

Connections in the Deep: The Last Unexplored Territory

Grade Level or Special Area: 6th Grade Connections

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Length of Unit: Seven 45-minute lessons

I. ABSTRACT

- A.** Dive in and discover a world that lies 6 miles under the surface of the water. Visit places where new species and new ecosystems are being discovered every day. This unexplored territory is challenging a history of assumptions, unlocking new connections for a wide variety of young learners. During this unit, students will study deep ocean environments and ecosystems while connecting them to 6th grade elements of music, art, history, math, and language arts.

II. OVERVIEW

A. Concept Objectives

1. Students will understand environmental conditions related to the deep ocean.
2. Students will understand how natural processes create or change land forms.
3. Students will develop knowledge of the bio-diversity in deep sea ecosystems.
4. Students will understand relationships between the deep oceans and music, math, art, history, and language arts.

B. Content from the *Core Knowledge Sequence*

1. Writing And Research (CK Sequence p. 133)
 - a. Asking open ended questions
 - b. Write a standard business letter
2. Grammar and usage (CK Sequence p.133)
 - a. Identify different sentence types and write for variety
3. Spelling (CK Sequence p. 134)
 - a. Characteristic
 - b. Cooperate
 - c. Dependent
 - d. Interrupt
 - e. Occurrence
4. Vocabulary (CK Sequence p. 134-135)
 - a. Acoustics: *not from CK Sequence*
 - b. Aquarium
 - c. Bacteria: *not from CK Sequence*
 - d. Chemosynthesis: *not from CK Sequence*
 - e. Evident
 - f. Hydrogen Sulfide: *not from CK Sequence*
 - g. Hydrothermal Vent: *not from CK Sequence*
 - h. Primary
 - i. Sonar
 - j. Sulfur bacterium: *not from CK Sequence*
 - k. Upwelling: *not from CK Sequence*
5. Poems (CK Sequence p.135)
 - a. *If* (Rudyard Kipling)

- b. “Apostrophe to the Ocean” [from *Childe Harold’s Pilgrimage*, Canto 4, Nos. 178-184] (George Byron)
- 6. Sayings and Phrases (CK Sequence p.136)
 - a. Truth is stranger than fiction
 - b. There’s more than one way to skin a cat
 - c. Bite the dust
 - d. Necessity is the mother of invention
 - e. He who hesitates is lost
- 7. Spatial Sense (CK Sequence p. 137)
 - a. Continents and major oceans (CK Sequence p. 137)
- 8. Visual Arts (CK Sequence p. 144-145)
 - a. Renaissance: Leonardo DaVinci: *Old Man with Water Studies, c. 1513*
 - b. Romantic: Caspar David Friedrich, *The Chalk Cliffs of Rugen*
 - c. Baroque: El Greco, *View of Toledo*
 - d. Realism: Winslow Homer, *Noreaster*
- 9. Elements of Music (CK Sequence p. 146)
 - a. Recognize frequently used Italian terms
 - i. Grave
 - ii. Largo
 - iii. Allegro
 - iv. Presto
 - v. Prestissimo
 - vi. Legato
 - vii. Staccato
- 10. Classical Music: From Baroque to Romantic (CK Sequence p.147)
 - a. Classical: Ludwig van Beethoven, *Symphony No. 6*, final movement: “Thunderstorm”
 - b. Romantic: Ludwig van Beethoven: Thunderstorm
 - c. Baroque: George Frederick Handel: selections from *Water Music*
 - d. Classical: Vivaldi: *La Tempesta di mare*
- 11. Numbers and Number Sense (CK Sequence p. 148)
 - a. Round to the nearest ten; to the nearest hundred; to the nearest thousand; to the nearest hundred-thousand; to the nearest million
- 12. Percent (CK Sequence p. 148)
 - a. Find the given percent of a number, and find what percent a given number is of another number
 - b. Solve problems involving percent increase and decrease
- 13. Solving Problems and Equations (CK Sequence p. 149)
 - a. Solve word problems with multiple steps
- 14. Measurement (CK Sequence p. 149)
 - a. Solve problems requiring conversion of units within the U.S. Customary System and with the metric system
- 15. Plate Tectonics (CK Sequence p. 152)
 - a. The surface of the earth
 - b. Crust movements
 - c. Evidence for long-term movement of plates. . .
- 16. Oceans (CK Sequence p. 152)

- a. Surface
 - b. Subsurface land features
 - c. Ocean bottom
 - d. Composition of seawater
 - e. Currents, tides, and waves
 - i. Upwelling
 - f. Marine life
 - i. Life zones
 - b. The bottom or “Benthic zone”
 - ii. Deepwater life
17. Energy (CK Sequence p. 153)
- a. Sources of energy
18. The Human Body (CK Sequence p. 154)
- a. The immune system: bacteria, fungi
19. Science Biographies (CK Sequence p. 154)
- a. Alfred Wegner

