

Environmental Science Institute

The University of Texas at Austin

The Exotic World of Bats

Dr. George D. Pollak

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

[§112.2. Science, Kindergarten.](#)

[§112.3. Science, Grade 1.](#)

[§112.4. Science, Grade 2.](#)

[§112.5. Science, Grade 3.](#)

[§112.6. Science, Grade 4.](#)

[§112.7. Science, Grade 5.](#)

[§112.22. Science, Grade 6.](#)

[§112.23. Science, Grade 7.](#)

[§112.24. Science, Grade 8.](#)

[§112.42. Integrated Physics and Chemistry.](#)

[§112.43. Biology.](#)

[§112.44. Environmental Systems.](#)

[§112.45. Chemistry.](#)

[§112.46. Aquatic Science.](#)

[§112.47. Physics.](#)

[§112.48. Astronomy.](#)

[§112.49. Geology, Meteorology, and Oceanography.](#)

§112.2. Science, Kindergarten.

(K.1) Scientific processes. The student participates in classroom and field investigations following home and school safety procedures. The student is expected to:

(A) demonstrate safe practices during classroom and field investigations;
and

Barbara French holds a bat carefully (slide 40).

(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;

How do animals see the world differently from people? (slide 5-9)

How can a bat hunt in the dark? (slide 14-16)

(B) plan and conduct simple descriptive investigations;

Discover the varied diet of bats by looking at slides 19-32.

(C) gather information using simple equipment and tools to extend the senses;

(D) construct reasonable explanations using information; and

(E) communicate findings about simple investigations.

See [Lesson Plans](#) file for inquiry and lab ideas.

(K.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;

Bats live under bridges and in caves. Why would they like to live here?
(slide 39)

(B) discuss and justify the merits of decisions; and

-Habitat provides shelter so they can sleep during the day.

-Habitat provides safety from predators.

(C) explain a problem in his/her own words and propose a solution.

Bats are active at night. It is very hard to see at night. Bats need another way to “see” at night. (slide 14-15)

(K.6) Science concepts. The student knows that systems have parts and are composed of organisms and objects. The student is expected to:

(C) record observations about parts of animals including wings, feet, heads, and tails;

Draw pictures of bats and label the parts. (slide 17)

(K.9) Science concepts. The student knows that living organisms have basic needs. The student is expected to:

(A) identify basic needs of living organisms;

What do bats need? Food, shelter (slide 16-39)

(B) give examples of how living organisms depend on each other; and

Some bats need to eat fruit (slide 32). These bats may help spread the seeds of the fruit.

(C) identify ways that the Earth can provide resources for life.

The Earth has caves for bats to live in (10, 36, 37). It also provides food for the bats (slides 16-39).

§112.3. Science, Grade 1.

(1.1) Scientific processes. The student conducts classroom and field investigations following home and school safety procedures. The student is expected to:

(A) demonstrate safe practices during classroom and field investigations;
and

Barbara French holds a bat carefully (slide 40).

(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;

How do animals see the world differently from people? (slide 5-9)

How can a bat hunt in the dark? (slide 14-16)

(B) plan and conduct simple descriptive investigations;

Discover the varied diet of bats by looking at slides 19-32.

(C) gather information using simple equipment and tools to extend the senses;

See [Lesson Plans](#) for inquiry and lab ideas.

(D) construct reasonable explanations and draw conclusions; and

See [Lesson Plans](#) for inquiry and lab ideas.

(E) communicate explanations about investigations.

See [Lesson Plans](#) for inquiry and lab ideas.

(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;

Bats live under bridges and in caves. Why would they like to live here? (slide 39)

(B) discuss and justify the merits of decisions; and

-Habitat provides shelter so they can sleep during the day.

-Habitat provides safety from predators.

(C) explain a problem in his/her own words and propose a solution.

Bats are active at night. It is very hard to see at night. Bats need another way to “see” at night. (slide 14-15)

(1.6) Science concepts. The student knows that systems have parts and are composed of organisms and objects. The student is expected to:

(B) observe and describe the parts of plants and animals;

Draw pictures of bats and label the parts. (slide 17)

(1.9) Science concepts. The student knows that living organisms have basic needs. The student is expected to:

(A) identify characteristics of living organisms that allow their basic needs to be met; and

Bats have really good hearing and can use echolocation to “see” things in the dark (slides 14-16).

