



Fields of Sound

Instructional Plan

OVERVIEW OF LESSON:

Students will compare and contrast different kinds of fields, including magnetic fields, sound fields, and electromagnetic fields. They will experiment with magnetic field behavior, enact a sound field, and collect data to map a wireless router's field. They will articulate their understanding of the concept of "fields."

SUBJECT MATTER:

Physical Science
English

GRADE LEVEL(S):

8

Fields of Sound

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TIME ALLOTMENT:

Time estimated to complete this lesson is five 40-minute class periods, but may require some out-of-class work for students.

LEARNING OBJECTIVES:

- Students will be able to describe the similarities and differences of the speed and movement of electromagnetic waves (light, magnet, and radio) and sound waves.
 - Students will be able to describe a field.
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LEARNING STANDARDS:

Content

Standards listed below are not given in their entirety. Rather, the parts of the standards covered by this instruction are included. For complete text of the Virginia Standards of Learning, go to: http://www.doe.virginia.gov/testing/sol/standards_docs/index.shtml

Physical Science

PS.1 The student will plan and conduct investigations in which

- chemicals and equipment are used safely;
- research skills are utilized using a variety of resources;
- independent and dependent variables, constants, controls, and repeated trials are identified;
- data tables showing the independent and dependent variables, derived quantities, and the number of trials are constructed and interpreted;
- valid conclusions are made after analyzing data;
- research methods are used to investigate practical problems and questions;
- experimental results are presented in appropriate written form; and
- an understanding of the nature of science is developed and reinforced.

PS.8 The student will investigate and understand characteristics of sound and technological applications of sound waves. Key concepts include

- speed of sound
- the nature of mechanical waves; and
- technological applications of sound.

PS.9 The student will investigate and understand the nature and technological applications of light. Key concepts include

- the wave behavior of light (reflection, refraction, diffraction, and interference);

- the electromagnetic spectrum.

PS.11: The student will investigate and understand basic principles of electricity and magnetism. Key concepts include

- magnetic fields and electromagnets

English

English 8.7: The student will write in a variety of forms, including narrative, expository, persuasive, and informational.

- a) Use prewriting strategies to generate and organize ideas.
- b) Organize details to elaborate the central idea.
- c) Select specific vocabulary and information.
- d) Revise writing for word choice, sentence variety, and transitions among paragraphs.
- e) Use available technology.

World Geography

WG.1 The student will use maps, globes, satellite images, photographs, or diagrams to

- apply the concepts of location, scale, map projection, or orientation
- create thematic maps

Technology

See complete Technology standards at <http://www.iste.org/standards/nets-for-students/nets-student-standards-2007.aspx>

1. Creativity and Innovation
 - a. apply existing knowledge to generate new ideas, products or processes.
 - b. Create original works as a means of personal or group expression.
2. Communication and Collaboration
 - d. contribute to project teams to produce original works or solve problems
3. Research and Information Fluency
 - b. locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
4. Critical Thinking, Problem Solving, and Decision Making
 - b. plan and manage activities to develop a solution or complete a project
 - c. collect and analyze data to identify solutions and/or make informed decisions.
5. Digital Citizenship
 - a. advocate and practice safe, legal and responsible use of information and technology.
 - b. exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.
6. Technology Operations and Concepts
 - a. understand and use technology systems
 - b. select and use applications effectively and productively

Arts

See complete Arts standards at <http://artsedge.kennedy-center.org/educators/standards.aspx>

Dance (5-8)

- Content Standard #1: Identifying and demonstrating movement elements and skills in performing dance
 - Students demonstrate increasing kinesthetic awareness, concentration, and focus in performing movement skills
- Content Standard #3: Understanding dance as a way to create and communicate meaning
 - Students create a dance that successfully communicates a topic of personal significance

Visual Arts (5-8)

- Content Standard #6: Making connections between visual arts and other disciplines
 - Students compare the characteristics of works in two or more art forms that share similar subject matter, historical periods, or cultural context

CRITICAL AND CREATIVE THINKING OBJECTIVES:

A complete listing and explanation of critical and creative thinking objectives can be found at www.ideas.soe.vt.edu.

| | |
|--|--|
| Conceptualizing | Students will verbalize or represent ideas using 2D and 3D representations, movement, or other forms relevant to the context. |
| Exploring | Students will explore a challenge using a variety of raw materials, stimuli, and experiences. |
| Metaphorical Thinking | Students will identify words or phrases that are symbolic or representative of other ideas to which they are not literally applicable. |
| Examining ideas in new and varied ways | Students will engage in activities that provide others' perspectives on a challenge. |
| Observing | Students will observe things related to the challenge closely to identify details, procedures, and methods |
| Elaborating | Students will develop ideas and information that expands on what is explicitly given. |
| Inferring | Students will draw conclusions not explicitly stated based on evidence and reasoning. |
| Questioning | Students will identify missing or unclear information and ask questions to seek clarity. |
| Separating | Students will discard ideas that are not relevant to the context. |