C. Skill Objectives

1. Students will generate topics and develop ideas for a variety of writing and speaking purposes. (Adapted from Colorado Standards and Grade Level Expectations (CSGLE) for language arts, 6.2.A)
2. Students will organize their writing so that there is an introduction, logical arrangement of ideas, and a conclusion. (Adapted from CSGLE 6.2.B)
3. Use correct transitions to link ideas. (CSGLE 6.2.C)
4. Choose vocabulary that communicates messages clearly and precisely. (CSGLE 6.2.D)
5. Revise drafts for coherence, progressions, and logical support. (CSGLE 6.2.F)
6. Edit drafts for specific purposes such as to ensure standard usage, varied sentence structure, and appropriate word choice. (CSGLE 6.2.G)
7. Create readable documents with legible handwriting or word processing at the appropriate time. (CSGLE 6.2.H)
8. Write in complete sentences varying the types such as compound and complex, and using appropriately punctuated dependent clauses (CSGLE 6.3.B)
9. Know and use correct capitalization, punctuation, and abbreviations. (CSGLE 6.3.E)
10. Read, respond to, and discuss a variety of poetry. (Adapted from CSGLE 6.6.A)
11. Explain how natural processes create or change land forms, and give actual geographic locations as examples. (Adapted from CSGLE for GEO.5-8.3.2.B)
12. Identify unique features of particular art styles and movements. (CSGLE for ART 6.16) (S=4)
13. Apply the four steps of art criticism: 1) describe, 2) analyze the work in terms of elements and design principles, 3) interpret the work in terms of ideas and emotions, and 4) judge the work as to its success both technically and in either communicating an idea, and emotion, or fulfilling a practical purpose. (CSGLE for ART 6.22) (S=5)

14. Develop criteria for evaluating the quality of musical performances. (Adapted from CSGLE for MUSIC 6.8) (S4)
15. Analyze the form in music from varied world cultures (Adapted from CSGLE for MUSIC 6.10) (S4, S5)
16. Recognize the scientific contributions that are made by individuals of diverse backgrounds, interests, talents, and motivations. (CSGLE for SCIENCE 6.6.E)
17. Explain how adaptations affect a species survival. (CSGLE for SCIENCE 6.3.A)
18. Challenge prevailing theories and new theories which lead to looking at old observations in a new way. (CSGLE for SCIENCE 6.6.B)

III. BACKGROUND KNOWLEDGE

A. For Teachers

1. Aleshire, P. *Ocean Ridges and Trenches (The Extreme Earth)*. New York: Chelsea House Publications, 2007, ISBN-10: 0816059195, ISBN-13: 978-0816059195. (Available used from \$19.80)
2. Hoyt, E. *Creatures of the Deep: In search of the sea's 'monsters' and the world they live in*. Ontario, Canada: Firefly Books, 2001, ISBN-10: 1552093409, ISBN-13: 978-1552093405. (Available used for \$9.09)
3. Gowell, E. T. *Fountains of Life: The Story of Deep Sea Vents (First Books - Ecosystems)*. New York: Franklin Watts, 1998, ISBN-10: 0531159086, ISBN-13: 978-0531159088. (Available used from \$1.08)

B. For Students

1. 1st Grade: Elements of art (CK Sequence p. 31)
2. 2nd Grade: Atlantic & pacific oceans (CK Sequence p. 51)
3. 4th Grade: Reading maps and globes (CK Sequence p. 91)
4. 4th Grade: Black plaque (CK Sequence p. 92)
5. 4th Grade: Geology: The earth and its changes (CK Sequence p. 105)
6. 5th Grade: Recognize musical form (CK Sequence p. 121)
7. 5th Grade: Composers and their music (CK Sequence p. 122)
8. 5th Grade: Multiplication & division (CK Sequence p. 124)
9. 5th Grade: Finding mathematical averages (CK Sequence p. 124)
10. 5th Grade: Cells without nuclei: Monerans: Bacteria (CK Sequence p. 127)

IV. RESOURCES

- A. Caldecott, J., & Salmon, M. *Deep Water*: London: Ellipsis, 1999. ISBN-10: 1899858792, ISBN-13: 978-1899858798. (Available used from www.amazon.com for less than \$1.00.) (Lessons 2-5)
- B. Madin, K. *Down to a Sunless Sea: The Strange World of Hydrothermal Vents*: Austin, TX; Raintree Steck-Vaughn, 2000. ISBN-10: 0739812394, ISBN-13: 978-0739812396. (Available used at www.amazon.com for less than \$2.00.) (Lessons 1-5)
- C. CD 1 – *Tempest: Classic Storms*. Helsinki Philharmonic Orchestra, Proarte, 1993. ASIN: B000009JAR (Beethoven's 6th Symphony is in most Core Knowledge Music Libraries: available used on www.amazon.com for \$5.00.) (Lessons 1 & 2)
- D. CD 2 – Camille Saint-Seans. *Carnival of the Animals*. London festival Orchestra, Arte Nova Classics, 2006, ASIN: B000E1P24E (In most Core Knowledge Music Libraries. Available used on www.amazon.com for \$4.00.) (Lesson 2)

- E. CD 3 – Handel. *Water Music; Music for the Royal Fireworks*. Aradia Endemle, Naxos, 2006, ASIN: B000CEVU5I (In most Core Knowledge Music Libraries. Available used on www.amazon.com for \$5.00.) (Lesson 3)
- F. CD 4 – Vivaldi: *Nature Concertos*. Sonatori de la Gioiosa Marca, Erato, 2000, ASIN: B00004GP1Y (In most Core Knowledge Music Libraries. Available used on www.amazon.com for \$6.00.) (Lesson 4)

