Physics of Sound

Youth Science Institute

Fourth-Grade Teacher Resource Guide

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Physics of Sound and Motion:
Lesson Summary and Vocabulary

Lesson Summary: The YSI ***Physics of Sound and Motion*** program provides a hands-on introduction to physics and a closer look at two of its major topics. Students participate in an instructor-led discussion on energy, matter, and other physics fundamentals before moving on to the specifics of sound and motion. During the Sound portion of the presentation, activities are used to qualify sound as a vibration and determine how it travels. Students work together to model molecules and waves, participate in experiments on sound traveling through different states of matter, and create a noisemaking device to take home. The Motion half of the program places an emphasis on flight. Students discuss the four fundamental forces of flight and Bernoulli's principle, creating first paper fliers and then stomp rockets to try different methods of propulsion through the air. For older groups, an emphasis is also placed on Newton's laws of motion, and how adding mass to their rocket can affect it. This program focuses on critical thinking and experimentation, encouraging students to join in the discovery process at every stage.

Vocabulary: Below are words and concepts that relate to the ***Physics of Sound and Motion*** program.

Drag: the "backward" force of flight; friction due to collisions with air molecules
Energy: the ability to do work; found in forms such as light, heat, and chemical storage
Force: a push or a pull
Gas: the least dense state of matter, where molecules move freely to fill all space provided
Gravity: the "downward" force of flight; the universal force attracting two objects with mass
Lift: the "upward" force of flight; an upward push due to differences in air pressure
Liquid: the state of matter where molecules can move, but stay close to each other
Matter: the basic structural component of the universe; everything physical
Molecules: small particles of matter
Motion: a change in position caused by a force
Physics: the field of science that deals with matter, energy, motion, and force
Solid: the densest state of matter, where molecules are fixed in place
Thrust: the "forward" force of flight; a force that propels a flying object
Vibrations: small movements back and forth; sound

Definitions based on www.dictionary.reference.com

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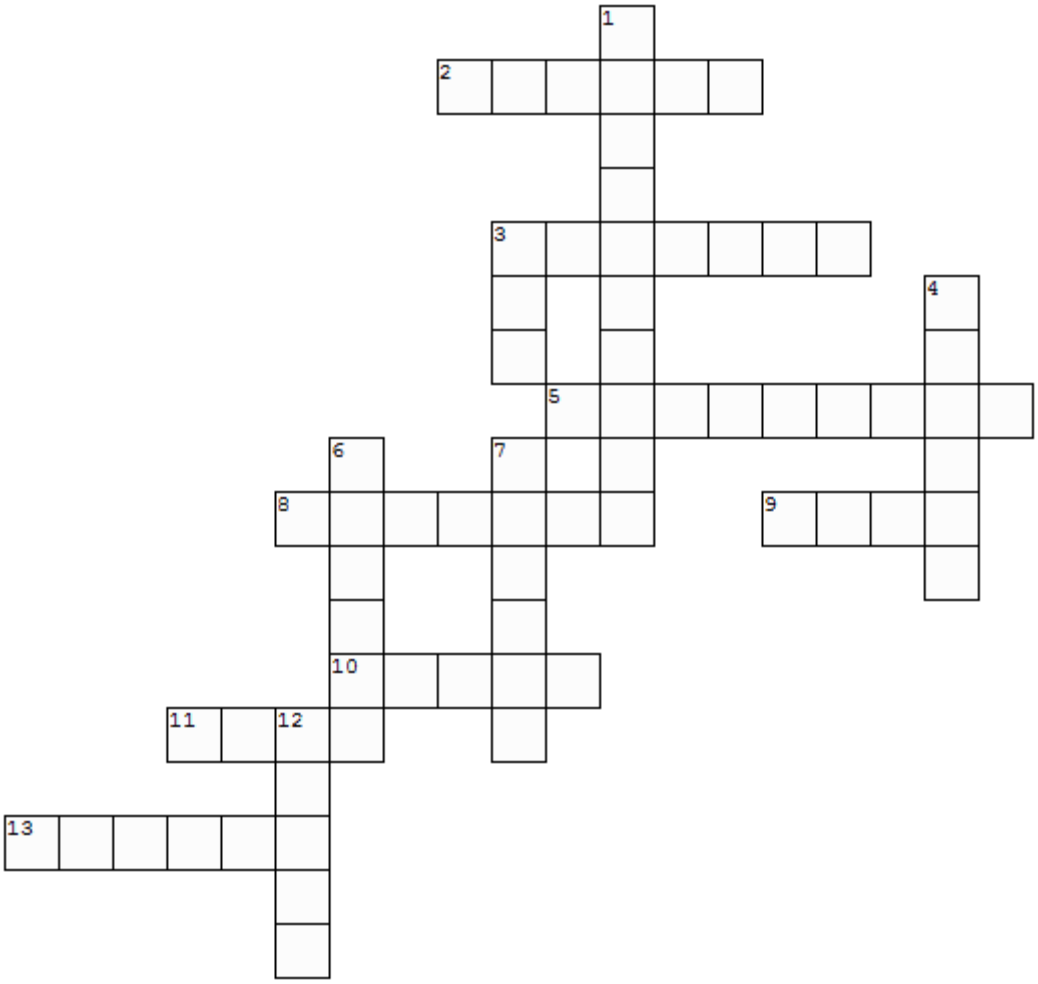
Name_____