| | |
|--|--|
| Relating | Students will identify associations between objects or ideas. |
| Organizing | Students will arrange information such that connections and relationships are made clear. |
| Summarizing | Students will condense multiple ideas into a cohesive and comprehensive summary and restate it using personal connections and interpretations. |
| Composing | Students will use written, oral, and symbolic language to communicate a summary of thoughts, ideas, and solutions. |
| Recognizing the existence of a challenge | Students will state the challenge and outline related conditions and scope. |
| Understanding ability | Students will identify personal abilities that are helpful to meeting goals. |
| Allocating resources | Students will outline all available resources and develop a timeline for action. |
| Cognitive restructuring | Students will verbalize positive thoughts about their performance and abilities. |
| Rejecting stereotypes and prejudice | Students will identify preexisting ideas and opinions regarding a challenge and how they might affect decisions and progress toward goals. |
| Demonstrating autonomy | Students will initiate activity and exercise self-direction and self-discipline. |
| Persisting | Students will continue to work until goals are met. |
| Maintaining intrinsic motivation | Students will identify how the task or problem provides personal satisfaction. |
| Recognizing relevance | Students will identify personal beliefs and values relating to the context. |
| Risk-taking | Students will describe how the challenges faced in the process of meeting their goal encouraged them to work beyond their comfort level. |

PREREQUISITE KNOWLEDGE:

Prior to this lesson, students should be able to orient and find their location on a map. They should also be able to identify whether a computer or mobile device is receiving a signal from a wireless router.

MEDIA/TECHNOLOGY COMPONENTS:

- Laptops or other portable devices that use wireless router signals.
- A wireless router (likely already installed at your school)

- Computer(s) with internet access
 - Video camera
 - Video editing software (such as Windows Movie Maker)
 - Monitor or projector and screen for viewing movie
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MATERIALS:

- 20 to 25 basic compasses (included in the kit)
 - Magnet
 - Video camera
 - Map of the school and grounds
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PREPARATION FOR TEACHERS:

- Preview all media materials to check for content appropriateness, thoroughness and understanding.
 - Bookmark all necessary websites and check to make sure computer security allows access.
 - Inform students to all wear or bring a black (or any other color, but the same for all students) t-shirt for the demonstration in Part 3. You should also have two shirts of a different color from the other students for the student(s) who will represent “sound” in the demonstration.
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INSTRUCTIONAL PLAN:

Suggested method of lesson procedures:

1. Explore a magnetic field by setting up an array of compasses and passing a magnet over and around it. In addition (or alternatively) visit <http://www.phoebesfield.org> and play on the home page. If the compasses were not there, would the magnetic field still exist? If the magnet were not there, would the compasses still point in some direction?
2. [OPTIONAL] If your school has a wireless network, have students take laptops to different locations inside and outside the school to see where the wireless network reaches. Using a map of the school and grounds as a base, construct a map of the wireless signal.
3. Use body movement to illustrate how sound moves through a field. Go outside to a football field or other large open space. Set up a video camera as high as possible (i.e., in the bleachers if available). The view should encompass the field. Set up the

- learners. Most of the learners will be the field. They stand at points in a grid (i.e., on 10-yard lines if on a football field). The “field students” will wear blindfolds or just close their eyes, and they will wear t-shirts of the same color. Start the camera. One student, who wears the different colored t-shirt, will then move through and around the field, making noise. The students in the field should turn their bodies to face the source of the sound. Students may take turns playing the different roles. For a more challenging task, two noisemakers move through and around the field. Noisemakers should make continuous noise.
- a. While outside, demonstrate the difference in the speeds of light and sound by moving far from the students and making a loud sound like clapping. The learners should see the clapping motion of your hands before they hear the sound.
4. Divide students into small groups and have them use Windows Movie Maker or other video editing software to overlay sound on the video that you made. The sound should coordinate with the movement of the student with the different colored t-shirt. Students can record their own sounds or choose pre-recorded sounds. (A variety of sound effects can be downloaded free online at www.freesound.org)
 5. Review the video that you made. Ask students to compare and contrast the behavior of the students in the field with the compasses in Step 1.
 - a. Can you see the difference in the speed of sound vs. speed of light? [Probably not. When human reaction times are factored in, too much variation exists.]
 - b. What if you could remove the reaction time problem by using a different method for indicating when the sound was “heard”?
 - c. Watch the Sound Fields video (included in the kit). Can you see the sound moving? What would the lights do if they were arranged in an array instead of one line?
 6. Discuss in small groups and as a class how the wireless field is similar to and different from the Sound Field and the magnetic field. If you didn’t have a computer, would you know that the field was there? Would it still be there?
 7. Watch the Sound Fields video. Discuss its meaning in small groups and as a class. How can each statement be explained in the context of the different fields?
 - a. Fields exist everywhere
 - b. Field – a distribution of unique physical values at each point in space

- c. Fields can be disturbed
 - d. You are a source
8. Reflective writing. Think about the fields that you have seen as part of this unit. Can you think of another way that you have been a source or disturbed a field?
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ASSESSMENTS:

Students will be assessed on their

- Data Collection Worksheet,
- Wireless Mapping Worksheet,
- Video production, and
- Reflection Paper

See rubrics attached to this document.