V. LESSONS

Lesson One: Getting Under the Water (45 Minutes)

A. Daily Objectives

1. Concept Objective(s)
 - a. Students will understand environmental conditions related to the deep ocean.
 - b. Students will understand relationships between the deep oceans and music, math, art, history, and language arts.
2. Lesson Content
 - a. Spelling (CK Sequence p. 134)
 - i. Interrupt (lesson 1)
 - b. Vocabulary (CK Sequence p. 134-135)
 - i. Bacteria
 - ii. Evident
 - iii. Upwelling
 - c. Sayings and Phrases (CK Sequence p.136)
 - i. Truth is stranger than fiction (lesson 1)
 - d. Spatial Sense (CK Sequence p. 137)
 - i. Continents and major oceans (CK Sequence p. 137)
 - e. Visual Arts (CK Sequence p. 144-145)
 - i. Renaissance: Leonardo DaVinci: *Old Man with Water Studies, c. 1513*
 - f. Elements of Music (CK Sequence p. 146)
 - g. Classical Music: From Baroque to Romantic (CK Sequence p.147)
 - i. Classical: Ludwig van Beethoven, *Symphony No. 6*, final movement: “Thunderstorm”
 - h. Numbers and Number Sense (CK Sequence p. 148)
 - i. Round to the nearest ten; to the nearest hundred; to the nearest thousand; to the nearest hundred-thousand; to the nearest million.
 - i. Solving Problems and Equations (CK Sequence p. 149)
 - i. Solve word problems with multiple steps
 - j. Measurement (CK Sequence p. 149)
 - i. Solve problems requiring conversion of units within the U.S. Customary System and with the metric system.
 - ii. Associate prefixes used in metric system with quantities
 - k. Oceans (CK Sequence p. 152)
 - i. Surface
 - ii. Subsurface land features
 - iii. Ocean bottom
 - iv. Composition of seawater

- v. Currents, tides, and waves
- vi. Upwelling
- vii. Marine life
- viii. Life zones
- ix. The bottom or “Benthic zone”
- x. Deepwater life
- l. Energy (CK Sequence p. 153)
 - i. Sources of energy
- m. The Human Body (CK Sequence p. 154)
 - i. The immune system: bacteria, fungi
- 3. Skill Objective(s)
 - a. Identify unique features of particular art styles and movements. (CSGLE for ART 6.16) (S=4)
 - b. Apply the four steps of art criticism: 1) describe, 2) analyze the work in terms of elements and design principles, 3) interpret the work in terms of ideas and emotions, and 4) judge the work as to its success both technically and in either communicating an idea, and emotion, or fulfilling a practical purpose. (CSGLE for ART 6.22) (S=5)
 - c. Develop criteria for evaluating the quality of musical performances. (Adapted from CSGLE for MUSIC 6.8) (S4)
 - d. Analyze the form in music from varied world cultures (Adapted from CSGLE for MUSIC 6.10) (S4, S5)
 - e. Recognize the scientific contributions that are made by individuals of diverse backgrounds, interests, talents, and motivations. (CSGLE for SCIENCE 6.6.E)
 - f. Explain how adaptations affect a species survival. (CSGLE for SCIENCE 6.3.A)
 - g. Challenge prevailing theories and new theories which lead to looking at old observations in a new way. (CSGLE for SCIENCE 6.6.B)

B. Materials

- 1. White board or chalk board with markers/chalk
- 2. Track 4 from CD: Tempest: Beethoven, *Symphony No. 6*, final movement: “Thunderstorm”
- 3. CD Player
- 4. Writing utensils for all students
- 5. Calculators for all students
- 6. Overhead projector or LCD projector
- 7. One copy or overhead of Appendix B: *Old Man with Water studies*
- 8. Copies of Appendix C: Deep Math
- 9. Copies of Appendix D: First Review for the whole class
- 10. Book: *Down to a Sunless Sea*

C. Key Vocabulary

- 1. It became clear or **evident** that the sunlight could not penetrate a mile below the ocean’s surface.
- 2. In order to **interrupt** bacterial growth, cellular structures must be frozen.
- 3. **Bacteria** are round, spiral, or rod shaped organisms that typically live in soil, water, organic matter, or the bodies of plants and animals.

4. Areas of **upwelling** are created by surface winds that pull surface water away from one area inviting water from deeper areas to surface.