Physics of Sound and Motion
Language Arts Crossword Puzzle



MOLECULES PHYSICS VIBRATIONS GRAVITY FORCE LIQUID MATTER SOLID
MOTION ENERGY DRAG LIFT GAS THRUST

Down

1. Small movements back and forth; sound.
3. The least dense state of matter, where molecules move freely to fill all space provided.
4. The ability to do work, found in forms such as light, heat, and chemical storage.
6. The "forward" force of flight; a force that propels a flying object.
7. The state of matter where molecules can move, but stay close to each other.
12. A push or a pull.

Across

2. A change in position caused by a force.
3. The "downward" force of flight; the universal force attracting two objects with mass.
5. Small particles of matter.
8. The field of science that deals with matter, energy, motion, and force.
9. The "backward" force of flight; friction due to collisions with air molecules.
10. The densest state of matter, where molecules are fixed in place.
11. The "upward" force of flight; an upward push due to differences in air pressure.
13. The basic structural component of the universe; everything physical

Definitions based on www.dictionary.reference.com

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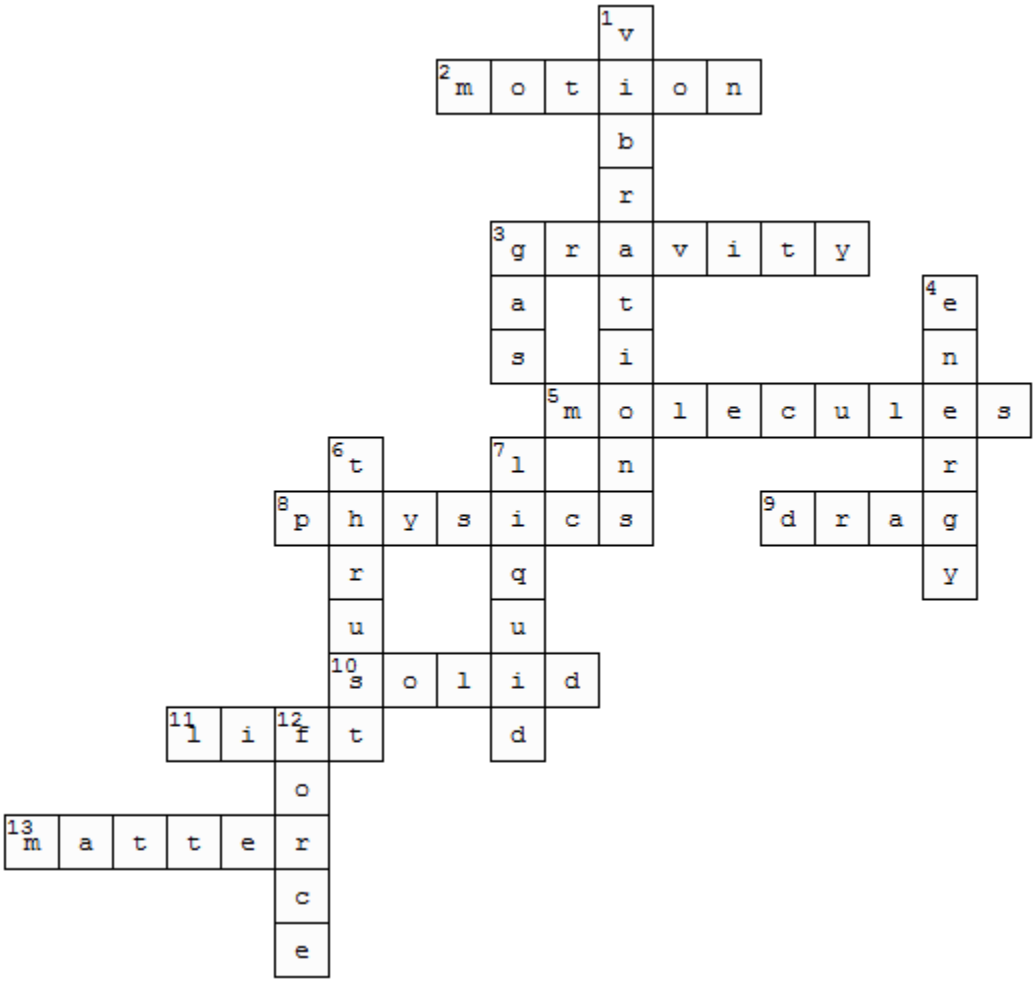
Answer Key
Physics of Sound and Motion
Language Arts Crossword Puzzle



Down

1. Small movements back and forth; sound **(vibrations)**.
3. The least dense state of matter, where molecules move freely to fill all space provided **(gas)**.
4. The ability to do work, found in forms such as light, heat, and chemical storage **(energy)**.
