

Environmental Science Institute

The University of Texas at Austin

I Spy... Seeing Our Environment in a New Light

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

112.7. Science, Grade 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; **What types of phenomena do scientists study with remote sensing? What questions are they asking and hypotheses are they testing?** (Slides 3, 6-13, 32-52) **What equipment do remote sensing analysts use?** (Slides 2, 4, 14-16). **What are AVHRR, Landsat, and QuickBird (IKONOS)?** (Slides 16, 24) **What is the difference between a passive and an active sensor? Why would you select one type of sensor or the other?** (Slides 16, 48) **What is GPS?** (Slide 42) **What types of questions about your neighborhood would you ask with remote sensing technology?** (Slides 4,18, 20) **How is the image created from remote sensing different from a picture?** (Slide 18-24) **What are the advantages and disadvantages of using the global positioning system to reflect the natural world as opposed to a single plane taking aerial pictures?** (Slides 7, 42)

(B) collect information by observing and measuring; **How is remote sensing an extension of our senses?** (Web Link http://rst.gsfc.nasa.gov/Intro/Part2_1.html) **What information are we collecting when we use remote sensing? What are we measuring?** (Slides 16-17, 25-26) **What is precision? What is resolution? Why would anyone want to use information that is not “perfectly” precise?** (Slide 24)

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence; **What does it mean to analyze and interpret**

information? (Slide 31) Why is human knowledge so important (why can't computers do all the work)? (Slide 30)

(D) communicate valid conclusions; What types of products are produced using remote sensing? Have you used any of these products? (Slides 2-15, 20-24)

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

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; Why do scientists believe that remote sensing can give us valid information about the environment? Slides (14-17)

(C) represent the natural world using models and identify their limitations; How are scientists today using computers and information technology to gather information and create a model of the world around us? (Slide 30) What are the advantages and disadvantages of using remote sensing images to interpret the environment? (Slides 7, 24)

(D) evaluate the impact of research on scientific thought, society, and the environment; Why is remote sensing a valued tool for scientific research today? (Slide 43) What types of applications is remote sensing used for that show the relationships between society and the environment? (Slides 3, 6-12, 32-52)

(4) Scientific processes. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to:

(A) collect and analyze information using tools including calculators, microscopes, cameras, sound recorders, computers, hand lenses, rulers, thermometers, compasses, balances, hot plates, meter sticks, timing devices, magnets, collecting nets, and safety goggles; and How are these instruments "sensing" the earth? Which of these instruments sense the earth "remotely" and which do not? (Slide 14)

(7) Science concepts. The student knows that matter has physical properties. The student is expected to:

(A) classify matter based on its physical properties including magnetism, physical state, and the ability to conduct or insulate heat, electricity, and sound; How does remote sensing use the physical properties of matter to gain useful information about the earth and objects around us? (Slides 14-17, 25) Remote sensing can differentiate between different types of vegetation, water and rock formations. Objects of different physical properties reflect light in different and specific ways. (Slide 25)

(8) Science concepts. The student knows that energy occurs in many forms. The student is expected to:

(A) differentiate among forms of energy including light, heat, electrical, and solar energy; **What form of energy do remote sensing instruments use to gather information? Where does the energy come from? (Slides 16-17)**

(B) identify and demonstrate everyday examples of how light is reflected, such as from tinted windows, and refracted, such as in cameras, telescopes, and eyeglasses; **How does remote sensing use reflected light? How is the perspective of remote sensing different than the perspective from a camera, telescope or eyeglasses? (Slide 16, 42)**

(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; **Remote sensing can observe changes that happen over an extended period of time due to human-environment interactions. (Slide 43-45)**

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

(A) interpret how land forms are the result of a combination of constructive and destructive forces such as deposition of sediment and weathering; **What information do remote sensing instruments give us about land forms? (Slides 6, 8, 9, 35)**

112.22. Science, Grade 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; **What do scientists study with remote sensing? What can they find out about the world using remote sensing? Do you think this important? (Slides 3, 6-13,32-52). What is a remote sensor? Do you think you have ever used one? (Slides 14-16) What equipment do remote sensing analysts use? (Slides 2, 4, 14-16). What is GPS? Have you ever used GPS? (Slide 42) What types of questions about your neighborhood would you ask and answer with remote sensing technology? (Slides 4,18,20) Many more activities useful for middle schools, see the Event-Based Science Remote Sensing Activities page at <http://www.mcps.k12.md.us/departments/eventscience/rs.index.html>**

(B) collect data by observing and measuring; What data are we collecting when we use remote sensing? What are we measuring? (Slides 16-17, 25-26) When you use a camera what are you recording, what are you measuring?

