Turn Off the Lights! Scientific Detectives Cross Examine Light Pollution Activity 5A

Scientific Detectives

This activity provides an opportunity for students to engage in authentic scientific research as they investigate the impact light pollution may have on the environment, on wildlife, or any other number of topics associated with light pollution. Scientific research is not limited to experiments. It also includes gathering information from scientific studies, making observations, and discovering connections between existing research. Like real scientists, students must present their findings. This can be done in multiple ways as suggested in the suggested methodology section below.

Activity Focus:

The purpose of this activity is to provide an awareness of the increasing problem of light pollution and its adverse effects worldwide. Students will research the negative effects of light pollution in order to gain a deeper understanding of this problem. Students will use their knowledge to create presentations highlighting their findings as well as innovative solutions to address this issue.

Activity Rationale:

Light pollution, which refers to the over illumination of the night sky caused by artificial light, is a world-wide epidemic with far reaching consequences. Astronomers at the forefront of this issue express concern over the rapidly disappearing night sky, but warn that the effects are more widespread than a few missing stars. It is reported that the U.S. alone wastes billions of dollars annually in energy costs illuminating the night sky. Light pollution is also reeking havoc on many wildlife species that rely on natural cycles of light and darkness for migration and mating patterns. Further investigations into this problem have also begun to draw strong correlations between nighttime lighting and certain forms of cancer. By gaining an understanding of this issue through independent research, students will create awareness presentations focusing on the adverse effects of light pollution in addition to a proposed solution to ease these effects.

Suggested Methodology:

As an inquiry based lesson, students will conduct independent research using teacher approved resources. Research should be guided by supplying students with questions or a topic fact sheet to focus their investigations. As students

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conduct their research, they should maintain accurate listings of sources, summarize information from each source using their own words, and use graphic organizers to assist in identifying connections and creating presentation format.

After students have completed their research, divide them into pairs or small groups to complete the remainder of their project. Groups can be created in many ways. Teachers may choose to group by similar research areas or by contrasting research areas. Each group will be responsible for presenting the information they have gathered concerning light pollution in addition to their proposed solution for this problem. Guidelines for the development and evaluation of this project could include:

- Quality of research and validity of sources used for data collection
- Effectiveness of presentation in persuading audience to take action for their cause
- Ability to assign roles and work collaboratively with peers
- Innovative use of media to promote message such as posters, banners, book covers, videos, plays, rallies, websites, pledge drives, brochures, etc.

Students must turn in their source summaries at the time of their presentation. They will be used by the teacher to evaluate the information presented by the students. Source summaries are found in the student handouts. Students may need multiple copies of source summaries. The exact number of sources as well as the type of sources required is to be determined by the teacher.

Activity Resources:

http://www.harcourtschool.com/newsbreak/night_sky.html

http://www.sciencenetlinks.com/sci_update.cfm?DocID=170

http://darksky.org

http://www.starrynightlights.com/

http://www.pha.jhu.edu/~atolea/second/page1.html

http://news.nationalgeographic.com/news/pf/42741575.html

http://laps.noaa.gov/albers/slides/ast/places.html

http://science.nasa.gov/headlines/y2001/ast01nov_1.htm

http://www.lightfromabove.org/

http://www.ctio.noao.edu/light_pollution/iau50/LP_working_group.htm

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Relevant TEKS:

Middle School Science TEKS

6.1, 7.1, & 8.1(A, B) Scientific investigation and reasoning. The student, for at least 40% of the instructional time, conducts laboratory and field investigations following safety procedures and environmentally appropriate and ethical practices. The student is expected to:

(A) demonstrate safe practices during laboratory and field investigations as outlined in the Texas Safety Standards; and

(B) practice appropriate use and conservation of resources, including disposal, reuse, or recycling of materials.

6th Grade MS Science TEKS

6.2 **Scientific investigation and reasoning**. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:

(A) plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology;

(B) design and implement experimental investigations by making observations, asking well-defined questions, formulating testable hypotheses, and using appropriate equipment and technology;

(C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers;

(D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and

(E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

6.3 **Scientific investigation and reasoning**. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) use models to represent aspects of the natural world such as a model of Earth's layers;

(C) identify advantages and limitations of models such as size, scale, properties, and materials

6.4 **Scientific investigation and reasoning**. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:

(A) use appropriate tools to collect, record, and analyze information, including journals/notebooks, beakers, Petri dishes, meter sticks, graduated cylinders, hot plates, test tubes, triple beam balances, microscopes, thermometers, calculators, computers, timing devices, and other equipment as needed to teach the curriculum; and

(B) use preventative safety equipment, including chemical splash goggles, aprons, and gloves, and be prepared to use emergency safety equipment, including an eye/face wash, a fire blanket, and a fire extinguisher.

