**Anticipatory Set:** Demonstrate/use several types of squirt guns

**Students will:** Determine best orientation to hold gun to hit target at various distances

**Class/team product:** Chart/tables to summarize findings

**Multicultural and/or ESL and/or Bilingual Link:** Group report on history of famous fountains from around the world

**Mathematics/Science Link and/or Humanities Link:** Discussion of physics involved in the parabolic shape of trajectory

**School-to-Career/Tech Prep Link:** Investigate what type of engineer designs fountains and the educational training of such an individual

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** Song – "Three Coins in a Fountain"

**Students will:** Digitally overlay selected fountain's flow on a Cartesian plane scaled to appropriate dimensions based on fountain's size. Using coordinates of selected points on overlay, run regression

on TI calculators to determine equation for flow of fountain.

**Class/team/individual product:** Equation and graph on calculator

INDIVIDUAL JOURNAL ASSIGNMENT:

Discus/write about how fountain design would be different on moon

HOMELINK:

Demonstrate flow from hose and explain mathematics/physics that causes parabolic shape.

---

Benchmark 9: OHIO Social Studies - Chronology Grade 11-12

Explain patterns of historical continuity and change by analyzing historical developments and hypothesizing the influence of the past on the present in a way that challenges arguments historical inevitability.

ESSENTIAL QUESTION: How does the discipline/sub-discipline of social studies relate to mastery learning of conic sections?

## **11. SOCIAL STUDIES**

KNOWLEDGE:

**Anticipatory Set:** Collage for postage stamps depicting various mathematicians/scientists

**Students will:** identify the names of five mathematics and scientists from history that helped in the discovery/understanding of conic sections [eg Hypatia, Kepler, etc]

COMPREHENSION:

Students will create a timeline showing accomplishments and cross discipline connections of the identified mathematicians/scientists

APPLICATION:

**Anticipatory Set:** Teacher displays common objects that utilize conic sections. Ask what they have in common.

**Students will:** Conduct independent research to write response paper to topic “How would my life be different if the conic sections were not discovered?”

**Class/team product:** student papers

**Multicultural and/or ESL and/or Bilingual Link:** Bring in pictures of great mathematicians/scientists from different countries Arrange on bulletin board

**Mathematics/Science Link and/or Humanities Link:** Generate crossword puzzle matching mathematics/scientists to their countries/discoveries

**School-to-Career/Tech Prep Link:** Survey area businesses to determine recent inventions utilizing conic sections

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** Clip from Time Machine

**Students will:** imagine participating in a forum with the important mathematicians/scientists previously identified

**Class/team/individual product:** puppet show or drama depicting the forum

INDIVIDUAL JOURNAL ASSIGNMENT:

Early mathematicians and scientists often faced persecution due to personal beliefs or nature of their mathematical/scientific discoveries. If you were one of those people, describe why you would or would not have changed your beliefs/discoveries to prevent persecution.

HOMELINK:

Ask elders to describe currently accepted fact/discovery that seemed far-fetched when they were younger

---

BENCHMARK #: 4 & 5 please see benchmarks listed earlier in this unit

ESSENTIAL QUESTION: How does the discipline/sub-discipline of science relate to mastery learning of conic sections?

## 12. SCIENCE

### KNOWLEDGE:

**Anticipatory Set:** Fly by sequence of planets from “Mechanical Universe” introduction

**Students will:** Describes common patterns of planetary motion found within solar system

### COMPREHENSION:

Defends idea that solar systems around other stars would exhibit structures similar to our solar system

### APPLICATION:

**Anticipatory Set:** Brief video reviewing the relationship between mass and distance in determining the gravitational force acting between objects

**Students will:** Predict how orbits and motion of various objects in solar system would change if mass of this object’s changed

**Class/team product:** Model solar system in which students move planets

**Multicultural and/or ESL and/or Bilingual Link:** Beliefs of other ancient cultures on nature of solar system

**Mathematics/Science Link and/or Humanities Link:** Watch video from Kepler to Einstein from “Mechanical Universe” Series

**School-to-Career/Tech Prep Link:** visit JPL/NASA website to review current planned missions to other planets

### HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** Video clip from ‘Mechanical Universe’ on Kepler’s work

**Students will:** select appropriate numeric constraints to place object in either circular or elliptical orbit in computer simulation

**Class/team/individual product:** Develop correct form of Kepler’s third law of motion

### INDIVIDUAL JOURNAL ASSIGNMENT:

Throughout history, mathematicians/scientists were often at odds with the religious establishment. Both math/science and religion seek to identify and understand the forces and processes by which the physical world operates. Are math/science a part of religion or are they separate?

### HOMELINK:

Ask parents if they would be willing to take a trip to another planet?

---

BENCHMARK #10 Develop or co-develop with others in one or more of the arts, grounding its artistic merit within historical, social, cultural, critical, and aesthetic parameters, and taking into account the merit of the arts form or arts concept in an in-depth manner.

