Moving, Exploding Earth

Youth Science Institute

Fourth-Grade Teacher Resource Guide

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Moving, Exploding Earth:
Lesson Summary and Vocabulary

Lesson Summary: YSI's ***Moving, Exploding Earth*** program offers students a comprehensive overview of geological forces. Students will first work with the instructors to discuss the earth and identify its composition. A food-based model provides an early snack and helps students visualize the layers of the earth and how they move. From there, students split into two groups to cycle between 'plate tectonics' and 'rocks and minerals' stations. In the first, they recreate tectonic forces and discover the nature of different boundaries and the earthquakes they produce. In the second, they learn how minerals can be combined and form into rocks, and how one type of rock can transform into another. Lastly, programs scheduled at YSI facilities will go on an instructor-led hike to observe some of the features and forces of our local earth. Throughout the program, students will be challenged to address and respond to a wide range of open-ended questions and help their classmates build a better picture of the planet we live on.

Vocabulary: Below are words and concepts that relate to the ***Moving, Exploding Earth*** program.

Asthenosphere: the soft, flowing part of the mantle that is near the surface and higher in temperature but lower in pressure than the inner mantle
Convergent: a type of boundary where plates come together; colliding or merging
Core: the iron and nickel center of the earth; includes a solid inner core and liquid outer core
Crust: the solid outer layer of the earth, the crust is more dense under the ocean and less dense under the continents
Divergent: a type of boundary where plates move apart; splitting
Earthquake: strong vibrations in the lithosphere caused by motion at faults and boundaries
Erosion: the process by which the surface of the earth is worn away by wind, water, or other natural forces
Igneous: a type of rock produced by the heat of a volcano; literally "born in fire"
Lava: melted rock that has exited the surface of the earth
Lithosphere: cool layer of rigid rock that includes the cooler, outermost layer of the mantle
Mantle: the semisolid portion of the earth between the crust and the core
Mesosphere: the dense lower rock layer between the asthenosphere and core; flows very slowly
Metamorphic: a type of rock that has changed forms due to extreme heat and pressure
Mineral: a naturally occurring, inorganic, crystalline solid
Rock: a substance composed of mineral matter put together under heat or pressure
Sedimentary: a type of rock formed by small deposited particles that are compressed over time
Subduction: the process by which one tectonic plate is pushed or driven under another
Transform: a type of boundary where plates move sideways to each other; change
Weathering: chemical and mechanical processes by which rocks exposed to weather (wind, rain, snow, ice, and temperature changes) decay to soil

Definitions based on www.dictionary.reference.com

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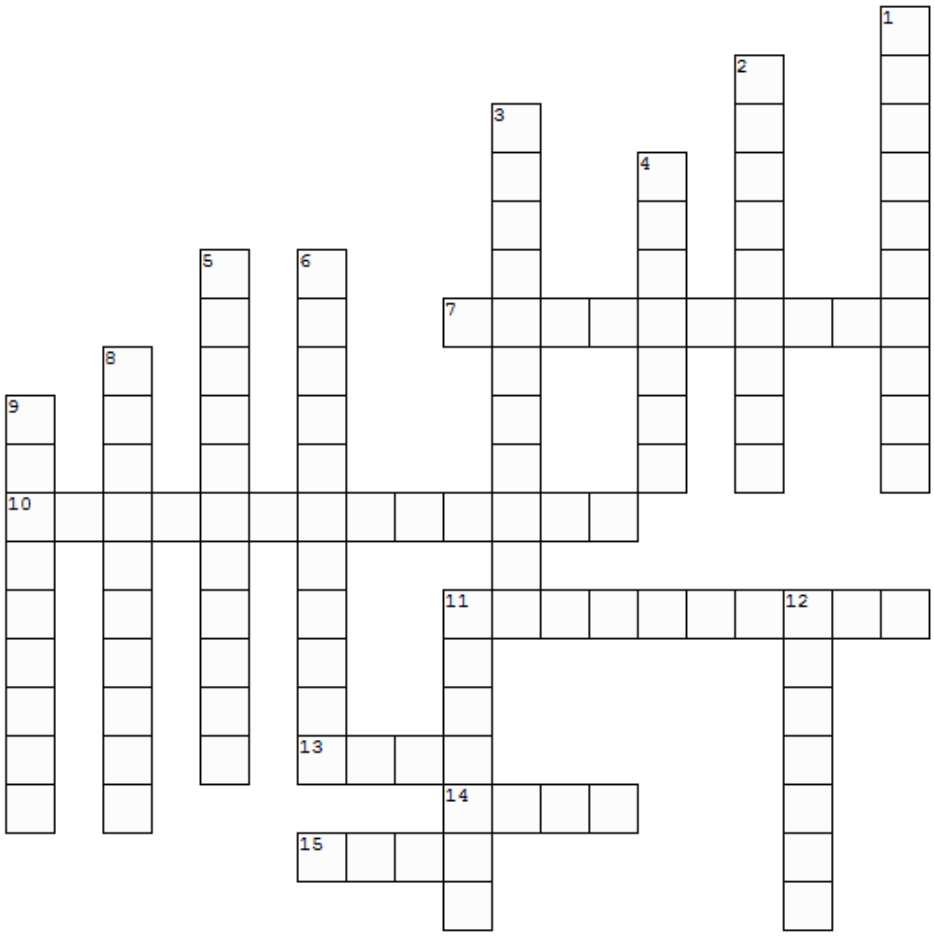
Moving, Exploding Earth
Language Arts Crossword Puzzle



