

Environmental Science Institute  
The University of Texas at Austin  
**Supermassive Black Holes**  
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This file contains suggestions for how to incorporate the material from this CDROM into curriculum using the Texas Essential Knowledge and Skills for Science.

**§112.2. Science, Kindergarten**

(K.5) Science concepts. The student knows that organisms, objects, and events have properties and patterns. The student is expected to:

(A) describe properties of objects and characteristics of organisms; [Slides 4, 6 & 31 – Describe the characteristics of the objects and discuss what they are. Slides 24, 25, 26 & 27 – Describe the characteristics of these black holes.]

(K.7) Science concepts. The student knows that many types of change occur. The student is expected to:

(A) observe, describe, and record changes in size, mass, color, position, quantity, time, temperature, sound, and movement; [A possibility would be to have a trip to the planetarium to view the solar system and have the students questions answered there.]

**§112.3. Science, Grade 1**

(1.2) 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; [Have the students ask questions about stars and the solar system.]

(D) construct reasonable explanations and draw conclusions; and [A possibility would be to have a trip to the planetarium to view the solar system and have the students questions answered there.]

(1.7) Science concepts. The student knows that many types of change occur. The student is expected to:

(A) observe, measure, and record changes in size, mass, color, position, quantity, sound, and movement; [Have students observe stars and record changes in them.]

#### **§112.4. Science, Grade 2.**

(2.2) 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; [Have the students ask questions about stars and the solar system.]

(E) construct reasonable explanations and draw conclusions using information and prior knowledge; and [A possibility would be to have a trip to the planetarium to view the solar system and have the students questions answered there.]

(2.5) Science concepts. The student knows that organisms, objects, and events have properties and patterns. The student is expected to:

(A) classify and sequence organisms, objects, and events based on properties and patterns; and [Slides 4, 6 & 31 – Describe the characteristics of the objects and discuss what they are. Slides 24, 25, 26 & 27 – Describe the characteristics of these black holes.]

#### **§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; [Have the students form well-defined questions about the stars and if a telescope is available let the students take a closer look at the sky. A good idea would be a trip to the planetarium to get a better view.]

(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 7]

#### **§112.6. Science, Grade 4.**

(4.2) 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;

(B) collect information by observing and measuring; [Have the students collect their data by observing stars through a telescope as well as researching their topic.]

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence;

(E) construct simple graphs, tables, maps, and charts to organize, examine, and evaluate information. . [Refer to slides 18 & 32]

(4.6) Science concepts. The student knows that change can create recognizable patterns. The student is expected to:

(B) illustrate that certain characteristics of an object can remain constant even when the object is rotated like a spinning top, translated like a skater moving in a straight line, or reflected on a smooth surface; and [Slide 4 – The Earth remains constant even though it is continuously rotating. Why is this so?]

### **§112.7. Science, Grade 5.**

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

(A) plan and implement descriptive and simple experimental investigations including asking well-defined questions, formulating testable hypotheses, and selecting and using equipment and technology;

(B) collect information by observing and measuring; [Have the students collect their data by observing stars through a telescope as well as researching their topic.]

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence;

(E) construct simple graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate information. [Refer to slides 18 & 32]

(5.11) Science concepts. The student knows that certain past events affect present and future events. The student is expected to:

(A) identify and observe actions that require time for changes to be measurable, including growth, erosion, dissolving, weathering, and flow; [For example, the movement of stars.]

(5.12) 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 physical characteristics of the Earth and compare them to the physical characteristics of the moon; and [Slides 4 & 20 –How are they alike and how do they differ? Which one is bigger?]

(D) identify gravity as the force that keeps planets in orbit around the Sun and the moon in orbit around the Earth. [Refer to slide 3 & 7]

## **§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; [Have the students form questions about space they want answered and if telescope is available have the students investigate their topic.]

(B) collect data by observing and measuring; [Have the students collect their data by observing stars through a telescope as well as researching their topic.]

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence; [Have the students analyze their findings.]

(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data. [Slides 18 & 32 – Have the students make a chart or graph of their data either on a computer or by hand.]

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

(A) identify and describe a system that results from the combination of two or more systems such as in the solar system; and [Slides 45-48 – Discuss how bulgeless galaxies do not contain a black hole.]

(6.13) Science concepts. The student knows components of our solar system. The student is expected to:

(A) identify characteristics of objects in our solar system including the Sun, planets, meteorites, comets, asteroids, and moons; and [Slides 7, 24 - 27 – Discuss the characteristics of a black hole and how they differ from other objects in space.]

### **§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; [Have the students form questions about space they want answered and if a telescope is available have the students investigate their topics.]

(B) collect data by observing and measuring; [Have the students collect their data by observing stars through a telescope if one is available as well as researching their topic.]

(C) organize, analyze, make inferences, and predict trends from direct and indirect evidence; [Have the students analyze their findings.]

(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data. [Slides 18 & 32– Have the students make a chart or graph of their data either on a computer or by hand.]

### **§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 11, 12, & 13 – Discuss why jets imply black holes.]

(B) collect data by observing and measuring; [Have the students collect data by observing stars through a telescope if one is available as well as researching their topic.]

(C) organize, analyze, evaluate, make inferences, and predict trends from direct and indirect evidence; [Have the students analyze their findings.]

(D) communicate valid conclusions; and [Have the students present their findings to the class making sure their conclusions are valid.]

(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data. [Slides 18 & 32 – Have the students make a chart or graph of their data either on a computer or by hand.]

(8.13) Science concepts. The student knows characteristics of the universe. The student is expected to:

(A) describe characteristics of the universe such as stars and galaxies; [Slides 6, 19, 25, 26, 47, 48 – Describe the characteristics of these stars, black holes, and galaxies. What do they have in common? How do they differ?]

(B) explain the use of light years to describe distances in the universe; [Slide 13, 32, 50 – Relate these distances to the speed of light; relate these distances and compare them to objects and distances closer to our scale and understanding of distances.]

#### **§112.42. Integrated Physics and Chemistry.**

(4) Science concepts. The student knows concepts of force and motion evident in everyday life. The student is expected to:

(B) investigate and describe applications of Newton's laws such as in vehicle restraints, sports activities, geological processes, and satellite orbits; [Slide 3 – compare Earth's gravity to that of what would be required for Earth to become a black hole.]

(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 44 – Relate this to our solar system; Slide 47 – Interesting correlation between galactic nuclei and black holes; Slide 51 – Relate properties of galaxies (bulge component) and black holes]

#### **§112.47. Physics.**

(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; [Slide 3 – Use the models of gravitation as an example]

#### **§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 equipment and technology; [Slides 11, 12 & 13 – Why do jets imply black holes? Have student formulate questions, and think about what equipment and technology would be used to answer them.]

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

(E) research and describe the history of astronomy and contributions of scientists. [Slides 8 & 10 – Discuss past scientist's contributions to astronomy.]

(4) Science concepts. The student knows scientific information about the universe. The student is expected to:

(B) describe characteristics of galaxies. [Slides 6, 19, 24-27, 30, 43, 48, 50 – Examples of different types of galaxies.]

(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:

(E) analyze the impact of the space program on the collection of data about the Earth and the universe. [Slide 28 – Picture of the Space Hubble Telescope, which has given us pictures and information about the Earth and the universe.]