ESSENTIAL QUESTION: How does the discipline/sub-discipline of art forms & functions relate to mastery learning of conic sections?

## 13. ART FORMS AND FUNCTIONS

### KNOWLEDGE:

**Anticipatory Set:** Unannounced, share jewelry that they wore that day.

**Students will:** Draw collection of shapes representing shapes present in jewelry

COMPREHENSION:

Identify shapes on board that can be derived from a cone. Circle, parabola, hyperbola, ellipse

APPLICATION:

**Anticipatory Set:** Song – Baubles, bangles, and beads

**Students will:** Use equations of conic sections to create graphs represent shapes identified in other students' jewelry

**Class/team product:** Create wire-link jewelry based on the scale graphs created

**Multicultural and/or ESL and/or Bilingual Link:** Research jewelry –knights' armor chain mail – and use of chain links in armor of other cultures – show information as illustrated story

**Mathematics/Science Link and/or Humanities Link:** Video – Camelot – describe how art influenced shape of common objects Read Hobbit

**School-to-Career/Tech Prep Link:** Jeweler presentation on trends on modern jewelry design or CAD demonstration by design engineer

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** field trip to art museum and science/tech museum noting various displays

**Students will:** create display boards including equations, graphs, and actual jewelry created in earlier activity

**Class/team/individual product:** display boards

INDIVIDUAL JOURNAL ASSIGNMENT:

Analyze visual impact on various displays found in the community

HOMELINK:

Contact local community members [banks, churches, etc] and arrange for public display of boards for a month

---

**BENCHMARK #10** Dixie High School Art II and III

Develop or co-develop with others in one or more of the arts, grounding its artistic merit within historical, social, cultural, critical, and aesthetic parameters, and taking into account the merit of the arts form or arts concept in an in-depth manner.

**ESSENTIAL QUESTION:** How does the discipline/sub-discipline of humanities relate to mastery learning of conic sections

14. **Humanities**

KNOWLEDGE:

**Anticipatory Set:** Teacher reading Emily Dickinson's number 10 ["Poet's light, but lights themselves go out...]

**Students will:** Listen to poem and match parts of poem to previous topics studied

COMPREHENSION:

Class discussion in students match parts of poem to other topics in

APPLICATION:

**Anticipatory Set:** Reread poem – students will have eyes shut

**Students will:** Draw sketch of images envisioned

**Class/team product:** Discussion on how lessons on conics have changed images/perception of environment

**Multicultural and/or ESL and/or Bilingual Link:** How do we see visions differently if you are from another country

**Mathematics/Science Link and/or Humanities Link:** How would your interpretation of Dickinson's work be different if she was a trained mathematician

**School-to-Career/Tech Prep Link:** Round table discussion with poet/writer on what topics influence writing style, topics, and imagery

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** Walt Whitman – "I Heard the Learned Astronomer"

**Students will:** Compose/find poem that involves conic sections [either actual shape or related topic]

**Class/team/individual product:** Dramatic reading of poem

INDIVIDUAL JOURNAL ASSIGNMENT:

Discussion of how knowledge of light, lens, lamps, and circumference influence interpretation of Dickinson's poem

HOMELINK:

Read poem to younger person and ask for his/her interpretation

---

**BENCHMARK # 10** To develop or co-develop with others in one or more of the arts, grounding its artistic merit within historical, social, cultural, critical, and aesthetic parameters, and taking into account the merit of the arts form or arts concept in an in-depth manner.

**ESSENTIAL QUESTION:** How does the discipline/sub-discipline of fine arts relate to mastery learning of conic sections?

15. **Fine Arts**

KNOWLEDGE:

**Anticipatory Set:** Story of how/why the sundial ring was created.

**Students will:** Complete paper on history of sundials based on information located at [www.sheperdswatch.ca](http://www.sheperdswatch.ca)

Carpe' diem [examine/describe jewelry of Harris Morson & ancient cultures use of sundials]

COMPREHENSION:

Show short clip from Back to Future Part 1

Predict how movie would have to be changed if there were no clocks – only sundials.

APPLICATION:

**Anticipatory Set:** By means of PowerPoint, students share types of sundials discovered in research.

**Students will:** Design, diagram, and build functioning sundial of own design.

**Class/team product:** Sundial

**Multicultural and/or ESL and/or Bilingual Link:** After listening to song "The sun doesn't shine on the same folks all the time." Describe how time depends on location on globe. As humans is time a real event or is it an experiential event?

**Mathematics/Science Link and/or Humanities Link:** Relate conic sections to structure and function of sundials.

**School-to-Career/Tech Prep Link:** How is being on time important in your daily life and future plans?

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** Examination of various student-constructed sundials.

**Students will:** Describe construction process of own group's sundial and analyze functioning of other groups sundials.

**Class/team/individual product:** Oral analysis of the functionality of each sundial.

INDIVIDUAL JOURNAL ASSIGNMENT:

Describe problems encountered in the construction of the sundial and how your group solved these problems.