MINERAL | LAVA | CORE | ROCK | CONVERGENT | IGNEOUS | EROSION | ASTHENOSPHERE | LITHOSHPERE | SEDIMENTARY | METAMORPHIC | TRANSFORM | DIVERGENT | MESOSPHERE | EARTHQUAKE | SUBDUCTION

Down

1. The process by which one tectonic plate moves under another.
2. A type of boundary where plates move apart.
3. The outermost layer of the earth; includes everything we see.
4. Rock produced by the heat of a volcano.
5. Rock formed by small deposited particles that are compressed over time.
6. Rock that changed forms due to heat and pressure.
8. Strong vibrations in the earth's crust caused by motion at faults and boundaries.
9. A type of boundary where plates slide sideways past each other.
11. An inorganic crystalline solid.
12. The process by which the surface of the earth is worn away by wind, water, or other natural forces.

Across

7. A type of boundary where plates come together.
10. The layer of fluid and semi-fluid rock just below the lithosphere.
11. The dense semi-solid rock layer between the asthenosphere and core.
13. The iron and nickel center of the earth; includes a solid inner part and liquid outer part.
14. A substance composed of mineral matter put together under heat or pressure.
15. Melted rock that has exited the surface of the earth.

Definitions based on www.dictionary.reference.com

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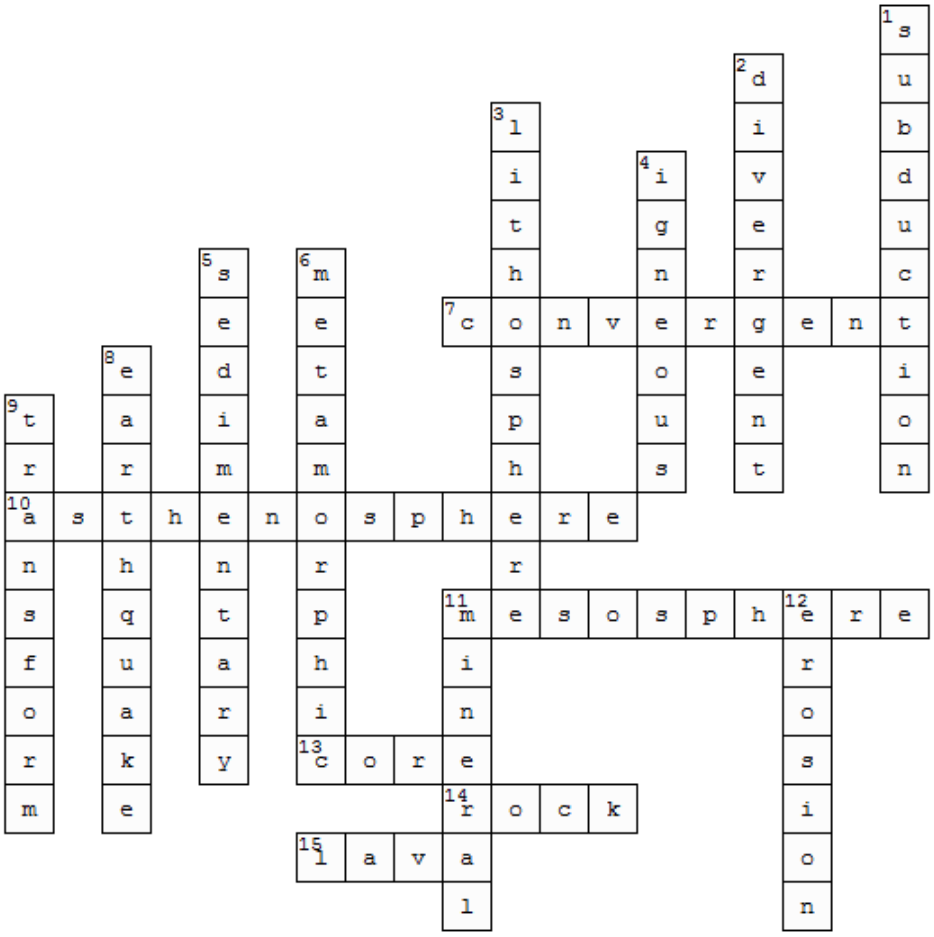
Answer Key
Moving, Exploding Earth
Language Arts Crossword Puzzle