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence; How is the information in an image analyzed and interpreted? Is there only one way to view the information in an image or can we view it different ways? Does this help us to get different information from the same image that we are interested in? (Slides 16-25)

(D) communicate valid conclusions; What types of products are produced using remote sensing? Have you used any of these products? (Slides 2-15, 20-24) What role does human knowledge play in making remote sensing work and communicate valid information? (Slides 27-31)

(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data. How can you use remote sensing to map the changes in urban growth in the Austin area in the last 31 years? (Slides 32, 33, 37) See the following link for some LULC sets for Texas

http://edcwww.cr.usgs.gov/glis/hyper/guide/1_250_lulcfig/states/TX.html See also the following links for many examples and activities using remote sensing and computers

<http://www.mcps.k12.md.us/departments/eventscience/rs.index.html>

112.23. Science, Grade 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; What do scientists study with remote sensing? What can they find out about the world using remote sensing? Do you think this important? (Slides 3, 6-13,32-52). What is a remote sensor? Do you think you have ever used one? (Slides 14-16) What equipment do remote sensing analysts use? (Slides 2, 4, 14-16). What is GPS? Have you ever used GPS? (Slide 42) What types of questions about your neighborhood would you ask and answer with remote sensing technology? (Slides 4,18,20) Many more activities useful for middle schools, see the Event-Based Science Remote Sensing Activities page at <http://www.mcps.k12.md.us/departments/eventscience/rs.index.html>

(B) collect data by observing and measuring; What data are we collecting when we use remote sensing? What are we measuring? (Slides 16-17, 25-26) When you use a camera what are you recording, what are you measuring?

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence; **How is the information in an image analyzed and interpreted? Is there only one way to view the information in an image or can we view it different ways? Does this help us to get different information from the same image that we are interested in? (Slides 16-25)**

(D) communicate valid conclusions; **What types of products are produced using remote sensing? Have you used any of these products? (Slides 2-15, 20-24) What role does human knowledge play in making remote sensing work and communicate valid information? (Slides 27-31)**

(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data. **How can you use remote sensing to map the changes in urban growth in the Austin area in the last 31 years? (Slides 32, 33, 37) See the following link for some LULC sets for Texas http://edcwww.cr.usgs.gov/glis/hyper/guide/1_250_lulcfig/states/TX.html See also the following links for many examples and activities using remote sensing and computers <http://www.mcps.k12.md.us/departments/eventscience/rs.index.html>**

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

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; **What theories form the basis for remote sensing? (Slides 16-19, 21-26) Why do scientists believe that remote sensing can give us valid information about the environment? (Slides 14-17)**

(C) represent the natural world using models and identify their limitations; **Remote sensing uses the concept of electromagnetic (EM) radiation and how EM radiation interacts with objects in order to gather information about the world. What is electromagnetic radiation? How are different wavelengths of EM radiation used to tell us about objects and the world? (Slides 16-25)**

(D) evaluate the impact of research on scientific thought, society, and the environment; **Why is remote sensing a valued tool for scientific research today? (Slide 43) What types of applications is remote sensing used for that show the relationships between society and the environment? (Slides 3, 6-12, 32-52)**

(4) Scientific processes. The student knows how to use tools and methods to conduct science inquiry. The student is expected to:

(A) collect, analyze, and record information to explain a phenomenon using tools including beakers, petri dishes, meter sticks, graduated cylinders, weather instruments, hot plates, dissecting equipment, test tubes, safety goggles, spring

scales, balances, microscopes, telescopes, thermometers, calculators, field equipment, computers, computer probes, timing devices, magnets, and compasses; In what ways is information gathered in remote sensing? Have you ever used remote sensing? (note to teachers, photographs count, and if you have access to GPS units they are another source of remote sensing data) For ways to use computers with remote sensing see <http://www.mcps.k12.md.us/departments/eventscience/rs.index.html>

B) collect and analyze information to recognize patterns such as rates of change. Ecologists use information derived from remote sensing to describe landscapes with percentages, averages, ranges, and frequencies using pattern metrics (Slides 46-47). Can you use remote sensing to determine the percentage of your city that is urban, forest, and built? Could you use remote sensing to determine how that changes over time and rates of change? (Slides 31-34)

112.24. Science, Grade 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; What do scientists study with remote sensing? What can they find out about the world using remote sensing? Do you think this important? (Slides 3, 6-13,32-52). What is a remote sensor? Do you think you have ever used one? (Slides 14-16) What equipment do remote sensing analysts use? (Slides 2, 4, 14-16). What is GPS? Have you ever used GPS? (Slide 42) What types of questions about your neighborhood would you ask and answer with remote sensing technology? (Slides 4,18,20) Many more activities useful for middle schools, see the Event-Based Science Remote Sensing Activities page at <http://www.mcps.k12.md.us/departments/eventscience/rs.index.html>

(B) collect data by observing and measuring; What data are we collecting when we use remote sensing? What are we measuring? (Slides 16-17, 25-26) When you use a camera what are you recording, what are you measuring?