(B) compare and give examples of the ways living organisms depend on each other for their basic needs.

Some bats need to eat fruit (slide 32). These bats may help spread the seeds of the fruit.

§112.4. Science, Grade 2.

(2.1) Scientific processes. The student conducts classroom and field investigations following home and school safety procedures. The student is expected to:

(A) demonstrate safe practices during classroom and field investigations; and

Barbara French holds a bat carefully (slide 40).

(2.3) 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;

Use information gathered from slides 16-35 to determine what bats eat.

(B) discuss and justify the merits of decisions; and

(C) explain a problem in his/her own words and identify a task and solution related to the problem.

(B) measure and compare organisms and objects and parts of organisms and objects, using standard and non-standard units.

Have students compare models and skeletons of bats and birds. What is similar? What is different? Have students compare the finger bones of bats to their own hands (slide 21).

(2.8) Science concepts. The student distinguishes between living organisms and nonliving objects. The student is expected to:

(A) identify characteristics of living organisms; and

Bats are alive. They display characteristics such as obtaining food, seeking out shelter, living in colonies, mating behavior (slides 14-45). Since they are mammals, they have fur, mammary glands and bear live young (slide 17).

(2.9) Science concepts. The student knows that living organisms have basic needs. The student is expected to:

(A) identify the external characteristics of different kinds of plants and animals that allow their needs to be met; and

Bats need to hunt at night, but they cannot see with vision at night. They use echolocation to “see” at night (slides 5, 7). Rattlesnakes can see at night using infrared sensing pits (slides 14-16).

(B) compare and give examples of the ways living organisms depend on each other and on their environments.

Some bats need to eat fruit (slide 32). These bats may help spread the seeds of the fruit.

§112.5. Science, Grade 3.

(3.1) Scientific processes. The student conducts field and laboratory investigations following home and school safety procedures and environmentally appropriate and ethical practices. The student is expected to:

(A) demonstrate safe practices during field and laboratory investigations; and

Barbara French holds a bat carefully (slide 40).

(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;

Spallanzani wondered how bats flew through the night without crashing into things. Perhaps the students also wonder about this too. Have

students plan an experiment by which they could discover what senses bats use to navigate. Maybe like Spallanzani, they will want to inhibit the bats' senses to find out which one(s) are responsible for "seeing" (slide 11).

(B) collect information by observing and measuring;

It may be hard to conduct the above experiment with a bat, but perhaps the teacher, assistant, or other student can pretend to be the bat, and act out what would happen if s/he was a bat, or perhaps an animation could be made. S/he could crash into things only when the hearing was blocked.

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

Students can deduce from their experiments that hearing is the sense involved in bat navigation.

(D) communicate valid conclusions; and

Students can talk about their findings or make posters or vee maps to describe their findings.

(E) construct simple graphs, tables, maps, and charts to organize, examine and evaluate information.

A simple chart or graph could include number of crashes when a certain sense was blocked.

(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:

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;

Have students review and critique Spallanzani's experiment (slide 11).

(E) connect Grade 3 science concepts with the history of science and contributions of scientists.

Talk about the contribution of Spallanzani and Griffin and Galambos (slide 11-13). Discuss the fact that in the history of science sometimes discoveries are made and then forgotten only to be rediscovered later.

(3.4) 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, safety goggles, sound recorders, clocks, computers, thermometers, hand lenses, meter sticks, rulers, balances, magnets, and compasses; and

Have students try to photograph bats flying. Make use of bat detectors if available: <http://www.econvergence.net/batdet.htm> (bat detector website).

(3.8) Science concepts. The student knows that living organisms need food, water, light, air, a way to dispose of waste, and an environment in which to live. The student is expected to:

(A) observe and describe the habitats of organisms within an ecosystem;

Numerous pictures of bats hunting and hanging are shown in the presentation. Have students predict what kind of habitats a bat may live in depending on what it eats. Example: Bats that eat fish must live near water. Bats that eat only fruit probably do not live in the desert where fruit is scarce.

(3.9) Science concepts. The student knows that species have different adaptations that help them survive and reproduce in their environment. The student is expected to:

(A) observe and identify characteristics among species that allow each to survive and reproduce; and

Bats are very successful creatures and inhabit habitats all over the earth (slide 18). What adaptations make them so successful? Example: Echolocation allows bats to hunt at night when most predators cannot see them. They can hide and sleep during the day.