Down

1. The process by which one tectonic moves under another **(subduction)**.
2. A type of boundary where plates move apart **(divergent)**.
3. The outermost layer of the earth; includes everything we see **(lithosphere)**.
4. Rock produced by the heat of a volcano **(igneous)**.
5. Rock formed by small deposited particles that are compressed over time **(sedimentary)**.
6. Rock that changed forms due to heat and pressure **(metamorphic)**.
8. Strong vibrations in the earth's crust caused by motion at faults and boundaries **(earthquake)**.
9. A type of boundary where plates slide sideways past each other **(transform)**.
11. An inorganic crystalline solid **(mineral)**.
12. The process by which the surface of the earth is worn away by wind, water, or other natural forces **(erosion)**.

Across

7. A type of boundary where plates come together **(convergent)**.
10. The layer of fluid and semi-fluid rock just below the lithosphere **(asthenosphere)**.
11. The dense semi-solid rock layer between the asthenosphere and core **(mesosphere)**.
13. The iron and nickel center of the earth; includes a solid inner part and liquid outer part **(core)**.
14. A substance composed of mineral matter put together under heat or pressure **(rock)**.
15. Melted rock that has exited the surface of the earth **(lava)**

Definitions based on www.dictionary.reference.com

Name: _____

Language Arts Word Search
Moving, Exploding Earth

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

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

Word Bank

ASTHENOSPHERE
CONVERGENT
CORE
DIVERGENT
EARTHQUAKE
EROSION
IGNEOUS
LAVA
LITHOSPHERE
MESOSPHERE
METAMORPHIC
MINERAL
ROCK
SEDIMENTARY
SUBDUCTION
TRANSFORM

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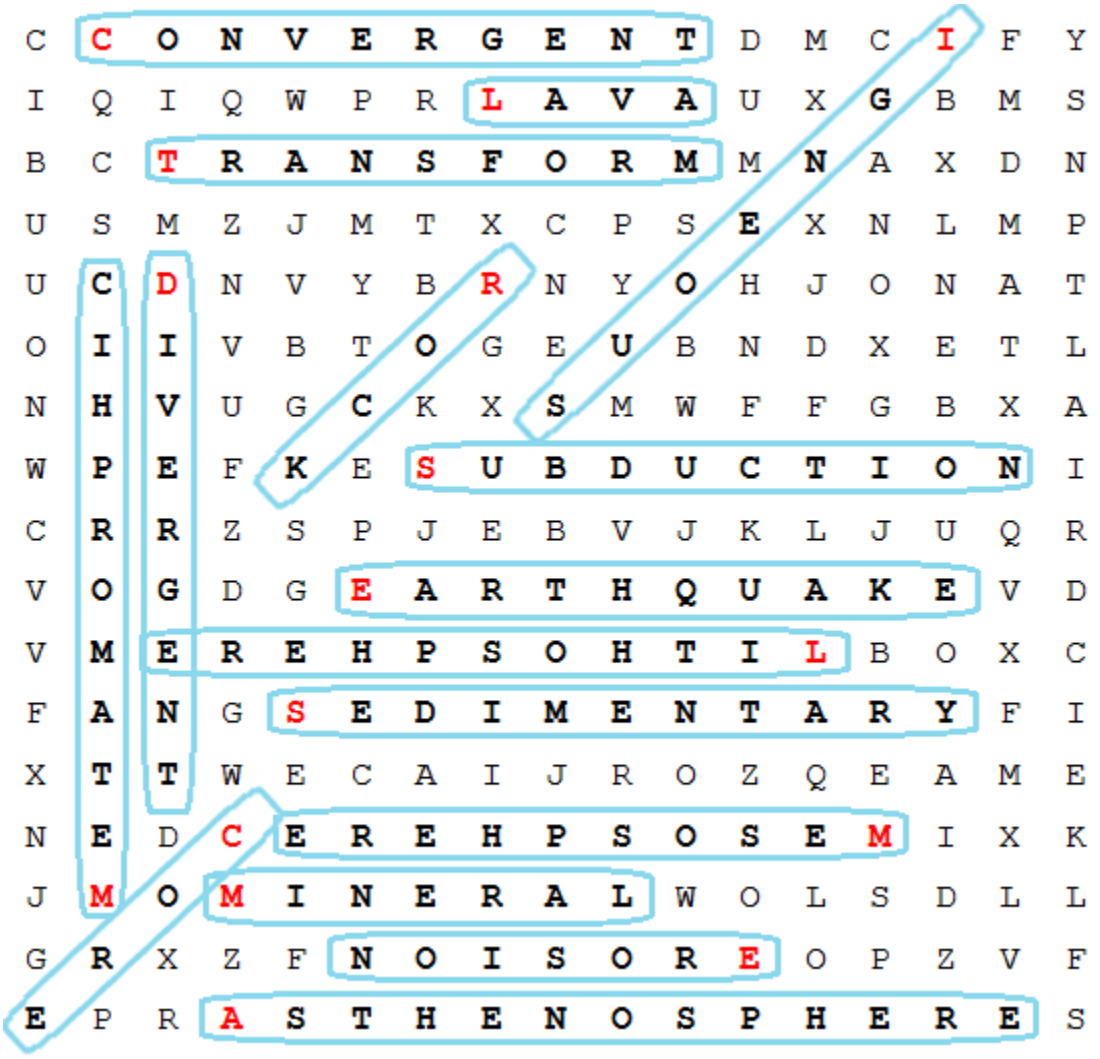
Answer Key
Language Arts Word Search
Moving, Exploding Earth