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence; How is the information in an image analyzed and interpreted? Is there only one way to view the information in an image or can we view it different ways? Does this help us to get different information from the same image that we are interested in? (Slides 16-25)

(D) communicate valid conclusions; What types of products are produced using remote sensing? Have you used any of these products? (Slides 2-15, 20-24) What role does human knowledge play in making remote sensing work and communicate valid information? (Slides 27-31)

(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data. How can you use remote sensing to map the changes in urban growth in the Austin area in the last 31 years? (Slides 32, 33, 37) See the following link for some LULC sets for Texas http://edcwww.cr.usgs.gov/glis/hyper/guide/1_250_lulcfig/states/TX.html See also the following links for many examples and activities using remote sensing and computers <http://www.mcps.k12.md.us/departments/eventscience/rs.index.html>

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

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; What theories form the basis for remote sensing? (Slides 16-19, 21-26) Why do scientists believe that remote sensing can give us valid information about the environment? (Slides 14-17)

(C) represent the natural world using models and identify their limitations; Remote sensing uses the concept of electromagnetic (EM) radiation and how EM radiation interacts with objects in order to gather information about the world. What is electromagnetic radiation? How are different wavelengths of EM radiation used to tell us about objects and the world? (Slides 16-25)

(D) evaluate the impact of research on scientific thought, society, and the environment; Why is remote sensing a valued tool for scientific research today? (Slide 43) What types of applications is remote sensing used for that show the relationships between society and the environment? (Slides 3, 6-12, 32-52)

4) Scientific processes. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to:

(A) collect, record, and analyze information using tools including beakers, petri dishes, meter sticks, graduated cylinders, weather instruments, hot plates, dissecting equipment, test tubes, safety goggles, spring scales, balances, microscopes, telescopes, thermometers, calculators, field equipment, computers, computer probes, water test kits, and timing devices; In what ways is information gathered in remote sensing? Have you ever used remote sensing? (note to teachers, photographs count, and if you have access to GPS units they are another source of remote sensing data) For ways to use computers with remote sensing see <http://www.mcps.k12.md.us/departments/eventscience/rs.index.html>

(B) extrapolate from collected information to make predictions Can you use remote sensing to determine the percentage of your city that is urban, forest, and built? Could you use remote sensing to determine how that changes over time and

rates of change? Could the rates of change be used to predict how much forest will be lost in your area by 2020? (Slides 31-34, 38-41).

(6) Science concepts. The student knows that interdependence occurs among living systems. The student is expected to:

(C) describe interactions within ecosystems How does urban growth impact surrounding areas in a landscape? (Slides 33,35) How can drought effect landscapes (Slide 36). For many other ecosystem questions that can be investigated with remote sensing, see <http://www.mcps.k12.md.us/departments/eventscience/rs.index.html>

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 equipment and technology; What types of phenomena do scientists study with remote sensing? What questions are they asking and hypotheses are they testing? (Slides 3, 6-13,32-52) What equipment do remote sensing analysts use? (Slides 2, 4, 14-16). What are AVHRR, Landsat, and QuickBird (IKONOS)? (Slides 16,24) What is the difference between a passive and an active sensor? Why would you select one type of sensor or the other?(Slides 16, 48) What does GPS refer to? (Slide 42) What types of questions about your neighborhood would you ask with remote sensing technology? (Slides 4,18,20)

(B) collect data and make measurements with precision; What data are we collecting when we use remote sensing? What are we measuring? (Slides 16-17, 25-26) When people use remote sensing what types of precision are they interested in? What is more precise, AVHRR, Landsat, or QuickBird? Why? (Slide 24)

(C) organize, analyze, evaluate, make inferences, and predict trends from data; With a Landsat image how is the data organized, analyzed, and evaluated? (Slides 14-31) What does LULC stand for? Could LULC be used to predict trends in spatial patterns? (Slides 43-45).