D. Procedures/Activities

1. Prior to the class arriving, write the unit name on the board along with today's lesson title. Prepare the CD, Ludwig van Beethoven, *Symphony No. 6*, final movement: "Thunderstorm" from the *Tempest* CD (Track 4). Have this music playing as the class enters the room and allow it to play in the background.
2. Upon arrival, explain to the class that it is time to head underwater. Explain that the next few days will be spent studying the largest unexplored part of our world, "*The Deep Ocean*".
3. Say, "*Imagine you are an apple. You are placed into a heavy lunch box and accidentally dropped into the ocean. You fall down, and farther down, and farther, and farther, and farther down until you touch the bottom of the ocean. It is now **evident** that you are 1 mile beneath the surface of the water.*"
4. Ask, "Can anyone tell me how many feet below the water the lunch box is?" (Answer is: 1 mile = 5,280 feet.)
5. Ask, "How many meters is 5,280 feet?" (Write on the board 1 meter = 3.281 feet.) Allow the class to attempt to answer, and allow volunteers to attempt the math (5,280/3.281) on the board. (Answer is approx. 1609 meters.)
6. Say, "*So, I said it was "evident" that we were 1 mile below the surface. Did you know that the Latin root of the word evident is "video" or "visum". This is because the word "evident" is related to seeing visual proof. So, think about the evidence of the world around you 1 mile below the surface.*"
7. Ask, "*What does the world look like around you?*" (Allow for answers from the class – good answers are: very dark, cold, desolate, empty).
8. Ask, "*What is the temperature around you?*" (Allow for answers from the class. Answer is 32 – 35 degrees Fahrenheit or 0-3 degrees Celsius.)
9. Then say, "*Imagine if a year went by in these conditions before the lunch box was discovered by a deep sea vehicle, which then brings it back to the surface. A hungry diver opens the lunch box, looks strangely at the apple and then eats it.*"
10. Ask, "*What do you think the apple would look like?*" (Allow for brief answers from the class).
11. Ask, "*What do you think the apple would smell or taste like?*" (Allow for brief answers from the class).
12. Turn off the CD.
13. Open the book *Down To A Sunless Sea* and turn to page 31. Read the highlighted blue section in the right column. (This section describes the 1968 deep sea accident that left a lunch one mile below sea level that was still edible after 10 months.)
14. Say, "*Was this apple story fiction or non-fiction?*" (The answer is fiction.)
15. Write the phrase, "Truth is stranger than fiction" on the board. Explain to the class that the true story of the apple is so unbelievable that many people would think it was fiction (false). Stories like these are often explained with the Core Knowledge phrase, "Truth is stranger than fiction".
16. Ask, "*What factors stopped or **interrupted** the food from rotting?*" (Answers: Bacteria develop slower because of the intense pressure and colder temperatures at lower depths.)

17. Repeat the question from point #15 above and spell the word “interrupt” on the board, and explain that this word is a 6th grade spelling word. Note the double “rr” to the class and ask for a student in the class to use it in a sentence.
18. Ask, “*If an apple was still edible after 10 months because the bacteria was slow to develop at such a deep point in the ocean, would bacteria affect a human body in the same way at the same depth?*” (Allow for brief answers – 2 minutes).
19. Explain that there are anywhere between 500 and 100000 types of bacteria alive in the human body at any given time. Some bacteria are helpful to the human body, such as bacteria that help our digestive system break down food. Most of these helpful bacteria live in the large intestine. Another majority of bacteria are considered useless to the human body, but some bacteria can be very harmful.
20. Write the definition (listed above) of bacteria on the board.
21. Ask, “*Can anyone name types of bacteria that can be harmful to the human body?*” (Some answers: tuberculosis, leprosy, cholera, bronchitis, pneumonia, syphilis, tetanus, and typhoid.) (*4th Grade connection – Yersinia pestis: Black Plague. 5th Grade connection - cells without nuclei: Monerans: bacteria.*)
22. Ask, “*If a deep sea diver had just been exposed to a harmful bacterial infection such as bronchitis or pneumonia, would the illness develop any slower 1 mile underwater?*” (Answer is “yes”, but the warmth required for a human body to stay alive would still allow for a faster bacterial development than the apple. Allow for brief discussion – 2 minutes).
23. Explain to the class that, like the lunch box, there are many surprising things about the deep ocean. Because of the pressures and dangers of studying the deep seas, our scientists have only been able to personally study it for the past 40 years. In fact, the deep oceans are only now being discovered. There are still thousands of miles of unexplored territories and thousands of undiscovered species. But, this deep sea excitement and fascination is not a new trend. Humans have been curious about the unknown mysteries underwater since the beginning of history.
24. Explain to the class that there have been many musicians who have written music that relates to the sea. Explain that the song they heard when they came into class was related to the ocean. It was called “Thunderstorm” by Ludwig van Beethoven. Write the song name and composer’s name on the board.
25. **OPTIONAL:** *Music teachers may expand this section about this 6th grade Core Knowledge composer. For more information, see Appendix I: Connections*
26. Ask the class how a thunderstorm can relate to or affect the deep ocean and allow for a few brief answers.
 - a. Answers to look for and bring to light:
 - i. Thunderstorms and hurricanes develop over deep water.
 - ii. Storms churn the seas, allowing for the lifting and falling of vital undersea nutrients. This churning can help vital nutrients reach deepwater life. This is a function of “upwelling” (write this word on the board with its definition from the vocabulary listed above).