HOMELINK:

Find place at home where sundial can be placed to function properly.

---

BENCHMARK # 8 Demonstrates responsible personal and social behaviors in physical activity settings.

ESSENTIAL QUESTION: How does the discipline/sub-discipline of physical education relate to mastery learning of c.s.?

16. PHYSICAL EDUCATION

KNOWLEDGE:

**Anticipatory Set:** Activity in which students throw balls, Frisbees, and other objects in gym or outdoors.

**Students will:** list characteristics of each object's motion [eg follows curved path, moves upward and down, drag force present]

COMPREHENSION:

Students will predict how the observed motions would be different on the moon. [eg – objects go higher, go farther]

APPLICATION:

**Anticipatory Set:** Conic aerobics – adapt YMCA by the Village People into MATH. Students will mimic shapes of conic sections with arms and bodies.

**Students will:** Research latest technology development on sport of choice which involves conic section.

**Class/team product:** Video showing developments in sport technology and how it relates to conic section

**Multicultural and/or ESL and/or Bilingual Link:** Re-enact “ancient games” or sports played in other countries that involve conic sections

**Mathematics/Science Link and/or Humanities Link:** Read biography/autobiography of famous/not so famous sports person. Create short video highlighting this person's accomplishments

**School-to-Career/Tech Prep Link:** Research how Frisbee progressed from idea to product

HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** Play “Stand” by the B-52s

**Students will:** Arrange team members to become graphs of various conic sections when given the equation

**Class/team/individual product:** Human graph

INDIVIDUAL JOURNAL ASSIGNMENT:

How did becoming part of the graph help you better understand the equations and conic sections?

HOMELINK:

Survey family members about favorite sport. Why?

---

BENCHMARK # 10 To develop or co-develop with others in one or more of the arts, grounding its artistic merit within historical, social, cultural, critical, and aesthetic parameters, and taking into account the merit of the arts form or arts concept in an in-depth manner.

ESSENTIAL QUESTION: How does the discipline/sub-discipline of \_\_\_\_\_ relate to mastery learning of \_\_\_\_\_?

### 17. VOCATIONAL/TECH ARTS

#### KNOWLEDGE:

**Anticipatory Set:** Clip of movie on Taj Mahal – focusing on elliptical ceiling

**Students will:** Identify how ceiling shape uses ellipse’s reflective properties to maximize acoustics of room

#### COMPREHENSION:

Lead students in discussion on why “whispering gallery” works the way it does

#### APPLICATION:

**Anticipatory Set:** Listen to – “You light up my life”

**Students will:** Apply principle by which “whispering gallery” works to design lighting conditions for a stage

**Class/team product:** Diagram illustrating stage design

**Multicultural and/or ESL and/or Bilingual Link:** Research ancient stages – noting any elements of conic sections in their designs Share results with labeled diagrams

**Mathematics/Science Link and/or Humanities Link:** Solve problems involving design of various structures/buildings.

**School-to-Career/Tech Prep Link:** Research “roadies” – office title, training, and job responsibilities

#### HIGHER ORDER THINKING SKILLS (H.O.T.S.):

**Anticipatory set:** Show clip from movie “ROCK STAR”

**Students will:** Arrange members/instruments of imaginary band on elliptical stage such that instruments produce the best sound quality during a recording session

**Class/team/individual product:** Diorama of stage depicting location of various instruments

#### INDIVIDUAL JOURNAL ASSIGNMENT:

Write on who is favorite rock star and why

#### HOMELINK:

Explore home/neighborhood for conic shaped rooms/structures and report on acoustics.

## MORAL/ETHICAL/SPIRITUAL REASONING AND DILEMMAS

### TEN ETHICAL DILEMMAS

ESSENTIAL QUESTION: How does the content of this unit reflect **character education** through Moral and Ethical dilemmas?

1. **Producing, Exchanging, and Distributing** [Economics]

ESSENTIAL QUESTION: How does the **Human Activity** of **Producing, Exchanging and Distributing** create moral/ethical dilemmas?

#### **DILEMMA:**

As superintendent of small school system, you are in the position of setting school policy for community of approximately 3000 people. For over 100 years, your school mascot has been the Red Chief. A family of native-American descent recently moved into your community. Shortly after that, the National Tribal Council contacts you and requests that you change the school's mascot. You know that a strong sense of community pride exists and that any attempt to change the mascot will be met with opposition. The majority of the members of the community will ask for your resignation. Yet, the threat of a costly lawsuit exists if you do not respond to the council's demand. How do you resolve this conflict?

2. **Transportation**

ESSENTIAL QUESTION: How does the **Human Activity** of **Transportation** create moral/ethical dilemmas?