(D) communicate valid conclusions. What types of products are produced using remote sensing? Have you used any of these products? (Slides 2-15, 20-24) Why are people needed in order to make remote sensing work and communicate valid information? (Slides 27-31)

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

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; **What theories form the basis for remote sensing? (Slides 16-19, 21-26) Why do scientists believe that remote sensing can give us valid information about the environment? Slides (14-17)**

(C) evaluate the impact of research on scientific thought, society, and the environment; **Why is remote sensing a valued tool for scientific research today? (Slide 43) What types of applications is remote sensing used for that show the relationships between society and the environment? (Slides 3, 6-12, 32-52)**

(5) Science concepts. The student knows the effects of waves on everyday life. The student is expected to:

(A) demonstrate wave types and their characteristics through a variety of activities such as modeling with ropes and coils, activating tuning forks, and interpreting data on seismic waves; **How are electromagnetic waves used to gather information about the environment using remote sensing? (Slides 14-17). What is the relationship between band and wavelength in remote sensing? (Slides 17, 19, 21-23,25-26)**

(C) identify uses of electromagnetic waves in various technological applications such as fiber optics, optical scanners, and microwaves; **With the exception of the visual part of the electromagnetic spectrum, what other parts of the spectrum are used in remote sensing and how are they also used in every day life? (Slides 12-13, 17, 19, 25)**

112.43. Biology.

(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; **What types of phenomena do scientists study with remote sensing? What questions are they asking and hypotheses are they testing? (Slides 3, 6-13,32-52) What equipment do remote sensing analysts use? (Slides 2, 4, 14-16). What are AVHRR, Landsat, and QuickBird (IKONOS)? (Slides 16,24) What is the difference between a passive and an active sensor? Why would you select one type of sensor or the other?(Slides 16, 48) What does GPS refer to? (Slide 42) What types of questions about your neighborhood would you ask with remote sensing technology? (Slides 4,18,20)**

- (B) collect data and make measurements with precision; What data are we collecting when we use remote sensing? What are we measuring? (Slides 16-17, 25-26) When people use remote sensing what types of precision are they interested in? What is more precise, AVHRR, Landsat, or QuickBird? Why? (Slide 24)
- (C) organize, analyze, evaluate, make inferences, and predict trends from data; With a Landsat image how is the data organized, analyzed, and evaluated? (Slides 14-31) What does LULC stand for? Could LULC be used to predict trends in spatial patterns? (Slides 43-45).
- (D) communicate valid conclusions. What types of products are produced using remote sensing? Have you used any of these products? (Slides 2-15, 20-24) Why are people needed in order to make remote sensing work and communicate valid information? (Slides 27-31)
- (3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
- (A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; What theories form the basis for remote sensing? (Slides 16-19, 21-26) Why do scientists believe that remote sensing can give us valid information about the environment? Slides (14-17)
- (C) evaluate the impact of research on scientific thought, society, and the environment; Why is remote sensing a valued tool for scientific research today? (Slide 43) What types of applications is remote sensing used for that show the relationships between society and the environment? (Slides 3, 6-12,32-52)
- (D) describe the connection between biology and future careers; What types of biological careers would remote sensing be useful for? What aspects of ecology have and could be addressed with remote sensing technologies (Slides 32-34, 36-41, 43-47).
- (E) evaluate models according to their adequacy in representing biological objects or events; How landscapes change over time is very important for ecologists as are the human impacts on environments. How is remote sensing used to investigate the event of land use change over time? (Slides 32, 34-40, 43-45)
- (12) Science concepts. The student knows that interdependence and interactions occur within an ecosystem. The student is expected to:

(D) identify and illustrate that long-term survival of species is dependent on a resource base that may be limited; **How can remote sensing tell us how a landscape is changing and how that might impact a species?** (Slides 32-37, 43-47)

112.44. Environmental Systems

(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; **What types of phenomena do scientists study with remote sensing? What questions are they asking and hypotheses are they testing?** (Slides 3, 6-13,32-52) **What equipment do remote sensing analysts use?** (Slides 2, 4, 14-16). **What are AVHRR, Landsat, and QuickBird (IKONOS)?** (Slides 16,24) **What is the difference between a passive and an active sensor? Why would you select one type of sensor or the other?**(Slides 16, 48) **What does GPS refer to?** (Slide 42) **What types of questions about your neighborhood would you ask with remote sensing technology?** (Slides 4,18,20)

(B) collect data and make measurements with precision; **What data are we collecting when we use remote sensing? What are we measuring?** (Slides 16-17, 25-26) **When people use remote sensing what types of precision are they interested in? What is more precise, AVHRR, Landsat, or QuickBird? Why?** (Slide 24)

(C) organize, analyze, evaluate, make inferences, and predict trends from data; **With a Landsat image how is the data organized, analyzed, and evaluated?** (Slides 14-31) **What does LULC stand for? Could LULC be used to predict trends in spatial patterns?** (Slides 43-45).