- iii. Ocean currents and temperatures dictate wind and low pressure developments, and affect the continents around them with developing storms.
27. Transition past this dialogue by displaying the picture in Appendix B: *Old Man with Water Studies*, c. 1513. (Use an overhead or LCD projector.)
 28. Ask the class if they recognize the old man in the picture. (The answer is Leonardo daVinci.) Read the four points on the appendix aloud and ask the class if they know of any other artists or musicians who have related their work to water or to oceans. Allow for a brief discussion.
 29. **OPTIONAL:** *Art teachers may expand this section about this 6th grade Core Knowledge art connection. For more information, see Appendix I: Connections.*
 30. Explain that Leonardo would have loved to explore the deep oceans, but there were no possible ways to study the earth at such depths.
 31. Ask, “How deep do you think our oceans can get?” (Allow time for answers.)
 32. Pass out Appendix C: Deep Math to all students. Read the instructions aloud and let the students complete the questions. This will take 5-10 minutes. Students should use calculators for this task. (*Appendix C may be used as a take-home assignment for considerations of time and differentiation.*)
 33. **OPTIONAL:** *Science teachers or lab instructors may expand this section in a lab setting by adding the following 6th Grade CK Sequence content connections:*
 - a. *Surface*
 - b. *Subsurface land features*
 - c. *Ocean bottom*
 - d. *Composition of seawater*
 - e. *Currents, tides, and waves*
 - f. *Upwelling (from this lesson)*
 - g. *Marine life*
 - h. *Life zones*
 - i. *The bottom or “Benthic zone”*
 34. Collect Appendix C for grading and use Appendix E to conduct a verbal review of the day’s lesson.

E. Assessment/Evaluation

1. Appendix C: Deep Math
2. Appendix E: First Review

Lesson Two: Going Deep! (45 Minutes)

A. Daily Objectives

1. Concept Objective(s)
 - a. Students will understand environmental conditions related to the deep ocean.
 - b. Students will understand how natural processes create or change land forms.
 - c. Students will develop knowledge of the bio-diversity in deep sea ecosystems.
 - d. Students will understand relationships between the deep oceans and music, math, art, history, and language arts.

2. Lesson Content
 - a. Vocabulary (CK Sequence p. 134-135)
 - i. Aquarium
 - ii. Hydrothermal Vents: not in CK Sequence
 - b. Sayings and Phrases (CK Sequence p.136)
 - i. Necessity is the mother of invention
 - ii. There's more than one way to skin a cat
 - c. Spatial Sense (CK Sequence p. 137)
 - i. Continents and major oceans (CK Sequence p. 137)
 - d. Visual Arts (CK Sequence p. 144-145)
 - i. Romantic: Caspar David Friedrich, *The Chalk Cliffs of Rugen*
 - e. Elements of Music (CK Sequence p. 146)
 - i. Recognize frequently used Italian terms
 - a. Grave
 - b. Largo
 - c. Allegro
 - d. Presto
 - e. Prestissimo
 - f. Legato
 - g. Staccato
 - f. Classical Music: From Baroque to Romantic (CK Sequence p.147)
 - i. Romantic: Camille Saint-Seans: "Aquarium" from *Carnival of the Animals*
 - g. Percent (CK Sequence p. 148)
 - i. Find the given percent of a number, and find what percent a given number is of another number
 - ii. Solve problems involving percent increase and decrease
 - h. Solving Problems and Equations (CK Sequence p. 149)
 - i. Solve word problems with multiple steps
 - i. Plate Tectonics (CK Sequence p. 152)
 - i. The surface of the earth
 - ii. Crust movements
 - iii. Evidence for long-term movement of plates. . .
 - j. Oceans (CK Sequence p. 152)
 - i. Subsurface land features
 - ii. Ocean bottom
 - iii. Marine life
 - iv. Deepwater life
 - k. Energy (CK Sequence p. 153)
 - i. Sources of energy
3. Skill Objective(s)
 - a. Identify unique features of particular art styles and movements. (CSGLE for ART 6.16) (S=4)
 - b. Apply the four steps of art criticism: 1) describe, 2) analyze the work in terms of elements and design principles, 3) interpret the work in terms of ideas and emotions, and 4) judge the work as to its success

- both technically and in either communicating an idea, and emotion, or fulfilling a practical purpose. (CSGLE for ART 6.22) (S=5)
- c. Develop criteria for evaluating the quality of musical performances. (Adapted from CSGLE for MUSIC 6.8) (S4)
 - d. Analyze the form in music from varied world cultures (Adapted from CSGLE for MUSIC 6.10) (S4, S5)
 - e. Recognize the scientific contributions that are made by individuals of diverse backgrounds, interests, talents, and motivations. (CSGLE for SCIENCE 6.6.E)
 - f. Explain how adaptations affect a species survival. (CSGLE for SCIENCE 6.3.A)
 - g. Challenge prevailing theories and new theories which lead to looking at old observations in a new way. (CSGLE for SCIENCE 6.6.B)

B. Materials

1. White board or chalk board with markers/chalk
2. CD: Track 4: Tempest: Beethoven, *Symphony No. 6*, final movement: “Thunderstorm”
3. CD: CD 2 – Track 8: Camille Saint-Seans, *Carnival of the Animals*: “Aquarium”
4. CD Player
5. Writing utensils for all students
6. Overhead projector or LCD projector
7. Copies of Appendix A: Listening Worksheet for the whole class
8. One copy or overhead of Appendix F: *The Chalk Cliffs of Rugen*
9. Copies of Appendix G: Going Deep Quiz
10. Book: *Down to a Sunless Sea*
11. Book: *Deep Water*

C. Key Vocabulary

1. An **aquarium** is a container (often a glass tank) or an artificial pond in which living aquatic animals or plants are kept..
2. **Hydrothermal Vents** are hot spots at the bottom of the deep ocean that allow hot water mixed with chemicals to flow outward.

