Environmental Science Institute
The University of Texas at Austin

Extra-Solar Planets

William D. Cochran

This file contains suggestions for how to incorporate the material from this CD-ROM into curriculum using the Texas Essential Knowledge and Skills for Science.

Elementary School

§112.2. Science Kindergarten

(K.2) Scientific processes. The student develops abilities necessary to do scientific inquiry in the field and the classroom. The student is expected to:

(A) ask questions about organisms, objects, and events; [Slide 16: What is unique about this star? Can you find a planet around it?]

(B) plan and conduct simple descriptive investigations; [Using slide 16 have the student try to find the planet from the picture.]

§112.3. Science Grade 1

(1.3) Scientific processes. The student knows that information and critical thinking are used in making decisions. The student is expected to:

(A) make decisions using information; [Slides 32-36: What evidence is presented in this lecture that suggests the existence of extrasolar planets? Is this evidence strong enough to conclude that extrasolar planets exist? Slides 8-9, 8-16, 17- 23, 24-29: What information did scientists use to decide how to look for extrasolar planets?]

§112.4. Science Grade 2

(2.3) Scientific processes. The student knows that information and critical thinking are used in making decisions. The student is expected to:

(C) explain a problem in his/her own words and identify a task and solution related to the problem. [Slides 10-29: How do scientists search for planets in other solar systems? Have students formulate different ways they would search for a planet and compare with the methods on the slides.]

§112.5. Science Grade 3

(3.2) Scientific processes. The student uses scientific inquiry methods during field and laboratory investigations. The student is expected to:

(A) plan and implement descriptive investigations including asking well-defined questions, formulating testable hypotheses, and selecting and using equipment and technology; [Slides 10-29: How do scientists search for planets in other solar systems? Have student formulate different ways they would search for a planet and compare with the methods on the slides.]

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence; . [Slides 10-29: Discuss the indirect vs. direct detection of a planet.]

(3.3) Scientific processes. The student knows that information, critical thinking, and scientific problem solving are used in making decisions. The student is expected to:

(D) evaluate the impact of research on scientific thought, society, and the environment; and [Ask the students how finding more planets outside of our solar system would affect society. If a planet exactly like Earth was found, it might mean life exists in outer space!]

(3.11) Science concepts. The student knows that the natural world includes earth materials and objects in the sky. The student is expected to:

(C) identify the planets in our solar system and their position in relation to the Sun; and [Slide 1: Use this slide to identify the planets and their positions relative to the Sun.]

(D) describe the characteristics of the Sun. [Refer to slide 1 for a picture of the sun and have the student describe the characteristics of the sun.]

§112.6. Science Grade 4

(4.3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:

(D) evaluate the impact of research on scientific thought, society, and the environment; and [Ask the students how finding more planets outside of our solar system would affect society. If a planet exactly like Earth was found, it might mean life exists in outer space!]

§112.7. Science Grade 5

(5.5) Science concepts. The student knows that a system is a collection of cycles, structures, and processes that interact. The student is expected to:

(A) describe some cycles, structures, and processes that are found in a simple system; and [Refer to slide 4-6 for the cycle of how stars are formed. Have the students formulate their own cycle of how stars are formed and present to the class, and then show how scientists believe stars are formed.]

(B) describe some interactions that occur in a simple system. [Refer to slides 6, 17-23 for interactions between objects in a system.]

Middle School

§112.22. Science Grade 6

(6.2) Scientific processes. The student uses scientific inquiry 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 and using equipment and technology; [Slides 4-5: What questions are scientists still trying to answer about the existence and nature of other solar systems? Slide 6, 30, 46-47: What hypotheses (expectations) have scientists formulated to explain the nature of solar systems? What are these hypotheses based on? How have planetary detection efforts improved our understanding of solar systems? Slides 13-16, 24-29, 32-36: What methods have scientists used to make observations about other solar systems? What are these observations?]

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence; [Slides 13-16, 17-29: Elaborate on possible direct and indirect ways of locating and observing planets, stars, etc. Slides 46-47: What conclusions have scientists made based on made in planetary detection studies? Slides 41-42: What new questions have arisen as a result of these observations? Slides 4-5, 37-40, 46-47: How do scientists use established knowledge and data to make comparisons and draw conclusions about new information and data?]

(6.5) Scientific concepts. The student knows that systems may combine with other systems to form a larger system. The student is expected to:

(B) describe how the properties of a system are different from the properties of its parts. [Slides 8-9: Compare properties of stars, planets, and planetary systems.]

§112.23. Science Grade 7

(7.2) Scientific processes. The student uses scientific inquiry 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 and using equipment and technology; [Slides 4-5: What questions are scientists still trying to answer about the existence and nature of other solar systems? Slide 6, 30, 46-47: What hypotheses (expectations) have scientists formulated to explain the nature of solar systems? What are these hypotheses based on? How have planetary detection efforts improved our understanding of solar systems? Slides 13-16, 24-29, 32-36: What methods have scientists used to make observations about other solar systems? What are these observations?]

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence; [Slides 13-16, 17-29: Elaborate on possible direct and indirect ways of locating and observing planets, stars, etc. Slides 46-47: What conclusions have scientists made based on made in planetary detection studies? Slides 41-42: What new questions have arisen as a result of these observations? Slides 4-5, 37-40, 46-47: How do scientists use established knowledge and data to make comparisons and draw conclusions about new information and data?]

§112.24. Science Grade 8

(8.2) Scientific processes. The student uses scientific inquiry 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 and using equipment and technology; [Slides 4-5: What questions are scientists still trying to answer about the existence and nature of other solar systems? Slide 6, 30, 46-47: What hypotheses (expectations) have scientists formulated to explain the nature of solar systems? What are these hypotheses based on? How have planetary detection efforts improved our understanding of solar systems? Slides 13-16, 24-29, 32-36: What methods have scientists used to make observations about other solar systems? What are these observations?]