(D) communicate valid conclusions. **What types of products are produced using remote sensing? Have you used any of these products?** (Slides 2-15, 20-24) **Why are people needed in order to make remote sensing work and communicate valid information?** (Slides 27-31)

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

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; **What theories form the basis for remote sensing?** (Slides 16-19, 21-26) **Why do scientists believe that remote sensing can give us valid information about the environment?** Slides (14-17)

(C) evaluate the impact of research on scientific thought, society, and the environment; **Why is remote sensing a valued tool for scientific research today? (Slide 43) What types of applications is remote sensing used for that show the relationships between society and the environment? (Slides 3, 6-12, 32-52)**

(5) Science concepts. The student knows the interrelationships among the resources within the local environmental system. The student is expected to:

(A) summarize methods of land use and management; **What information do remote sensing images give us about land use (Slides 21, 32-41)?**

(B) identify source, use, quality, and conservation of water; **How do remote sensing images help identify and classify bodies of water (Slide 6)?**

(8) Science concepts. The student knows that environments change. The student is expected to:

(A) analyze and describe the effects on environments of events such as fires, hurricanes, deforestation, mining, population growth, and municipal development. **What effects of fires, municipal development and deforestation appear in remote sensing images (Slides 10, 11, 32-38)? What methods have scientists used to describe these effects (changes) (Slide 30, 43, 46-47)? Is remote sensing a “sensible” method for examining sudden events? Why or why not (Slide 7)?**

(C) describe how communities have restored an ecosystem **Slides 44-45 – How do remote sensing images show evidence of restoration? How might remote sensing images help decision makers target areas for restoration?; and**

(D) examine and describe a habitat restoration or protection program **Use the web links as a starting point for research on deforestation and climate change in Thailand. Examine the role remote sensing plays in helping scientists discover the causes of deforestation and related phenomena, such as flooding**

(5) Science concepts. The student knows the interrelationships among the resources within the local environmental system. The student is expected to:

(A) summarize methods of land use and management; **What information do remote sensing images give us about land use (Slides 21, 32-41)?**

(B) identify source, use, quality, and conservation of water; **How do remote sensing images help identify and classify bodies of water (Slide 6)?**

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(A) analyze and describe the effects on environments of events such as fires, hurricanes, deforestation, mining, population growth, and municipal development. What effects of fires, municipal development and deforestation appear in remote sensing images (Slides 10, 11, 32-38)? What methods have scientists used to describe these effects (changes) (Slide 30, 43, 46-47)? Is remote sensing a “sensible” method for examining sudden events? Why or why not (Slide 7)?

(C) describe how communities have restored an ecosystem Slides 44-45 – How do remote sensing images show evidence of restoration? How might remote sensing images help decision makers target areas for restoration?; and

(D) examine and describe a habitat restoration or protection program Use the web links as a starting point for research on deforestation and climate change in Thailand. Examine the role remote sensing plays in helping scientists discover the causes of deforestation and related phenomena, such as flooding

112.45. 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 equipment and technology; What types of phenomena do scientists study with remote sensing? What questions are they asking and hypotheses are they testing? (Slides 3, 6-13,32-52) What equipment do remote sensing analysts use? (Slides 2, 4, 14-16). What are AVHRR, Landsat, and QuickBird (IKONOS)? (Slides 16,24) What is the difference between a passive and an active sensor? Why would you select one type of sensor or the other?(Slides 16, 48) What does GPS refer to? (Slide 42) What types of questions about your neighborhood would you ask with remote sensing technology? (Slides 4,18,20)

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(C) organize, analyze, evaluate, make inferences, and predict trends from data; With a Landsat image how is the data organized, analyzed, and evaluated? (Slides 14-31) What does LULC stand for? Could LULC be used to predict trends in spatial patterns? (Slides 43-45).