D. Procedures/Activities

1. Prior to the arrival of the class, begin playing Beethoven’s Thunderstorm (CD 1: Track 4) once again. Write the title of the unit and title of the lesson on the board.
2. If Appendix C was sent home as an assignment at the end of the previous lesson, collect it as students arrive.
3. Once the class is seated, pass out Appendix A: Listening Worksheet to the whole class. Tell them to carefully read the instructions, and complete the worksheet.
4. After 3-5 minutes stop the CD and ask for a brief discussion on the final question of the worksheet.
5. Now play CD 2: Track 8 (Camille Saint-Seans, “Aquarium”). Write the composer’s name and the song title on the board. Instruct the class to fill out and respond to the worksheet questions just below their answers from the previous song. They may use the back if they need additional room.
6. Stop the CD after 3 to 5 minutes.

7. Discuss volunteer answers from the worksheet, and compare the two musical selections by contrasting style, mood, and intensity.
8. Collect the worksheets.
9. Say, *“Both of the songs we have heard relate to the ocean. Most of us have visited an aquarium, which is an experience that allows us to experience the ocean without being in the ocean”*
10. **OPTIONAL:** *Music teachers may expand this section about these 6th grade Core Knowledge composers. For more information, see Appendix I: Connections*
11. Explain that the first song we heard (“Thunderstorm”) was from the classical music era, and the 2nd (Aquarium) was from the Romantic era. But, as was explained in the previous lesson, there were many different people interested in the oceans, and this interest appeared in art in the Romantic period. Let’s take a look at an example.
12. Display Appendix F: *The Chalk Cliffs of Rugen*. Read each of the 5 questions on the appendix aloud and allow students to answer. Spend 3-5 minutes discussing the questions and answers.
13. **OPTIONAL:** *Art teachers may expand this section about this 6th grade Core Knowledge art connection. For more information, see Appendix I: Connections.*
14. Transition by opening the book *Deep Water* to page 28.
15. **OPTIONAL:** *This book (Deep Water) has three languages on each page – English, French, and Spanish. This allows for multicultural connections/uses for foreign language throughout the unit.*
16. Say, *“It is time to go deep and seek out the mystery, the mystery that all the artists we have discussed likely wanted to know: What the undiscovered world deep below the ocean floor is truly like.”*
17. Read page 28 and share the pictures with the class.
18. Open the book *Down to a Sunless Sea*.
19. Read the green highlighted section titled, “Welcome to the Bottom of the World” on page 6.
20. From the same book, select readers to come forward and read chapter one to the class (pages 5-17). Allow time for the class to see the pictures when the reading lends itself to it, switching readers periodically. This will take 15 minutes.
21. When finished with chapter one, explain that the deep ocean is still being discovered. Now that scientists have discovered hot spots called **hydrothermal vents** that can support life, they have begun finding amazing new species in places that they thought could not support life.
22. Say, *“These findings help explain two Core Knowledge sayings. The first is, “There’s more than one way to skin a cat “, and the second is, “Necessity is the mother of invention.”*
23. Ask, *“Can someone help to explain why these two phrases are explained by these new deep ocean discoveries?”* (Repeat the phrases as needed. The answers are just below. Beyond these, there are many possible explanations.)
 - a. *Skin a cat . . . There are many different ways to get a job done. There are many different ways to survive in nature. In this case, life at this depth without both sunlight and surface food sources was thought to be impossible.*

- b. *Necessity. . . Something that you say which means that if you want to do something very much you will think of a way to do it. Scientists needed to understand why there appeared to be areas of warmth in the deep ocean, and finally invented a deep ocean vehicle named “Alvin” in 1977 for finding their answers.*
 - 24. Ask, “*If Alvin allowed scientists to see the deep ocean floor for the first time in 1977, how many years have we been visually studying the deep ocean?*” (Allow for a volunteer answer.)
 - 25. Say, “*Because of the new discoveries in the deep ocean, and the short amount of time we’ve been studying it, perhaps we are all like the two people in Friedrich’s painting of “The Chalk Cliffs of Rugen”. We are staring curiously down at something we can’t yet completely see.*”
 - 26. Pass out Appendix G: Going Deep Quiz to all students and allow 10 minutes for completion.
 - 27. If time permits, collect the quizzes and review the answers.
- C. *Assessment/Evaluation*
- 1. Review of Appendix A: Listening Worksheet (Effort-based pass/fail)
 - 2. Appendix G: Going Deep Quiz

Lesson Three: Scary Creatures, Strange Lands! (45 Minutes)

A. Daily Objectives

- 1. Concept Objective(s)
 - a. Students will understand environmental conditions related to the deep ocean.
 - b. Students will develop knowledge of the bio-diversity in deep sea ecosystems.
 - c. Students will understand relationships between the deep oceans and music, math, art, history, and language arts.
- 2. Lesson Content
 - a. Spelling (CK Sequence p. 134)
 - i. Dependent
 - b. Vocabulary (CK Sequence p. 134-135)
 - i. Chemosynthesis
 - ii. Hydrogen Sulfide
 - iii. Sulfur Bacterium
 - c. Sayings and Phrases (CK Sequence p.136)
 - i. Bite the dust
 - ii. He who hesitates is lost
 - d. Spatial Sense (CK Sequence p. 137)
 - i. Continents and major oceans (CK Sequence p. 137)
 - e. Visual Arts (CK Sequence p. 144-145)
 - i. Baroque: El Greco, *View of Toledo*
 - f. Elements of Music (CK Sequence p. 146)
 - i. Recognize frequently used Italian terms
 - a. Grave
 - b. Largo
 - c. Allegro
 - d. Presto
 - e. Prestissimo