**DILEMMA:**

As the head quality control engineer for Firestone Tires, you have just discovered a very minor flaw in the structural stability of the polymer used in a new tire recently designed for the top selling car produced by Ford. After spending millions of dollars on research and development, production has just begun on this tire and Firestone will make billions from the contract with Ford. In testing, 1 in every 500,000 tires will fail catastrophically. If one of these tires failed on a car, the ensuing accident would probably be fatal to all occupants in the car. Do you announce the flaw to your supervisors or do you keep quiet?

3. **Communications**

ESSENTIAL QUESTION: How does the **Human Activity** of **Communications** create moral/ethical dilemmas?

**DILEMMA:**

You are a brilliant mathematician and have been working with NASA on satellite communications between Mission Control and the astronauts. Your talents have been discovered by the Defense Department. You are now being asked to work on a communications system used to guide missiles. At first, you refuse because of your pacifist beliefs. Yet, the \$100,000 salary increase will help pay for the treatments your terminally ill spouse needs to stay alive. What do you do?

4. **Protecting and Conserving**

ESSENTIAL QUESTION: How does the **Human Activity** of **Protecting and Conserving** create moral/ethical dilemmas?

**DILEMMA:**

As your county's landfill reaches capacity, the county commission has okayed the construction of a new landfill. While using a GPR to examine the rock strata and water table of an area for a proposed new landfill, a hydro-geologist comes across a few blips that appear to be human bones. After consulting a local archeologist, it is determined that this site is a sacred ritual site for the Mound Indians. This site is the only known burial site that is still in its pristine condition. As the chief commissioner of the county, you must decide to okay the construction of the landfill – thus saving your county thousands of dollars in fees to dispose trash in a neighboring county and thus destroying a priceless cultural treasure. Where is the trash going?

5. **Providing Education**

ESSENTIAL QUESTION: How does the **Human Activity** of **Providing Education** create moral/ethical dilemmas?

**DILEMMA:**

Your younger sibling is applying for admission into the engineering program at university in which you were just accepted. As you have known for years, your sibling is not the strongest in math. Your sibling asks you to tell share what specific questions will be on the mathematics portion of the admissions test. The university has a zero tolerance policy on cheating – one strike and you are out. Do you help your bro or diss your sis?

6. **Making and Using Tools and/or Technology**

ESSENTIAL QUESTION: How does the **Human Activity** of **Making and Using Tools and/or Technology** create moral/ethical dilemmas?

**DILEMMA:**

Since you have reached American soil, you have dreamed of serving your fellow Americans in the United States Senate. After years of personal dedication and sacrifice, you have been elected as a Senator. One of your first duties as Senator is to vote on a controversial defense project. As the last Senator to vote, you will determine the fate a multi-billion dollar and multi-nation space defense system. If you vote yes, the construction of a laser defense system will become a reality and millions of dollars will be pumped into the economy of your state. However, a yes vote would also permit the chance that a military power may use this system to annihilate thousands of innocent people in attempts to control the political unrest in unstable nation from which you emigrated. As roll is called, Senator, what is your vote?

7. **Providing Recreation**

ESSENTIAL QUESTION: How does the **Human Activity** of **Providing Recreation** create moral/ethical dilemmas?

**DILEMMA:**

On the night your art team is going to edit the short film you have been working on all semester, the girl/guy you have been trying to go out with for over a year finally says yes to a date. If your art teacher finds out that you skipped out on the editing process, you will receive a failing grade for the course. So what is your choice – hours of splicing and dubbing with your art team or hours of dancing and romancing with your dream date?

8. **Organizing and Governing**

ESSENTIAL QUESTION: How does the **Human Activity** of **Organizing and Governing** create moral/ethical dilemmas?

**DILEMMA:**

You awake in the middle of the night to the roar of police sirens, helicopters, and a slamming door. As you turn on the kitchen light, you see the nation's top nuclear scientist passed out on the kitchen floor. The scientist is badly beaten and appears to have suffered horrendous torture. Earlier that week he had been taken into government custody on charges of supplying nuclear technology to a foreign power. Based on the limited information in the news, you feel that the government's case against this person is not legitimate. If you offer this person a safe place to stay, you risk being convicted of aiding a foreign agent and sent to prison. If you go flag down the police, you risk violating your personal convictions. What do you do?

9. **Moral, Ethical and Spiritual Behavior**

ESSENTIAL QUESTION: How does the **Human Activity** of **Moral, Ethical and Spiritual Behavior** create moral/ethical dilemmas?

**DILEMMA:**

After many months of community debate, the local school board has adopted the policy that divine creationism is the only viewpoint to be presented to explain the origin of the universe and development of life here on Earth. The board has also adopted the policy that any faculty member that violates this policy will be immediately terminated. As a physicist and scientist, you feel you must present the scientific perspective in your class. What is your lesson plan on the origins of the universe?

10. **Aesthetic Needs**

ESSENTIAL QUESTION: How does the **Human Activity** of **Aesthetic Needs** create moral/ethical dilemmas?