(D) communicate valid conclusions. What types of products are produced using remote sensing? Have you used any of these products? (Slides 2-15, 20-24) Why are people needed in order to make remote sensing work and communicate valid information? (Slides 27-31)

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

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; What theories form the basis for remote sensing? (Slides 16-19, 21-26) Why do scientists believe that remote sensing can give us valid information about the environment? Slides (14-17)

(C) evaluate the impact of research on scientific thought, society, and the environment; Why is remote sensing a valued tool for scientific research today? (Slide 43) What types of applications is remote sensing used for that show the relationships between society and the environment? (Slides 3, 6-12, 32-52)

112.46. Aquatic Science

(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; What types of phenomena do scientists study with remote sensing? What questions are they asking and hypotheses are they testing? (Slides 3, 6-13,32-52) What equipment do remote sensing analysts use? (Slides 2, 4, 14-16). What are AVHRR, Landsat, and QuickBird (IKONOS)? (Slides 16,24) What is the difference between a passive and an active sensor? Why would you select one type of sensor or the other?(Slides 16, 48) What does GPS refer to? (Slide 42) What types of questions about your neighborhood would you ask with remote sensing technology? (Slides 4,18,20)

(B) collect data and make measurements with precision; What data are we collecting when we use remote sensing? What are we measuring? (Slides 16-17, 25-26) When people use remote sensing what types of precision are they interested in? What is more precise, AVHRR, Landsat, or QuickBird? Why? (Slide 24)

(C) organize, analyze, evaluate, make inferences, and predict trends from data; With a Landsat image how is the data organized, analyzed, and evaluated? (Slides 14-31) What does LULC stand for? Could LULC be used to predict trends in spatial patterns? (Slides 43-45).

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

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; What theories form the basis for remote sensing? (Slides 16-19, 21-26) Why do scientists believe that remote sensing can give us valid information about the environment? Slides (14-17)

(C) evaluate the impact of research on scientific thought, society, and the environment; Why is remote sensing a valued tool for scientific research today? (Slide 43) What types of applications is remote sensing used for that show the relationships between society and the environment? (Slides 3, 6-12, 32-52)

(D) describe the connection between aquatic science and future careers How can knowledge of remote sensing better prepare you for a career in aquatic science? What are some applications of remote sensing to aquatic sciences you have seen or you can think of? (Slides 6, 32, 35, 39,42,45-46)

(5) Science concepts. The student knows the relationships within and among the aquatic habitats and ecosystems in an aquatic environment. The student is expected to:

(A) observe and compile data over a period of time from an established aquatic habitat documenting seasonal changes and the behavior of organisms; Can remote sensing be used to detect annual sea surface temperature change and also the onset of El Nino and La Nina episodes? See http://rst.gsfc.nasa.gov/Sect14/Sect14_11.html

(B) observe and evaluate patterns and interrelationships among producers, consumers, and decomposers in an aquatic ecosystem; Can remote sensing be used to detect the spatial foodweb patterns in oceanic waters? How could remote sensing of ocean waters benefit fishermen? See http://www.dgl.salemstate.edu/Profs/Young/RS-final/Fishing/html_files/main.htm

(6) Science concepts. The student knows the roles of cycles in an aquatic environment. The student is expected to:

(B) interpret the role of aquatic systems in climate and weather; How do ocean currents, movement of air over oceans, and global climate and weather relate to one another? See http://www.jpl.nasa.gov/earth/ocean_motion/ocean_motion_index.cfm

(C) collect and evaluate global environmental data using technology. **What types of global environmental processes and parameters are being investigated and measured using remote sensing technology?** (Slides 6-12, 32-47, see also <http://www.ciesin.org/TG/RS/RS-home.html>)

(8) Science concepts. The student knows that aquatic environments change. The student is expected to:

(A) predict effects of chemical, organic, physical, and thermal changes on the living and nonliving components of an aquatic ecosystem; **How is remote sensing used to examine the links between thermal changes and the living and nonliving components of an aquatic ecosystem?** See http://rst.gsfc.nasa.gov/Sect14/Sect14_11.html

(B) analyze the cumulative impact of natural and human influence on an aquatic system; **Can remote sensing be used to show changes in aquatic systems over time and relate these to human changes in the surrounding landscape?** (Slides 34-35, 37-38, see also <http://www.ciesin.org/TG/RS/RS-home.html>)

(C) identify and describe a local or global issue affecting an aquatic system; See <http://www.ciesin.org/TG/RS/RS-home.html>

(D) analyze and discuss human influences on an aquatic environment including fishing, transportation, and recreation. See <http://www.ciesin.org/TG/RS/RS-home.html> and http://www.dgl.salemstate.edu/Profs/Young/RS-final/Fishing/html_files/main.htm