- f. Legato
- g. Staccato
- g.** Classical Music: From Baroque to Romantic (CK Sequence p.147)
 - i.** Baroque: George Frederick Handel: selections from *Water Music*
- h.** Plate Tectonics (CK Sequence p. 152)
 - i.** The surface of the earth
 - ii.** Crust movements
 - iii.** Evidence for long-term movement of plates. . .
- i.** Oceans (CK Sequence p. 152)
 - i.** Subsurface land features
 - ii.** Ocean bottom
 - iii.** Marine life
 - iv.** Deepwater life
- j.** Energy (CK Sequence p. 153)
 - i.** Sources of energy
- 3.** Skill Objective(s)
 - a.** Identify unique features of particular art styles and movements. (CSGLE for ART 6.16) (S=4)
 - b.** Apply the four steps of art criticism: 1) describe, 2) analyze the work in terms of elements and design principles, 3) interpret the work in terms of ideas and emotions, and 4) judge the work as to its success both technically and in either communicating an idea, and emotion, or fulfilling a practical purpose. (CSGLE for ART 6.22) (S=5)
 - c.** Develop criteria for evaluating the quality of musical performances. (Adapted from CSGLE for MUSIC 6.8) (S4)
 - d.** Analyze the form in music from varied world cultures (Adapted from CSGLE for MUSIC 6.10) (S4, S5)
 - e.** Recognize the scientific contributions that are made by individuals of diverse backgrounds, interests, talents, and motivations. (CSGLE for SCIENCE 6.6.E)
 - f.** Explain how adaptations affect a species survival. (CSGLE for SCIENCE 6.3.A)
 - g.** Challenge prevailing theories and new theories which lead to looking at old observations in a new way. (CSGLE for SCIENCE 6.6.B)

B. Materials

1. White board or chalk board with markers/chalk
2. CD 3: Handel: *Water Music* CD
3. CD Player
4. Writing utensils for all students
5. Overhead projector or LCD projector
6. Copies of Appendix A: Listening Worksheet for the whole class
7. One copy or overhead of Appendix J
8. One copy of Appendix K
9. Book: *Down to a Sunless Sea*
10. Book: *Deep Water*

C. Key Vocabulary

1. Vent crabs are **dependant** on (or rely on) a heat source for survival.

2. **Hydrogen Sulfide** is a poisonous compound chemical containing two parts hydrogen and one part sulfur.
3. **Sulfur Bacterium** is a type of bacteria that convert hydrogen sulfide (a poisonous chemical) into life generating energy.
4. Similar to photosynthesis, the process of converting chemical compounds such as hydrogen sulfide into food energy is called **chemosynthesis**.

D. Procedures/Activities

1. Prior to the class arriving, write the name of this lesson and the name of the unit on the board.
2. Play track one of CD 3: Handel: *Water Music* playing as the class enters.
3. Once seated, pass out Appendix A: Listening Worksheet to the entire class. Write the name of the composer and song on the board. Allow students to complete the worksheet.
4. Stop the CD after 3-5 minutes and allow volunteers to share their answers from the worksheet. Allow for a brief discussion and collect the worksheets.
5. **OPTIONAL:** *Music teachers may expand this section about this 6th grade Core Knowledge composer. For more information, see Appendix I: Connections*
6. Ask the class, “*Now we’ve heard a musical composer from the Baroque musical era connect to water. Can you name a painter from the Baroque period that related to water?*” (Answer is El Greco.)
7. Display Appendix J: El Greco for the class using an overhead or LCD. Review the questions on the appendix and allow for discussion.
8. **OPTIONAL:** *Art teachers may expand this section about this 6th grade Core Knowledge artist. For more information, see Appendix I: Connections*
9. Transition by opening the book, *Down to a Sunless Sea* to page 19 (chapter 2) and allow student volunteers to read from page 19 to the end of page 23. Take time to share the illustrations in the book and be sure to periodically switch readers. Reading these four pages will take five minutes.
10. Open the book, *Deep Water* to page 44. (Remember this book offers three language options on every page!) Read this page on ecosystem diversity to the class. Discuss the staggering numbers of species mentioned on the page. Share the illustration with the class.
11. Turn to page 56 in *Deep Water*. Read the page to the class and then share the illustrations of the Deep Sea Angler fish, Deep Sea Viper Fish, and Deep Sea Swallower. Explain to the class that many predators in the deep ocean seem more like aliens than creatures from our planet.
12. Ask, “*How many alien creatures in the movies do you think have been based on the actual strange creatures from the deep sea?*” Explain how some of Hollywood’s scariest creatures share a close resemblance to many of the Deep Sea’s creepy predators.
13. Explain that these scary looking creatures are likely designed that way in order to survive and find their place in the deep sea ecosystem and food chain.
14. Write the following two Core Knowledge sayings on the board, ‘Bite the dust’, and, ‘He who hesitates is lost’. Explain that these two phrases have close connections to life in the deep ocean.