**DILEMMA:**

You are the county commissioner who is responsible for revitalizing downtown Dayton. The “Riverscape” project will bring thousands of people and millions of dollars but the proposed fountains will use water directly from the Farmersville aquifer. Every hour every day, the fountains run for five minutes and use the same amount of water that the population of Farmersville uses every three days. The community will be outraged by this seemingly wasteful use of this precious resource. Do the fountains flow?

**PRODUCTIVE THINKING SKILLS  
DIVERGENT/CREATIVE THINKING**

1. **BRAINSTORM MODEL**

- A. BRAINSTORM ALL OF THE \_\_\_\_\_:
  - AHA #1. Things that are made of cones
  - AHA #2. Modes of transportation
  - AHA #3. Uses of an umbrella
  - AHA #4. Ways to make [objects that make] conic section shadows
  - AHA #5. Uses of marshmallows
  - AHA #6. Uses of mirrors
  - AHA #7. Cartoons you watched as child
  
- B. BRAINSTORM AS MANY \_\_\_\_\_ AS YOU CAN THINK OF.
  - AHA #8. Constellations
  - AHA #9. Astronomers
  - AHA #10. Fountains in your area
  - AHA #11. Historical moments/ with men/ with women/ with mathematicians & scientists
  - AHA #12. Stars
  - AHA #13. Types of jewelry
  - AHA #14. Poems
  
- C. HOW MANY WAYS CAN YOU COME UP WITH TO \_\_\_\_\_?
  - AHA #15. Tell time
  - AHA #16. Get exercise
  - AHA #17. Design a ceiling

2. **VIEWPOINT MODEL (Human or Animate) (Use Cultural Literacy Terms)**

- A. HOW WOULD \_\_\_\_\_ LOOK TO A(N) \_\_\_\_\_?

AHA #1. The conic sections	a blind person
AHA #2. School bus	a caveman [Fred Flintstone]
AHA #3. Headlight	lightning bug
AHA #4. GPR	an ant
AHA #5. Arch	bird/fish
AHA #6. Modern telescope	Incan astronomer
AHA #7. Movie Shrek	1930s animator
AHA #8. Computer	Tycho Brahe
  
- B. WHAT WOULD A \_\_\_\_\_ MEAN FROM THE VIEWPOINT OF A(N) \_\_\_\_\_?

AHA #9. Space shuttle	the Moon
AHA #10. Fountain	child in Calcutta
AHA #11. Radio antenna	Hypatia, Appolonius, Galileo, Hubble, and Pythagoras
AHA #12. Orbit	Copernican astronomer
AHA #13. Necklace	pig
AHA #14. Hyperbola’s equation	poet
AHA #15. Clock	family dog
AHA #16. Aerobics class	Martian



5. **FORCED ASSOCIATION MODEL (Use cultural literacy terms here)**

- A. HOW IS \_\_\_\_\_ LIKE \_\_\_\_\_ ?
- |                                       |                          |
|---------------------------------------|--------------------------|
| AHA #1. Conic section                 | piece of fruit           |
| AHA #2. Equation                      | work of art              |
| AHA #3. A parabola's vertex           | the equator              |
| AHA #4. Are Edgar Allen Poe's writing | ground penetrating radar |
| AHA #5. Concrete                      | a sponge                 |
| AHA #6. SETI                          | the Atzecs               |
| AHA #7. Animation                     | taking photographs       |
- B. GET IDEAS FROM \_\_\_\_\_ TO IMPROVE \_\_\_\_\_.
- |                             |                          |
|-----------------------------|--------------------------|
| AHA #8. Einstein's theories | your classroom           |
| AHA #9. Galileo's writings  | telescopes and satellite |
| AHA #10. Fountain designer  | water conservation       |
| AHA #11. Appolonius         | space station            |
| AHA #12. The Internet       | space exploration        |
| AHA #13. Nature             | jewelry designs          |
| AHA #14. Walt Whitman       | Emily Dickinson's poetry |
- C. I ONLY KNOW ABOUT \_\_\_\_\_. EXPLAIN \_\_\_\_\_ TO ME.
- |                             |                                       |
|-----------------------------|---------------------------------------|
| AHA #15. Time in Ohio       | different time zones around the globe |
| AHA #16. Sports             | conic sections                        |
| AHA #17. Instrumental music | acappella music                       |

6. **REORGANIZATION/SYNECTICS MODEL**

- A. WHAT WOULD HAPPEN IF \_\_\_\_\_ ?
- AHA #1. McDonald's logo wasn't the "golden arches"
- AHA #2. All the circles were replaced by squares
- AHA #3. China had launched the first satellite
- AHA #4. Light could not be reflected
- AHA #5. Engineers did not study mathematics
- AHA #6. The Cretaceous asteroid missed the Earth \_\_\_\_\_
- AHA #7. Producers stopped making movies, but only produced cartoons
- B. SUPPOSE \_\_\_\_\_ (HAPPENED)  
WHAT WOULD BE THE CONSEQUENCES?
- AHA #8. Kepler's ideas had been accepted during his lifetime
- AHA #9. Galileo had not recanted his famous statement
- AHA #10. Child's favorite toy was a squirt gun
- AHA #11. All of the historical records of the past disappeared
- AHA #12. Einstein was still alive
- AHA #13. Academy Awards show asked to create jewelry for both best male/female actor/actress
- AHA #14. Emily Dickinson was President George Bush's mother
- C. WHAT WOULD HAPPEN IF THERE WERE NO \_\_\_\_\_ ?
- AHA #15. Time
- AHA #16. Sports or physical exercise
- AHA #17. Humans had no vocal cords