§112.6. Science, Grade 4.

(4.1) Scientific processes. The student conducts field and laboratory investigations following home and school safety procedures and environmentally appropriate and ethical practices. The student is expected to:

(A) demonstrate safe practices during field and laboratory investigations; and

Barbara French holds a bat carefully (slide 40).

(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;

Spallanzani wondered how bats flew through the night without crashing into things. Perhaps the students also wonder about this too. Have students plan an experiment by which they could discover what senses bats use to navigate. Maybe like Spallanzani, they will want to inhibit the bats' senses to find out which one(s) are responsible for "seeing" (slide 11).

(B) collect information by observing and measuring;

It may be hard to conduct the above experiment with a bat, but perhaps the teacher, assistant, or other student can pretend to be the bat, and act out what would happen if s/he was a bat, or perhaps an animation could be made. S/he could crash into things only when the hearing was blocked.

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

Students can deduce from their experiments that hearing is the sense involved in bat navigation.

(D) communicate valid conclusions; and

Students can talk about their findings or make posters or vee maps to describe their findings.

(E) construct simple graphs, tables, maps, and charts to organize, examine and evaluate information.

A simple chart or graph could include number of crashes when a certain sense was blocked.

(4.3) 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;

Have students review and critique Spallanzani's experiment (slide 11).

(E) connect Grade 4 science concepts with the history of science and contributions of scientists.

Talk about the contribution of Spallanzani and Griffin and Galambos (slide 11-13). Discuss the fact that in the history of science sometimes discoveries are made and then forgotten only to be rediscovered later.

(4.4) 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, safety goggles, microscopes, cameras, sound recorders, computers, hand lenses, rulers, thermometers, meter sticks, timing devices, balances, and compasses; and

Have students try to photograph bats flying. Make use of bat detectors if available: <http://www.econvergence.net/batdet.htm> (bat detector website).

(4.8) Science concepts. The student knows that adaptations may increase the survival of members of a species. The student is expected to:

(B) compare adaptive characteristics of various species; and

Bats are very successful creatures and inhabit habitats all over the earth (slide 18). What adaptations make them so successful? Example: Echolocation allows bats to hunt at night when most predators cannot see them. They can hide and sleep during the day. Numerous pictures of bats hunting and hanging are shown in the presentation. Have students predict what kind of habitats a bat may live in depending on what it eats. Example: Bats that eat fish must live near water. Bats that eat only fruit probably do not live in the desert where fruit is scarce.

(4.9) Science concepts. The student knows that many likenesses between offspring and parents are inherited or learned. The student is expected to:

(B) identify and provide examples of inherited traits and learned characteristics.

Is echolocation an inherited trait or a learned characteristic?

§112.7. Science, Grade 5.

(5.1) Scientific processes. The student conducts field and laboratory investigations following home and school safety procedures and environmentally appropriate and ethical practices. The student is expected to:

(A) demonstrate safe practices during field and laboratory investigations;
and

Barbara French holds a bat carefully (slide 40)

(5.2) Scientific processes. The student uses scientific 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;

Spallanzani wondered how bats flew through the night without crashing into things. Perhaps the students also wonder about this too. Have students plan an experiment by which they could discover what senses bats use to navigate. Maybe like Spallanzani, they will want to inhibit the bats' senses to find out which one(s) are responsible for "seeing" (slide 11).

(B) collect information by observing and measuring;

It may be hard to conduct the above experiment with a bat, but perhaps the teacher, assistant, or other student can pretend to be the bat, and act out what would happen if s/he was a bat, or perhaps an animation could be made. S/he could crash into things only when the hearing was blocked.

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

Students can deduce from their experiments that hearing is the sense involved in bat navigation.

(D) communicate valid conclusions; and

Students can talk about their findings or make posters or vee maps to describe their findings.

(E) construct simple graphs, tables, maps, and charts to organize, examine and evaluate information.

A simple chart or graph could include number of crashes when a certain sense was blocked.

(5.3) 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;

Have students review and critique Spallanzani's experiment (slide 11).

(E) connect Grade 5 science concepts with the history of science and contributions of scientists.

Talk about the contribution of Spallanzani and Griffin and Galambos (slide 11-13). Discuss the fact that in the history of science sometimes discoveries are made and then forgotten only to be rediscovered later.

(5.4) 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

Make use of bat detectors if available:

<http://www.econvergence.net/batdet.htm> (bat detector website).