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence; [Slides 13-16, 17-29: Elaborate on possible direct and indirect ways of locating and observing planets, stars, etc. Slides 46-47: What conclusions have scientists made based on made in planetary detection studies? Slides 41-42: What new questions have arisen as a result of these observations? Slides 4-5, 37-40, 46-47: How do

scientists use established knowledge and data to make comparisons and draw conclusions about new information and data?]

High School

§112.42. Integrated Physics and Chemistry

(2) Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to:

(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting and using equipment and technology; [Slides 4-5: What questions are scientists still trying to answer about the existence and nature of other solar systems? Slide 6, 30, 46-47: What hypotheses (expectations) have scientists formulated to explain the nature of solar systems? What are these hypotheses based on? How have planetary detection efforts improved our understanding of solar systems? Slides 13-16, 24-29, 32-36: What methods have scientists used to make observations about other solar systems? What are these observations?]

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence; [Slides 13-16, 17-29: Elaborate on possible direct and indirect ways of locating and observing planets, stars, etc. Slides 46-47: What conclusions have scientists made based on made in planetary detection studies? Slides 41-42: What new questions have arisen as a result of these observations? Slides 4-5, 37-40, 46-47: How do scientists use established knowledge and data to make comparisons and draw conclusions about new information and data?]

(6) Science concepts. The student knows forces in nature. The student is expected to:

(A) identify the influence of mass and distance on gravitational forces; [Slides 20,22 can be used to demonstrate applications of radial velocity and centripetal force. What fundamental quantities are involved in calculating radial velocities (mass, distance, time, etc.)? What physical laws describe the motion of planets and stars?]

§112.48. Astronomy

(2) Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to:

(A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting and using equipment and technology; [Slides 4-5: What questions are scientists still trying to answer about the existence and nature of other

solar systems? Slide 6, 30, 46-47: What hypotheses (expectations) have scientists formulated to explain the nature of solar systems? What are these hypotheses based on? How have planetary detection efforts improved our understanding of solar systems? Slides 13-16, 24-29, 32-36: What methods have scientists used to make observations about other solar systems? What are these observations?]

(B) collect data and make measurements with precision; [Slides 22, 27, 29: What parameters have scientists measured and recorded in making observations of planetary systems? Slides 31,45: What shortcomings have scientists recognized in their own data-taking techniques? Slide 48: What can scientists do to improve their observation techniques?]

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence; [Slides 13-16, 17-29: Elaborate on possible direct and indirect ways of locating and observing planets, stars, etc. Slides 46-47: What conclusions have scientists made based on made in planetary detection studies? Slides 41-42: What new questions have arisen as a result of these observations? Slides 4-5, 37-40, 46-47: How do scientists use established knowledge and data to make comparisons and draw conclusions about new information and data?]

(3) Scientific processes. The student uses critical thinking and scientific problem solving skills to make informed decisions. The student is expected to:

(C) evaluate the impact of research on scientific thought, society, and the environment; [Slides 17-18, 46-47: Discuss how inferences can lead to new discoveries and theories. Slides 46-47: How have recent observations changed our expectations of new planetary systems? How does the discovery of extrasolar planetary systems affect our view of the universe? Might these discoveries motivate us to explore for life on other planets? What resources might another earth-like planet provide to future generations as we develop the capability to travel farther into space? What have we learned about the earth's environment that we could use in developing resources on other planets?]

(D) describe the connection between astronomy and future careers; and [Slides 3-5, 48: Discuss how successful and creative research can influence the economy, job market, funding for projects, etc.]

(E) research and describe the history of astronomy and contributions of scientists. [Slides 23, 45-46 to discuss how inferences can lead to new discoveries and theories.]

(5) Science concepts. 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. [Slide 6: Review the current theory of solar system and planetary formation:Refer Slides 32-47:

Review current data and interpretations of this data. Refer to slides 11-13 for discussion of an elliptical orbit. Slides 44, 46-47: How do other solar systems differ from ours?]

(6) Science concepts. The student knows the characteristics and the 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; and [Slides 8-9, 11-13, 22, 27, 29 discuss characteristics of planets and stars.]

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

(A) demonstrate the use of units of measurement in astronomy such as light year and Astronomical Units; [Slide 23: How are different measurements used in gathering data? Slides 25 & 28 provide examples of varying distances using Astronomical Units. How many milliarcsecs are there in one degree? Have students convert some of the measurements presented in slides 23, 25, 29 into more familiar units (e.g. AU to miles).]

(B) research and describe the historical development of the laws of universal gravitation and planetary motion and the theory of special relativity; [Refer to slides 11-13 for discussion of an elliptical orbit.]

(C) analyze a model that simulates planetary motion and universal gravitation; [Refer to slide 20, and relate the size of the star and planet to the definition of gravitation, and how one effects the other. Refer to slides 11-13 for discussion of an elliptical orbit.]

(9) Science concepts. The student knows that planets of different size, composition, and surface features orbit around the Sun. The student is expected to:

(B) compare the planets in terms of orbit, size, composition, rotation, atmosphere, moons, and geologic activity; [Slide 8 has the definition of a planet. Refer to slides 11-13 for discussion of an elliptical orbit. Slides 37-39, 46-47 provide insight on eccentricities of the planets in our solar system in comparison to other systems (slide 42 goes into further detail about eccentric orbits).]

Source: The provisions of this §112.2 - §112.48 adopted to be effective September 1, 1998, 22 TexReg 7647.