**CULTURAL LITERACY**

Abscissa  
Abstract art  
Acceleration

Acoustics  
Aerodynamics  
Algebra

Algorithm  
Amplitude  
Animate

Animation	Foci	Op art
Aphelion	Focus	Optics
Applied art	Force	Orbit
Apogee	Free fall	Ordinate
Apollonius	Frequency	Parabola
Arch	Frisbee	Perigee
Asteroid	Functional art	Perihelion
Asteroid belt	Galilei, Galileo	Physics
Astronomy	Geocentric	Plank, Max
Astrophysics	Gnomon	Plank's constant
Asymptotes	Gravitation	Planet
Axis	Gravity	Pop art
Banneker, Benjamin	Ground penetrating radar	Potential energy
Basilica	Heliocentric	Power
Big Bang	Hubble, Edwin	Ptolemaic universe
Carpe diem	Hubble Space telescope	Ptolemy, Claudius
Cartesian plane	Hypatia	Pythagorus
Cassegrain	Hyperbola	Pythagorean theorem
Center	Hypotenuse	Quasars
Center of gravity	Hypothesis	Radius
Chord	Hypotheses	Reflection
Circle	Impressionism	Refraction
Circumference	Inertia	Relativity
Claymation	Kepler, Johannes	Right triangle
Coliseum	Kepler's laws	Satellite
Collage	Kinetic energy	Shape
Concave	La place, Pierre-Simon	Solar system
Convex	Law of universal gravitation	Star
Conjugate axis	Lens	Storyboard
Constellation	Light	Sundial
Copernicus, Nicolas	Locus	Supernova
Coordinates	Major axis	Taj Mahal
Copernicus	Manipulate	Telescope
Cosmology	Mass	Theory
Cubism	Mechanics	Trajectory
Diameter	Medium	Transverse axis
Directrix	Minor axis	Universe
Eccentricity	Mirror	Vacuum
Eclipse	Momentum	Velocity
Einstein, Albert	Morph	Vertex
Ellipse	Mount Palomar	Wave
Equation	Nebula	Wavelength
Extraterrestrial	Newton, Isaac	Weight
Flipbook	Newton's laws of motion	
Focal length	Oppenheimer, J. Robert	