Word Bank

ASTHENOSPHERE
CONVERGENT
CORE
DIVERGENT
EARTHQUAKE
EROSION
IGNEOUS
LAVA
LITHOSPHERE
MESOSPHERE
METAMORPHIC
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ROCK
SEDIMENTARY
SUBDUCTION
TRANSFORM

Moving, Exploding Earth: 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 geology and the forces that make up our planet.

RAFT Idea: Playing with the Rock Cycle - Resource Area For Teaching - RAFT Bay Area
Grades Covered: 2 through 8
Subjects Covered: Physical Science, Earth/Space Science
Curriculum topics: Rocks and Minerals, Rock Cycle, Patterns of change
Description: Given enough time, everything changes…
http://www.raftbayarea.org/ideas/Playing%20with%20the%20Rock%20Cycle.pdf

RAFT Idea: Foam Faults – Resource Area For Teaching – RAFT Bay Area
Grades Covered: 4 through 12
Subjects Covered: Earth/Space Science
Curriculum topics: Earthquakes, Plate Tectonics, Faults
Description: In this activity, students will model the three main types of faults and examine the terrestrial movement that occurs along the fault lines.
http://www.raftbayarea.org/ideas/Foam%20Faults.pdf

RAFT Idea: On A Roll With Geologic Time – Resource Area For Teaching – RAFT Bay Area
Grades Covered: 2 through 12
Subjects Covered: Life Science, Earth/Space Science, Math
Curriculum topics: Geologic Time, Earth History, Scale
Description: Shrink billions of years and Earth's significant events…
http://www.raftbayarea.org/ideas/On%20a%20Roll%20with%20Geologic%20Time.pdf

RAFT Idea: California Geographic Assembly - Resource Area For Teaching - RAFT Bay Area
Grades Covered: 4 through 8.
Subjects Covered: Earth/Space Science, Social Studies.
Curriculum topics: Geology, Maps, California Land Features.
Description: Use transparent layers to diagram and represent different map details of California.
http://www.raftbayarea.org/ideas/California%20Geographic%20Assembly.pdf

Moving, Exploding Earth: Education Standards

Our Moving Exploding Earth 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:

Earth Sciences: 4. The properties of rocks and minerals reflect the processes that formed them. As a basis for understanding this concept:

- **a.** *Students know* how to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).
- **b.** *Students know* how to identify common rock-forming minerals (including quartz, calcite, feldspar, mica, and hornblende) and ore minerals by using a table of diagnostic properties.

5. Waves, wind, water, and ice shape and reshape Earth's land surface. As a basis for understanding this concept:

- **a.** *Students know* some changes in the earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.
- **b.** *Students know* natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.
- **c.** *Students know* moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places (weathering, transport, and deposition).

Investigation and Experimentation: 6. 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:

- **d.** 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:

Waves: Waves and Information

- **4-PS4-1:** Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.
  - **Science and Engineering Practices:**
    - **Developing and Using Models**: Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
    - Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)
  - **Disciplinary core ideas**:
    - **PS4.A: Wave Properties:** Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; it does not move in the direction of the wave except when the water meets the beach. (Note: This grade band endpoint was moved from K–2). (4-PS4-1)
    - Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)
  - **Crosscutting Concepts**
    - **Patterns:** Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1)

Earth's Systems: Processes that Shape the Earth

- **4-ESS2-2:** Analyze and interpret data from maps to describe patterns of Earth's features.
  - **Science and Engineering Practices:**
    - **Analyzing and Interpreting Data**: Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.
    - Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)
  - **Disciplinary core ideas**:
    - **ESS2.B: Plate Tectonics and Large-Scale System Interactions:** The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)
  - **Crosscutting Concepts**
    - **Patterns:** Patterns can be used as evidence to support an explanation. (4-ESS2-2)

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