6.7 **Matter and energy**. The student knows that some of Earth's energy resources are available on a nearly perpetual basis, while others can be renewed over a relatively short period of time. Some energy resources, once depleted, are essentially nonrenewable. The student is expected to:

(A) research and debate the advantages and disadvantages of using coal, oil, natural gas, nuclear power, biomass, wind, hydropower, geothermal, and solar resources; and

(B) design a logical plan to manage energy resources in the home, school, or community.

6.9 **Force, motion, and energy.** The student knows that the Law of Conservation of Energy states that energy can neither be created nor destroyed, it just changes form. The student is expected to:

(A) investigate methods of thermal energy transfer, including conduction, convection, and radiation;

(B) verify through investigations that thermal energy moves in a predictable pattern from warmer to cooler until all the substances attain the same temperature such as an ice cube melting; and

(C) demonstrate energy transformations such as energy in a flashlight battery changes from chemical energy to electrical energy to light energy.

Activity "Administrivia":

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7th Grade Science TEKS

7.2 **Scientific investigation and reasoning**. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:

(A) plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology;

(B) design and implement experimental investigations by making observations, asking well-defined questions, formulating testable hypotheses, and using appropriate equipment and technology;

(C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers;

(D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and

(E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

7.3 **Scientific investigation and reasoning**. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(C) identify advantages and limitations of models such as size, scale, properties, and materials;

7.4 **Science investigation and reasoning.** The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:

(A) use appropriate tools to collect, record, and analyze information, including life science models, hand lens, stereoscopes, microscopes, beakers, Petri dishes, microscope slides, graduated cylinders, test tubes, meter sticks, metric rulers, metric tape measures, timing devices, hot plates, balances, thermometers, calculators, water test kits, computers, temperature and pH probes, collecting nets, insect traps, globes, digital cameras, journals/notebooks, and other equipment as needed to teach the curriculum; and

(B) use preventative safety equipment, including chemical splash goggles, aprons, and gloves, and be prepared to use emergency safety equipment, including an eye/face wash, a fire blanket, and a fire extinguisher.

7.9 **Earth and space**. The student knows components of our solar system. The student is expected to:

(A) analyze the characteristics of objects in our solar system that allow life to exist such as the proximity of the Sun, presence of water, and composition of the atmosphere;

8th Grade Science TEKS

8.2 **Scientific investigation and reasoning**. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:

(A) plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology;

(B) design and implement comparative and experimental investigations by making observations, asking well-defined questions, formulating testable hypotheses, and using appropriate equipment and technology;

(C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers;

(D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and

(E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

8.3 **Scientific investigation and reasoning.** The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;

(B) use models to represent aspects of the natural world such as an atom, a molecule, space, or a geologic feature;

(C) identify advantages and limitations of models such as size, scale, properties, and materials;

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Grade Levels 6-8

8.4 **Scientific investigation and reasoning**. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:

(A) use appropriate tools to collect, record, and analyze information, including lab journals/notebooks, beakers, meter sticks, graduated cylinders, anemometers, psychrometers, hot plates, test tubes, spring scales, balances, microscopes, thermometers, calculators, computers, spectroscopes, timing devices, and other equipment as needed to teach the curriculum; and

(B) use preventative safety equipment, including chemical splash goggles, aprons, and gloves, and be prepared to use emergency safety equipment, including an eye/face wash, a fire blanket, and a fire extinguisher.

8.5 **Matter and energy**. The student knows that matter is composed of atoms and has chemical and physical properties. The student is expected to:

(A) describe the structure of atoms, including the masses, electrical charges, and locations, of protons and neutrons in the nucleus and electrons in the electron cloud;

(B) identify that protons determine an element's identity and valence electrons determine its chemical properties, including reactivity;

8.7 **Earth and space**. The student knows the effects resulting from cyclical movements of the Sun, Earth, and Moon. The student is expected to:

(A) model and illustrate how the tilted Earth rotates on its axis, causing day and night, and revolves around the Sun causing changes in seasons;

(B) demonstrate and predict the sequence of events in the lunar cycle; and

8.8 **Earth and space**. The student knows characteristics of the universe. The student is expected to:

(C) explore how different wavelengths of the electromagnetic spectrum such as light and radio waves are used to gain information about distances and properties of components in the universe;

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