### Important equations and laws:

#### Geometry and Trigonometry:

$$A^2 + B^2 = C^2$$

$$x^2 + y^2 = r^2$$

$$(x - h)^2 + (y - k)^2 = r^2$$

$$(x - h)^2 = 4p(y - k)$$

$$(y - k)^2 = 4p(x - h)$$

$$x^2 + y^2 + Dx + Ey + F = 0$$

$$y^2 + Dx + Ey + F = 0$$

$$x^2 + Dx + Ey + F = 0$$

$$(x - h)^2 / a^2 + (y - k)^2 / b^2 = 1$$

$$(y - k)^2 / a^2 + (x - h)^2 / b^2 = 1$$

$$(x - h)^2 / a^2 - (y - k)^2 / b^2 = 1$$

$$(y - k)^2 / a^2 - (x - h)^2 / b^2 = 1$$

$$y - k = \pm b/a (x - h)$$

$$y - k = \pm a/b (x - h)$$

$$Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$$

**Physics:**

$$\Sigma F = m a$$

$$F = G m_1 m_2 / d^2$$

$$T_a^2 / T_b^2 = r_a^3 / r_b^3$$

Newton's first law

Newton's second law

Newton's third law

Kepler's first law

Kepler's second law

Kepler's third law

Universal law of gravitation

$$v = \lambda f$$

**RESOURCES**

**I. Bibliography – Teacher/Professional Books and Resources**

The Creative Impulse: An Introduction to the Arts. Dennis J. Sporre  
 Glencoe: Art in Focus. Gene A. Mittler  
 ENC Focus Volume 9, Number 2, 2002 p 28.  
 Multiculturalism in Mathematics, Science, and Technology: Readings and Activities.  
 Addison-Wesley  
 Multiple Intelligence Approaches to Assessment: Solving the Assessment Conundrum  
 David Lazear  
 Seven Ways of Teaching: The Artistry of Teaching with Multiple Intelligences. David Lazear  
 Seven Ways of Knowing: Teaching for Multiple Intelligences. David Lazear  
 Advanced Mathematical Concepts: Precalculus with Applications. Glencoe  
 Celebrating Women in Mathematics and Science: National Council of Teacher of Mathematics  
 Agnesi to Zeno: Over 100 Vignettes from the History of Math. Sanderson Smith  
 Mathematics: A Concise History and Philosophy. W.S. Anglin  
 PreCalculus Larson Hostetler  
 Algebra 2 Holt, Rinehart, and Winston  
 The Literature Teacher's Book of Lists Judie L. H. Strouf  
 Dickinson Everyman's Library Pocket Poetry  
 Physics – 5<sup>th</sup> edition Douglas C. Giancoli – Prentice Hall  
 Conceptual Physics – 8<sup>th</sup> edition Paul G. Hewitt – Addison Wesley  
 A light in the book attic Shel Silverstein  
 Where the Sidewalk Ends Shel Silverstein  
 Favorite Poems Old and New Helen Ferris

**II. Bibliography**

The Lord of the Rings	J.R.R. Tolkien
The Expanded Quotable Einstein	Alice Calaprice
Art and Physics	Leonard Shlain
Isaac Newton the Last Sorcerer	Michael White
The Geometry of Art and Life	Matila Ghyka
Men of Mathematics	E.T. Bell

Women and Numbers	Teri Bell
Mathematics The Science of Patterns	Keith Devlin
The Tao of Physics	Fritjof Capra
Galileo's Daughter	David Sobel
Pale Blue Dot	Carl Sagan
Just Six Numbers	Martin Rees
It Started with Copernicus	Howard Margolis
A Beautiful Mind	Sylvia Nasar
Physics and Philosophy	Werner Heisenberg
Fermat's Enigma	Simon Singh
Flatland	Edwin Abbott
Flatterland	Ian Stewart
A light in the book attic	Shel Silverstein
Where the Sidewalk Ends	Shel Silverstein
Favorite Poems Old and New	Helen Ferris
A Brief History of Time	Steven Hawking
The Universe in a Nutshell	Steven Hawking
The Colossal Book of Mathematics	Martin Gardener
The Future of Space Time	Steven Hawking, etal
Fenyman's Lost Lecture	David L Goodstein
Imaginary Tale	Paul J Nahin
On Tycho's Island	John Robert Christianson
Parallax	Alan W Hirschfeld
What Science is and How it Works	Gregory N Derry
Cosmic Pinball	Carolyn Sumners and Carlton Allen
Math Trek 2	Ivers Peterson and Nancy Henderson
Acid Tongues and Tranquil Dream	Michael White
On the Revolution of the Celestial Orbs	Nicholas Copernicus
Distant Wanderers	Bruce Dorminey
Unweaving the Rainbow	Richard Dawkins
The Handy Physics Answer Book	P Erik Gundersen
Longitude	Dava Sobel
The Illustrated Longitude	William J H Andrewes
Trigonometric Delights	Eli Moar
e, The Story of a Number	Eli Moar
Lateral Thinking and Logical Induction	Mensa
Dictionary of Superstitions	David Pickering
Math Logic Puzzles	Kurt Smith
Men of mathematics: The Lives and	E.T. Bell, etal
Achievements of the Great Mathematicians	
20 <sup>th</sup> Century Geniuses: 250 Biographies of	A. Bullock
The People Who Shaped the Greatest Period In Human History	
Art in Our Times: A Pictorial History 1890-1980	Harry N. Abrams
A Different Mirror: A History of	Little, Brown, and Company
Multicultural America	

### III. Educational Films/Videos

The Classroom Channel	Slicing the Cone
Circle	
Parabola	
Ellipse	
Hyperbola	
Dragonfly TV Simple Machines	
Mechanical Universe and Beyond video series by Anneburg CPB Project & Learner:	
21 Kepler's Three Laws	24 Navigating In Space

22 The Kepler Problem  
 23 Energy And Eccentricity  
 Computer Animation Festival, Vol 2.0, Miramar 1994  
 Animation in the classroom, Art is... Video Series, Crystal Video

**IV. Commercial Films/Videos**

Ben Hur	Flintstones
Rock Star	Papillion
Golden eye	Contact
Clear and Present Danger	Enemy of the State
Shrek	Back to the Future – Part 1
Agony and Ecstasy	E.T.
Armageddon	Passage to India
Gandhi	Don't Look Now
Dirty Harry	The Fly
Star Trek [take your pick]	Star Wars [find your favorite]
Lord of the Rings	The Hobbit
Camelot	Time Machine
The Wizard of Oz	