6. The "forward" force of flight; a force that propels a flying object **(thrust)**.
7. The state of matter where molecules can move, but stay close to each other **(liquid)**.
12. A push or a pull **(force)**.

Across

2. A change in position caused by a force **(motion)**.
3. The "downward" force of flight; the universal force attracting two objects with mass **(gravity)**.
5. Small particles of matter **(molecules)**.
8. The field of science that deals with matter, energy, motion, and force **(physics)**.
9. The "backward" force of flight; friction due to collisions with air molecules **(drag)**.
10. The densest state of matter, where molecules are fixed in place **(solid)**.
11. The "upward" force of flight; an upward push due to differences in air pressure **(lift)**.
13. The basic structural component of the universe; everything physical **(matter)**.

Name: _____

Physics of Sound and Motion
Language Arts Word Search

Circle the vocabulary in the word search below. Can you find all the earth-related words?

F O R C E R N L G E C N M A U M
H E X L F Y H R X P O Q A P L O
F I R V X M I E X I X B T D I R
Y T I V A R G O T U O I T S R H
C V W V E P K O W O H I E E E F
D N M B I M M L M T V X R L N R
N U E X B B I D Q Y F P X U Q A
J J G V M Q R T S U R H T C X M
A Z G G U Q G A S W W A V E Q P
T K A I Y W E C T S X F P L Y A
W R D W K T E Y U I O B Y O F D
D Y G R E N E R F P O L R M N S
T F I L L Z F N P Y R N I X Q Z
V M H V J M U Z I H F E S D H J
X F Q Q Z F Y L M J W W G E S E
K I M T S P H Y S I C S Y K T T