112.47. Physics

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; **What types of phenomena do scientists study with remote sensing? What questions are they asking and hypotheses are they testing?** (Slides 3, 6-13,32-52) **What equipment do remote sensing analysts use?** (Slides 2, 4, 14-16). **What are AVHRR, Landsat, and QuickBird (IKONOS)?** (Slides 16,24) **What is the difference between a passive and an active sensor? Why would you select one type of sensor or the other?**(Slides 16, 48) **What does GPS refer to?** (Slide 42) **What types of questions about your neighborhood would you ask with remote sensing technology?** (Slides 4,18,20)

(B) collect data and make measurements with precision; **What data are we collecting when we use remote sensing? What are we measuring?** (Slides 16-17, 25-26) **When people use remote sensing what types of precision are they**

interested in? What is more precise, AVHRR, Landsat, or QuickBird? Why? (Slide 24)

(C) organize, analyze, evaluate, make inferences, and predict trends from data; With a Landsat image how is the data organized, analyzed, and evaluated? (Slides 14-31) What does LULC stand for? Could LULC be used to predict trends in spatial patterns? (Slides 43-45).

(D) communicate valid conclusions. What types of products are produced using remote sensing? Have you used any of these products? (Slides 2-15, 20-24) Why are people needed in order to make remote sensing work and communicate valid information? (Slides 27-31)

(E) graph data to observe and identify relationships between variables; How can pattern metric graph analysis show the relationships between the physical landscape and characteristics important to organisms that live there? (Slides 46-47)

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

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; What theories form the basis for remote sensing? (Slides 16-19, 21-26) Why do scientists believe that remote sensing can give us valid information about the environment? Slides (14-17)

(C) evaluate the impact of research on scientific thought, society, and the environment; Why is remote sensing a valued tool for scientific research today? (Slide 43) What types of applications is remote sensing used for that show the relationships between society and the environment? (Slides 3, 6-12,32-52)

(D) describe the connection between physics and future careers; In what ways can training in physics aid a career in remote sensing, in what ways can expertise in remote sensing be used in physics research? (Slides 16-17, 25) see also http://www.scientecmatrix.com/seghers/tecma/scientecmatrix.nsf/_/039CD00E63851C37C1256B9000403993

(8) Science concepts. The student knows the characteristics and behavior of waves. The student is expected to:

(A) examine and describe a variety of waves propagated in various types of media and describe wave characteristics such as velocity, frequency, amplitude, and behaviors such as reflection, refraction, and interference; How are electromagnetic waves used to gather information about the environment using remote sensing? (Slides 14-17). What is the relationship between band and

wavelength in remote sensing? (Slides 17, 19, 21-23,25-26). What is the importance of behaviors such as reflection, refraction, and interference in remote sensing? (Slide 16) see also http://rst.gsfc.nasa.gov/Intro/Part2_4.html

(B) identify the characteristics and behaviors of sound and electromagnetic waves; How are the behaviors of electromagnetic waves used in remote sensing? (Slides 16-23).

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

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

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; What theories form the basis for remote sensing? (Slides 16-19, 21-26) Why do scientists believe that remote sensing can give us valid information about the environment? (Slides 14-17)

(C) evaluate the impact of research on scientific thought, society, and the environment; Why is remote sensing a valued tool for scientific research today? (Slide 43) What types of applications is remote sensing used for that show the relationships between society and the environment? (Slides 3, 6-12, 32-52)

(D) describe the connection between astronomy and future careers; How has remote sensing contributed to the development of astronomy? Are the tools that astronomers use to explore our solar system, our galaxy, other galaxies, other planets, and other phenomena remote sensing instruments? (Slides 3, 12) See also http://cse.ssl.berkeley.edu/IU/ISTAT/astroSS/space_exploration.html

112.49. Geology, Meteorology, and Oceanography

(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; What

types of phenomena do scientists study with remote sensing? What questions are they asking and hypotheses are they testing? (Slides 3, 6-13,32-52) What equipment do remote sensing analysts use? (Slides 2, 4, 14-16). What are AVHRR, Landsat, and QuickBird (IKONOS)? (Slides 16,24) What is the difference between a passive and an active sensor? Why would you select one type of sensor or the other?(Slides 16, 48) What does GPS refer to? (Slide 42) What types of questions about your neighborhood would you ask with remote sensing technology? (Slides 4,18,20)

(B) collect data and make measurements with precision; What data are we collecting when we use remote sensing? What are we measuring? (Slides 16-17, 25-26) When people use remote sensing what types of precision are they interested in? What is more precise, AVHRR, Landsat, or QuickBird? Why? (Slide 24)

(C) organize, analyze, evaluate, make inferences, and predict trends from data; With a Landsat image how is the data organized, analyzed, and evaluated? (Slides 14-31) What does LULC stand for? Could LULC be used to predict trends in spatial patterns? (Slides 43-45).