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

(D) verify that vibrating an object can produce sound.

Echolocation makes use of sounds. What vibrates in a bat in order to make the sound? (Slide 14).

(5.9) Science concepts. The student knows that adaptations may increase the survival of members of a species. The student is expected to:

(A) compare the adaptive characteristics of species that improve their ability to survive and reproduce in an ecosystem;

How does echolocation allow a bat to escape detection by many predators? –At night many predators cannot see. Does escaping predation increase chances for survival? –yes, it does.

(B) analyze and describe adaptive characteristics that result in an organism's unique niche in an ecosystem; and

Bats are able to inhabit a variety of niches because they are able to exploit many different food sources. (Slides 19-37)

§112.22. Science, Grade 6.

(6.1) Scientific processes. The student conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during field and laboratory investigations; and

Barbara French hold a bats very carefully (slide 40).

(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 students investigate how bats see at night.

(B) collect data by observing and measuring;

Use sonar probes to map a surface or an object.

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

The bat does not have a sonar probe. How does a bat echolocate? Have students read a sonar probe manual and determine what a biological homologue might be like.

(D) communicate valid conclusions; and

Present their well-supported findings as posters, presentations, vee maps, etc.

(6.3) 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;

Have students review and critique Spallanzani's experiment (slide 11).

(E) connect Grade 6 science concepts with the history of science and contributions of scientists.

Talk about the contribution of Spallanzani and Griffin and Galambos (slide 11-13). Discuss the fact that in the history of science sometimes discoveries are made and then forgotten only to be rediscovered later.

(6.4) 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, analyze, and record information using tools including beakers, petri dishes, meter sticks, graduated cylinders, weather instruments, timing devices, hot plates, test tubes, safety goggles, spring scales, magnets, balances, microscopes, telescopes, thermometers, calculators, field equipment, compasses, computers, and computer probes; and

Make use of bat detectors if available:

<http://www.econvergence.net/batdet.htm> (bat detector website).

(6.10) Science concepts. The student knows the relationship between structure and function in living systems. The student is expected to:

(C) identify how structure complements function at different levels of organization including organs, organ systems, organisms, and populations.

Discuss the structure and function of the bat's hearing system. Compare and contrast with a human hearing system. Compare and contrast our senses to those of rattlesnakes and bees. (slides 4-7, 16)

§112.23. Science, Grade 7.

(7.1) Scientific processes. The student conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during field and laboratory investigations; and

Barbara French holds a bat carefully (slide 40).

(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 students investigate how bats see at night.

(B) collect data by observing and measuring;

Use sonar probes to map a surface or an object.

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

The bat does not have a sonar probe. How does a bat echolocate? Have students read sonar probe manual and determine what a biological homologue might be like.

(D) communicate valid conclusions; and

Present their well-supported findings as posters, presentations, vee maps, ect.

(7.3) 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;

Have students review and critique Spallanzani's experiment (slide 11).

(F) connect Grade 7 science concepts with the history of science and contributions of scientists.

Talk about the contribution of Spallanzani and Griffin and Galambos (slide 11-13). Discuss the fact that in the history of science sometimes discoveries are made and then forgotten only to be rediscovered later.

(7.4) 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; and

Make use of sonar probes or bat detectors if available:
<http://www.econvergence.net/batdet.htm> (bat detector website).

112.24. Science, Grade 8.

(8.1) Scientific processes. The student conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during field and laboratory investigations; and

Barbara French holds a bat very carefully (slide 40).

(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;

Have students investigate how bats see at night.

(B) collect data by observing and measuring;

Use sonar probes to map a surface or an object.

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

The bat does not have a sonar probe. How does a bat echolocate? Have students read sonar probe manual and determine what a biological homologue might be like.

(D) communicate valid conclusions; and

Present their well-supported findings as posters, presentations, vee maps, ect.

(8.3) 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;

Have students review and critique Spallanzani's experiment (slide 11).

(E) connect Grade 8 science concepts with the history of science and contributions of scientists.

Talk about the contribution of Spallanzani and Griffin and Galambos (slide 11-13). Discuss the fact that in the history of science sometimes discoveries are made and then forgotten only to be rediscovered later.

(8.4) 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; and

Make use of sonar probes or bat detectors if available.
<http://www.econvergence.net/batdet.htm> (bat detector website).