Word Bank

DRAG
ENERGY
FORCE
GAS
GRAVITY
LIFT
LIQUID
MATTER
MOLECULES
MOTION
PHYSICS
SOLID
THRUST
VIBRATIONS

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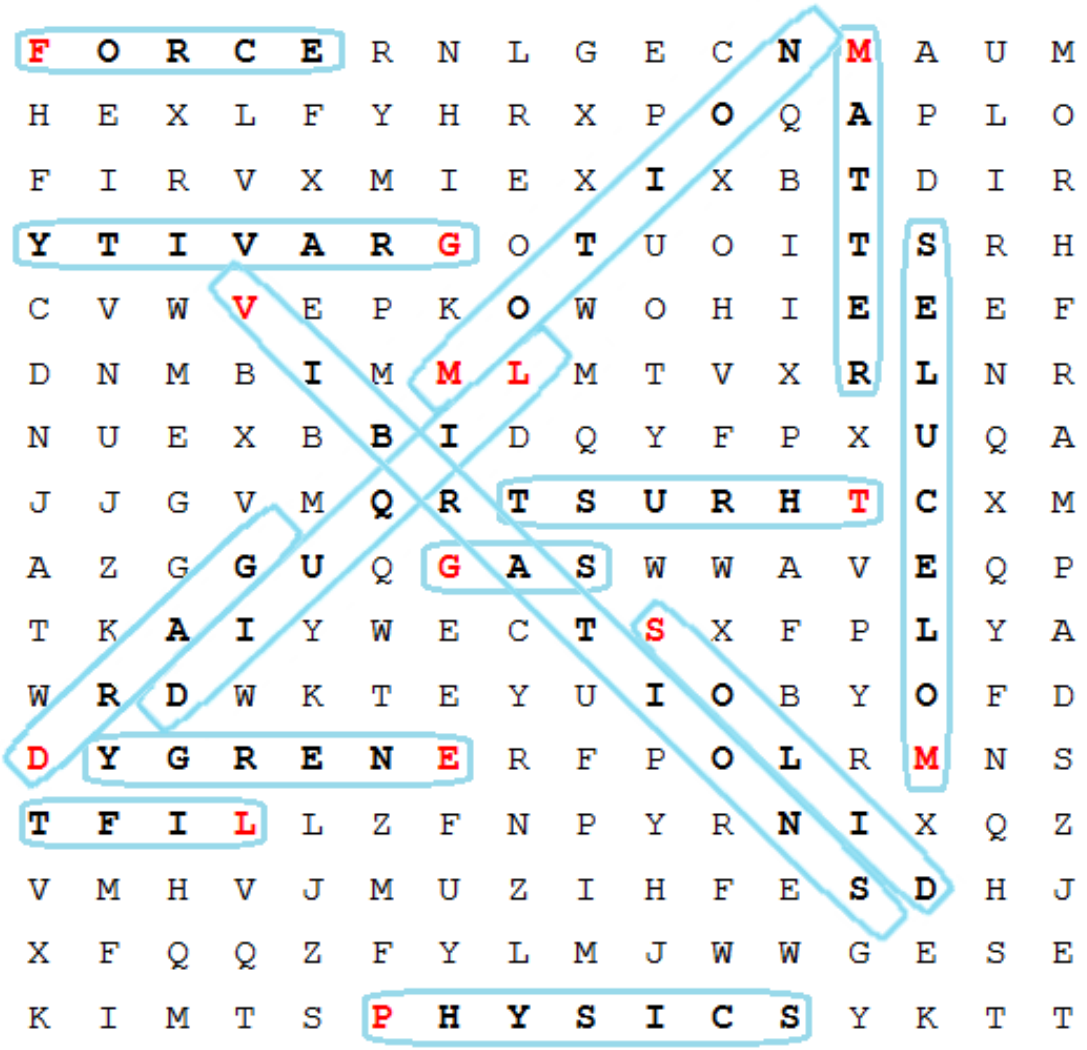
Answer Key
Physics of Sound and Motion
Language Arts Word Search



Word Bank

DRAG
ENERGY
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Physics of Sound and Motion: Extension Activities

The extension activities listed below are from RAFT (Resource Area For Teaching). RAFT educational content is available online (www.raftbayarea.org) at no cost and is aligned to California Science Standards and Next Generation Science Standards. Below is a selection of post-visit activities from RAFT to build on student learning about physics, sound, and motion.