(D) communicate valid conclusions. What types of products are produced using remote sensing? Have you used any of these products? (Slides 2-15, 20-24) Why are people needed in order to make remote sensing work and communicate valid information? (Slides 27-31)

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

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; What theories form the basis for remote sensing? (Slides 16-19, 21-26) Why do scientists believe that remote sensing can give us valid information about the environment? Slides (14-17)

(C) evaluate the impact of research on scientific thought, society, and the environment; Why is remote sensing a valued tool for scientific research today? (Slide 43) What types of applications is remote sensing used for that show the relationships between society and the environment? (Slides 3, 6-12, 32-52)

(6) Science concepts. The student knows the processes of plate tectonics Use the Remote Sensing Tutorial (http://rst.gsfc.nasa.gov/Sect2/Sect2_2.html) to investigate how remote sensing images and photographs can be used to study plate movement and crust deformation.:

(7) Science concepts. The student knows the origin and composition of minerals and rocks and the significance of the rock cycle Slides 16, 17, 25 – How do remote sensing

methods help distinguish mineral and rock formations? What properties of rocks and minerals might remote sensing images reveal?

(12) Science concepts. The student knows the characteristics of the atmosphere. The student is expected to:

(A) identify the atmosphere as a mixture of gases, water vapor, and particulate matter What effect does the atmosphere have on the quality of remote sensing data? Does the quality of data depend on the sensor's location with respect to the earth's atmosphere? Why or why not?

113.34. World Geography Studies

(8) Geography. The student uses geographic tools to collect, analyze, and interpret data. The student is expected to:

(A) create thematic maps, graphs, charts, models, and databases representing various aspects of the United States Slides 6,8,9 - When you are creating a map, how do you decide which features to include? Consider the difference between a map and an image. Maps show selected information to provide a tool for a specific purpose such as navigating the highway system (a road map) or identifying political boundaries (a political map). What details are shown in remote sensing images that are left out of these types of maps and why? What details shown in a remote sensing image might help create maps (sizes, relative locations, shapes of natural or man-made features)? Slides 19-23, 49, 51 – What unique information does each image of the UT campus provide? How might you use the information in these images to create a map of the UT campus? Are there any images you wouldn't use? Why or why not?

(B) pose and answer questions about geographic distributions and patterns shown on maps, graphs, charts, models, and databases Slides 32-47 Dr. Crews-Meyer describes the settlement pattern in slide 39 as a “piano-key” pattern. What other analogies can you think of to describe this pattern? What political factors affected this geographic distribution? Why is the landscape pattern shown in slide 41 different from the pattern shown in slide 39? Slide 37, 46, 47 - Why is important to understand spatial patterns and their causes? What useful information do patterns provide about how and why landscapes change over time?

(9) Geography. The student understands the impact of geographic factors on major events. The student is expected to:

(A) analyze the effects of physical and human geographic factors on major events including the building of the Panama Canal Slide 35 – How might the location of major developments in Austin affect this region's ecosystem? Consider the forest ecosystem, and changes in vegetation (native or invasive?). Also consider the Edwards aquifer ecosystem, and the quality of water in Barton Springs and the

Colorado River. Slide 44-45 – How do the locations of rivers and other geographic or topographic features affect deforestation in Thai forests?

(B) identify and explain reasons for changes in political boundaries such as those resulting from statehood and international conflicts Slide 39 – How might this settlement pattern affect the location and shape of political or economic boundaries? Slide 41 – How might this settlement pattern affect the location and shape of political or economic boundaries? How and why is this pattern different from the pattern in slide 39?

(11) Geography. The student understands the relationship between population growth and modernization on the physical environment. The student is expected to:

(A) identify the effects of population growth and distribution and predict future effects on the physical environment Slide 35 - How has population growth in Austin affected the physical environment? Based on these changes, what do you think will happen if growth continues? What regulations, restrictions, incentives or other policies would you consider if you were responsible for planning urban growth in Austin?

(B) trace the development of the conservation of natural resources, including the establishment of the National Park System and efforts of private nonprofit organizations Slides 44-45 – Identify the stages of deforestation and reclamation present in the region shown. How are these stages distributed? What geographic factors affect this distribution?