ADDITIONAL RESOURCES:

- Explore the Phoebe's Field website to discover more about fields:
<http://www.phoebesfield.org>
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ABOUT THE INTEGRATED DESIGN + EDUCATION + ARTS STUDIO:

The Integrated Design + Education + Arts Studio (IDEAS) is part of the Institute for Creativity, Arts, and Technology (ICAT) at Virginia Tech.

By merging the forces of art and technology into applicable prekindergarten through secondary school (PK-12) programs that strengthen student achievement, Virginia Tech is on the leading edge of a new paradigm in education. ICAT will reach beyond current educational models to fuse arts and technology with content. Our purpose is to strengthen critical and creative thinking skills that prepare students for future careers. ICAT will both generate research and produce learning modules and environments that address real needs identified by educators.

For more information, please see our website at www.ideas.soe.vt.edu.

WE VALUE YOUR FEEDBACK:

Please tell us about how you used the curriculum materials and/or arts project in your classroom. We welcome feedback, suggestions for improvement, and success stories. Find out more at www.ideas.soe.vt.edu.

Get the kit. The IDEAS team has available for loan a number of instructional kits for our various projects. Among other things, each kit includes a FlipCam, a small camera you can use to give us feedback. Because we can't be in the classroom with you, we turn to technology to help provide us a glimpse of the experience you and your students have with the program. That's where the FlipCam comes in.

All we ask is that you document your students engaged with the program and related activities. Feel free to make the filming an integrated part of your experience. Give the camera to the students, do the filming yourself, pass it around to multiple students - however you want to document. Once you are finished with the kit, simply return the camera with the other materials. The Institutional Review Board (IRB) of Virginia Tech requires parent, student, and school assent/consent for participation in this data collection. We provide you with all the necessary permission forms and information for your supervisors.

REFLECTION PAPER ASSIGNMENT:

Name: _____

Think about the fields that you have seen as part of this unit. Describe another way that you have been a source or disturbed a field.

STUDENT NAME _____

FIELDS OF SOUND ASSESSMENT RUBRIC

| Data Collection Notes | 3 | 2 | 1 | 0 |
|----------------------------------|---|--|--|---|
| Questions are answered correctly | Student answered all the questions correctly. | Student answered two of the questions correctly. | Student answered one of the questions correctly. | Student answered none of the questions correctly. |

| Wireless Signal Mapping | 3 | 2 | 1 | 0 |
|--|---|---|--|---|
| Wireless signal is accurately identified | Student correctly identified three locations with and without a wireless signal | Student correctly identified two locations with and without a wireless signal | Student correctly identified one location with and without a wireless signal | Student did not correctly identify locations with and without a wireless signal |

| Reflection paper | 3 | 2 | 1 | 0 |
|--|---|--|--|--|
| The paper includes an introduction and conclusion | The paper includes an excellent introduction and conclusion. | The paper includes an introduction and conclusion. | Either the introduction or conclusion is missing. | The paper does not include an introduction or conclusion. |
| The paper includes a description of the student as a source or disturbance of a field. | The reflection includes an accurate description of the student as a source or disturbance of a field. | The reflection is present but contains an inaccurate description of the student as a source or disturbance of a field. | The reflection is present but is missing a description of the student as a source or disturbance of a field. | The reflection is not completed. |
| The paper is well organized and free of grammar and spelling errors. | The paper is well organized and has no grammar or spelling errors. | The paper is generally organized and contains a few spelling or grammar errors. | The paper is disorganized or contains many spelling and grammar errors. | The paper is disorganized and contains many spelling and grammar errors. |

STUDENT NAME _____

| Critical and Creative Thinking | 3 | 2 | 1 | 0 |
|--------------------------------|--|--|--|---|
| Organizing | Ideas are organized and related. | Ideas are organized and somewhat related. | Ideas are somewhat organized but not clearly related. | Ideas are not organized or related. |
| Composing | Student uses written language, movement, and visual art to convey ideas. | Student uses two of written language, movement, and visual art to convey ideas. | Student uses one of written language, movement, and visual art to convey ideas. | Student does not compose to convey ideas. |
| Allocating resources | Student uses time and skills wisely to complete the project on time. | Student mostly uses time and skills wisely. | Student uses time and skills wisely some of the time. | Student does not use time or skills wisely. |
| Persisting | Student kept working until finished and maintained a positive attitude throughout. | Student kept working until finished and mostly maintained a positive attitude. | Student worked until finished, but did not have a positive attitude. | Student did not finish the project. |
| Autonomy | Student does (three of): initiating activity, exercising self-direction, and exercising self-discipline. | Student does (two of): initiating activity, exercising self-direction, and exercising self-discipline. | Student does (one of): initiating activity, exercising self-direction, and exercising self-discipline. | Student does (none of): initiating activity, exercising self-direction, and exercising self-discipline. |
| Column Total | | | | |
| Rubric Total | | _____ out of 30 | | |