RAFT Idea: Sound String - Resource Area For Teaching - RAFT Bay Area
Grades Covered: K through 6
Subjects Covered: Physical Science
Curriculum topics: Sound, Vibration, Sound Transfer
Description: Students can transmit sound using a simple device constructed from cups and string…
http://www.raftbayarea.org/ideas/Sound%20String.pdf

RAFT Idea: Lunch Plate Launch Pad - Resource Area For Teaching - RAFT Bay Area
Grades Covered: 2 through 12
Subjects Covered: Physical Science, Earth/Space Science
Curriculum topics: Forces, Motion, Gravity, Newton's Laws
Description: Explore forces, trajectories, and flight stability…
http://www.raftbayarea.org/ideas/Lunch%20Plate%20Launch%20Pad.pdf

RAFT Idea: Marble Rollercoaster - Resource Area For Teaching - RAFT Bay Area
Grades Covered: 2 through 12
Subjects Covered: Physical Science
Curriculum topics: Forces, Motion, Gravity, Potential and Kinetic Energy
Description: Students will love this hands-on exploration of forces and motion…
http://www.raftbayarea.org/ideas/Marble%20Rollercoaster.pdf

RAFT Idea: Earphone in a Lid - Resource Area For Teaching - RAFT Bay Area
Grades Covered: 3 through 12
Subjects Covered: Physical Science
Curriculum topics: Electricity, Magnetism, Electromagnetism, Sound, Air Pressure, Vibration
Description: Create a working earphone by combining cup lids, a magnet, and a coil of magnet wire…
http://www.raftbayarea.org/ideas/Earphone%20in%20a%20Lid.pdf

Physics of Sound and Motion: Education Standards

Our Physics of Sound and Motion program will contribute to students' ability to meet the California Science Content Standards, Common Core, and Next Generation Science Standards listed on the following pages.

California Science Content Standards Fourth Grade:

Investigation and Experimentation: Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

- **a.** Formulate and justify predictions based on cause-and-effect relationships.
- **b.** Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

Excerpted from CA State Standards: http://www.cde.ca.gov/

Common Core Fourth Grade:

Speaking and Listening Standards: Students will…

1. Engage effectively in a range of collaborative discussions with diverse partners on *grade four topics*, building on each others' ideas and expressing their own clearly.
    a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.
    b. Follow agreed-upon rules for discussions and carry out assigned roles.
    c. Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others.
    d. Review key ideas expressed and explain their own ideas and understanding in light of the discussion.
2. Paraphrase portions of information presented orally.
3. Identify the reasons and evidence a speaker provides to support particular points.

Excerpted from Common Core Standards: http://www.corestandards.org/

Next Generation Science Standards Fourth Grade:

Energy

- **4-PS3-2:** Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
    - **Science and Engineering Practices:**
        - **Planning and Carrying Out Investigations**: Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2)

- **Disciplinary core ideas**:
  - **PS3.A: Definitions of Energy:** Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2)
  - **PS3.B: Conservation of Energy and Energy Transfer** Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2)
  - Light also transfers energy from place to place. (4-PS3-2)
  - Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2)
- **Crosscutting Concepts:**
  - **Energy and Matter:** Energy can be transferred in various ways and between objects. (4-PS3-2)

Engineering Design

- **3-5-ETS1-3:** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
  - **Science and Engineering Practices:**
    - **Planning and Carrying Out Investigations**: Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
    - Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)
  - **Disciplinary core ideas**:
    - **ETS1.B: Developing Possible Solutions:** Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)
    - **ETS1.C: Optimizing the Design Solution:** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

Excerpted from NGSS: http://www.nextgenscience.org/