(8.14) Science concepts. The student knows that natural events and human activities can alter Earth systems. The student is expected to:

(B) analyze how natural or human events may have contributed to the extinction of some species; and

Mexican free-tail bats have made a habitat out of the Congress Avenue Bridge in Austin, Texas (slide 39). Why have the bats moved here?

§112.42. Integrated Physics and Chemistry.

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;

Have students review and critique Spallanzani's experiment (slide 11).

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

Talk about the contribution of Spallanzani and Griffin and Galambos (slide 11-13). Discuss the fact that in the history of science sometimes discoveries are made and then forgotten only to be rediscovered later.

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

(D) demonstrate the application of acoustic principles such as in echolocation, musical instruments, noise pollution, and sonograms.

Bats use echolocation to “see” at night (slide 16-18).

§112.43. Biology.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during field and laboratory investigations; and

Barbara French holds a bat carefully (slide 40).

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

(F) research and describe the history of biology and contributions of scientists.

Slides 11-13 describe the discovery and rediscovery of bat echolocation. What obstacles did the scientists have to overcome to make their discoveries? Why was the information lost and needed to be rediscovered again? How would the use of patents in science influence the rate of scientific discovery?

(7) Science concepts. The student knows the theory of biological evolution. The student is expected to:

(A) identify evidence of change in species using fossils, DNA sequences, anatomical similarities, physiological similarities, and embryology; and

Slide 17 shows bats have modified finger bones that comprise their wings. Compare these with homologous bones in other mammals. What have the same bones in other animals evolved into? Flippers, ungulate feet/legs, ect.?

(11) Science concepts. The student knows that organisms maintain homeostasis. The student is expected to:

(B) investigate and identify how organisms, including humans, respond to external stimuli;

Investigate how a bat responds to the movements of moths or fish (slides 14-16, 21-28).

(12) Science concepts. The student knows that interdependence and interactions occur within an ecosystem. The student is expected to:

(C) compare variations, tolerances, and adaptations of plants and animals in different biomes;

Compare what bats eat and what foods are available in the area (slides 16-36).

§112.44. Environmental Systems.

(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:

(A) demonstrate safe practices during field and laboratory investigations;
and

Barbara French holds a bat carefully (slide 40).

(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;

Slides 11-13 describe the discovery and rediscovery of bat echolocation. What obstacles did the scientists have to overcome to make their discoveries? Why was the information lost and needed to be rediscovered again? How would the use of patents in science influence the rate of scientific discovery?

(4) Science concepts. The student knows the relationships of biotic and abiotic factors within habitats, ecosystems, and biomes. The student is expected to:

(A) identify indigenous plants and animals, assess their role within an ecosystem, and compare them to plants and animals in other ecosystems and biomes;

Compare what bats eat and what foods are available in the area (slides 16-36).

§112.45. Chemistry.

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

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

Slides 11-13 describe the discovery and rediscovery of bat echolocation. What obstacles did the scientists have to overcome to make their discoveries? Why was the information lost and needed to be rediscovered again? How would the use of patents in science influence the rate of scientific discovery?

§112.46. Aquatic Science.

(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;

Slides 11-13 describe the discovery and rediscovery of bat echolocation. What obstacles did the scientists have to overcome to make their discoveries? Why was the information lost and needed to be rediscovered again? How would the use of patents in science influence the rate of scientific discovery?

(7) Science concepts. The student knows environmental adaptations of aquatic organisms. The student is expected to:

(B) compare and describe how adaptations allow an organism to exist within an aquatic environment;

Dolphins and whales also use echolocation. Why is this adaptation important? What advantage does the electric fish's ability convey to it? (slide 9)

§112.47. Physics.

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

(B) identify the characteristics and behaviors of sound and electromagnetic waves; and

When going over the electromagnetic spectrum, the visual spectrum is often emphasized. However, other organisms can sense frequencies outside human's range (slides 4-9).

§112.48. Astronomy.

(8) Science concepts. The student knows the role of the Sun in our solar system. The student is expected to:

(C) describe the Sun's effects on the Earth.

A bee can sense UV light (slide 8).

§112.49. Geology, Meteorology, and Oceanography.

(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;

Slides 11-13 describe the discovery and rediscovery of bat echolocation. What obstacles did the scientists have to overcome to make their discoveries? Why was the information lost and needed to be rediscovered again? How would the use of patents in science influence the rate of scientific discovery?