**V. Literature/Language Arts (on reserve in Media Center for interest reading)**

The Lord of the Rings	J.R.R. Tolkien
The Expanded Quotable Einstein	Alice Calaprice
Art and Physics	Leonard Shlain
Isaac Newton the Last Sorcerer	Michael White
The Geometry of Art and Life	Matila Ghyka
Men of Mathematics	E.T. Bell
Women and Numbers	Teri Bell
Mathematics The Science of Patterns	Keith Devlin
The Tao of Physics	Fritjof Capra
Galileo's Daughter	David Sobel
Pale Blue Dot	Carl Sagan
Just Six Numbers	Martin Rees
It Started with Copernicus	Howard Margolis
A Beautiful Mind	Sylvia Nasar
Physics and Philosophy	Werner Heisenberg
Fermat's Enigma	Simon Singh
Flatland	Edwin Abbott
Flatterland	Ian Stewart
A light in the book attic	Shel Silverstein
Where the Sidewalk Ends	Shel Silverstein
Favorite Poems Old and New	Helen Ferris
A Brief History of Time	Steven Hawking
The Universe in a Nutshell	Steven Hawking
The Colossal Book of Mathematics	Martin Gardener
The Future of Space Time	Steven Hawking, etal
Fenyman's Lost Lecture	David L Goodstein
Imaginary Tale	Paul J Nahin
On Tycho's Island	John Robert Christianson
Parallax	Alan W Hirschfeld
What Science is and How it Works	Gregory N Derry
Cosmic Pinball	Carolyn Sumners and Carlton Allen
Math Trek 2	Ivers Peterson and Nancy Henderson
Acid Tongues and Tranquil Dream	Michael White
On the Revolution of the Celestial Orbs	Nicholas Copernicus

Distant Wanderers  
Unweaving the Rainbow  
The Handy Physics Answer Book  
Longitude  
The Illustrated Longitude  
Trigonometric Delights  
e, The Story of a Number

Bruce Dorminey  
Richard Dawkins  
P Erik Gundersen  
Dava Sobel  
William J H Andrewes  
Eli Moar  
Eli Moar

### Poetry

The Raven by E.A. Poe  
Annabel Lee by E.A. Poe  
The Quartets T.S. Elliot  
Go Fly a Saucer by David McCord  
Number 10 by Emily Dickinson  
A Heard the Learned Astronomer by Walt Whitman  
Shapes by Shel Silverstein  
Shadow Race by Shel Silverstein  
Invention by Shel Silverstein  
Silver Ships by Mildred Plu Meigo

### Drama (Stage Productions)

Camelot  
Lion King

### Art Works

Raspberries and Goldfish	Janet I. Fish, 1981
Cliff Dwellers	George Bellows, 1913
Parts Through the Window	Marc Chagall, 1913
Stables	Marc Chagall, 1913
Zaga	Nancy Graves, 1983
Sydney Opera House	Jaern Utzon, 1959-72
Reims Cathedral	Reims France, 1225-1299
Madonna and Child on Curved Throne	Byzantine, 13 <sup>th</sup> century
The Conversion of St. Paul	Caravaggio, 1601
The Starry Night	Vincent Van Gogh, 1889
Design made at Airlic Gardens	Minnie Evans, 1967
The Coliseum	Rome, circa AD 70-80
Wells Cathedral, England	circa 1338
Sunday Afternoon on the Island of La Grande Jatte	George Seurat, 1884-86
Three Women	Fernand Liger, 1921
The Bride	Marcel Du Champs, 1912

### Music

Wheels on the Bus	Bauble, bangles, and beads
Big Wheel Keep on Turning	Stand
Champagne Supernova	You light up my life
You can take this job	YMCA
Working nine to five	The sun doesn't shine on some folks all the time
Somewhere over the rainbow	

## VI. Resource People/Mentors

Police officer	Astronaut	Architect
Forensics expert	Guidance counselor	Building engineer
NASA representative	Automotive engineer	County engineer

## **VII. Field Trips**

NASA facility  
Weather service  
Planetarium  
Art museum  
Goodyear/Firestone facility  
Native American mounds  
Automobile manufacturing plant

## **VIII. Other Material (CD-ROM, Laser Disc, Internet sites, etc.)**

[www.sheperdswatch.ca](http://www.sheperdswatch.ca)  
<http://lyrics.coolfreepages.com/lyrics/1969/531969.html>  
[www.adamsandler.com](http://www.adamsandler.com)  
<http://www.learner.org/resources/resource.html?uid=42&sj=SCI>  
<http://www.phschool.com/science/cpsurf/>  
<http://www.prenhall.com/giancoli/>  
<http://www.colorado.edu/physics/2000/index.pl>  
<http://webphysics.ph.msstate.edu/javamirror/>  
<http://www.glencoe.com/sec/math>  
<http://www.nytimes.com/learning/teachers/lessons/math.html>  
<http://forum.swarthmore.edu/dr.math>  
<http://forum.swarthmore.edu/~sarah/shapiro>  
<http://www.noaa.gov/>

### **CD-ROM**

Addison Wesley Longman - ActivPhysics 1  
Addison Wesley Longman - ActivPhysics 2

### **Software**

**Interactive Physics Simulations ISBN: 0201841673**  
Geometer's Sketchpad – Key Curriculum Press