15. Say, “*The saying, “Bite the dust” means “to die”, and “He who hesitates is lost” means that if you don’t take advantage of something when it is offered to you, you may never get the chance again.*”
16. Ask, “*Can anyone connect these sayings to the dangers of the deep sea?*”
17. Explain that even today, movies are being made that show unbelievable video of deep sea creatures, but even the narrators of the film have a hard time explaining the film beyond phrases like, “Cool! That looks neat, etc. This is primarily because they still do not know exactly what they are looking at. Many of these creatures have yet to be classified and properly identified.
18. Open the book *Down to a Sunless Sea* to page 27. Allow student volunteers to read from page 27 to the end of page 30. Take time to talk through the illustration on page 29 explaining **chemosynthesis**. This will take 10 minutes.
19. Now turn to page 50. Read through the descriptions of the vent-related creatures and share the illustrations with the class.
20. Use Appendix K: Scary Review to review the day’s lesson with the class. Repeat questions as needed to allow ample opportunities for students to participate.
21. If time permits, read page 39 from the book, *Down to a Sunless Sea* to finish the lesson.

D. Assessment/Evaluation

1. Review of Appendix A: Listening Worksheet (Effort-based pass/fail)
2. Appendix K: Scary Review

Lesson Four: The Fine Art of Water (45 Minutes)

A. Daily Objectives

1. Concept Objective(s)
 - a. Students will understand environmental conditions related to the deep ocean.
 - b. Students will understand how natural processes create or change land forms.
 - c. Students will develop knowledge of the bio-diversity in deep sea ecosystems.
 - d. Students will understand relationships between the deep oceans and music, math, art, history, and language arts.
2. Lesson Content
 - a. Writing And Research (CK Sequence p. 133)
 - i. Asking open ended questions
 - ii. Write a standard business letter
 - b. Grammar and usage (CK Sequence p.133)
 - i. Identify different sentence types and write for variety
 - c. Vocabulary (CK Sequence p. 134-135)
 - i. Acoustics
 - ii. Primary
 - iii. Sonar
 - d. Spatial Sense (CK Sequence p. 137)
 - i. Continents and major oceans (CK Sequence p. 137)
 - e. Visual Arts (CK Sequence p. 144-145)

- i. Realism: Winslow Homer, *Noreaster*
 - f. Elements of Music (CK Sequence p. 146)
 - i. Recognize frequently used Italian terms
 - a. Grave
 - b. Largo
 - c. Allegro
 - d. Presto
 - e. Prestissimo
 - f. Legato
 - g. Staccato
 - g. Classical Music: From Baroque to Romantic (CK Sequence p.147)
 - i. Baroque: Vivaldi: *La Tempesta di mare*
 - h. Plate Tectonics (CK Sequence p. 152)
 - i. Crust movements
 - ii. Evidence for long-term movement of plates. . .
 - i. Oceans (CK Sequence p. 152)
 - i. Surface
 - ii. Subsurface land features
 - iii. Ocean bottom
 - iv. Marine life
 - v. Deepwater life
 - j. Energy (CK Sequence p. 153)
 - i. Sources of energy
 - k. Science Biographies (CK Sequence p. 154)
 - i. Alfred Wenger
- 3. Skill Objective(s)
 - a. Students will generate topics and develop ideas for a variety of writing and speaking purposes. (Adapted from Colorado Standards and Grade Level Expectations (CSGLE) for language arts, 6.2.A)
 - b. Students will organize their writing so that there is an introduction, logical arrangement of ideas, and a conclusion. (Adapted from CSGLE 6.2.B)
 - c. Use correct transitions to link ideas. (CSGLE 6.2.C)
 - d. Choose vocabulary that communicates messages clearly and precisely. (CSGLE 6.2.D)
 - e. Create readable documents with legible handwriting or word processing at the appropriate time. (CSGLE 6.2.H)
 - f. Write in complete sentences varying the types such as compound and complex, and using appropriately punctuated dependent clauses (CSGLE 6.3.B)
 - g. Know and use correct capitalization, punctuation, and abbreviations.(CSGLE 6.3.E)
 - h. Explain how natural processes create or change land forms, and give actual geographic locations as examples. (Adapted from CSGLE for GEO.5-8.3.2.B)
 - i. Identify unique features of particular art styles and movements. (CSGLE for ART 6.16) (S=4)
 - j. Apply the four steps of art criticism: 1) describe, 2) analyze the work in terms of elements and design principles, 3) interpret the work in

terms of ideas and emotions, and 4) judge the work as to its success both technically and in either communicating an idea, and emotion, or fulfilling a practical purpose. (CSGLE for ART 6.22) (S=5)

- k. Develop criteria for evaluating the quality of musical performances. (Adapted from CSGLE for MUSIC 6.8) (S4)
- l. Analyze the form in music from varied world cultures (Adapted from CSGLE for MUSIC 6.10) (S4, S5)
- m. Recognize the scientific contributions that are made by individuals of diverse backgrounds, interests, talents, and motivations. (CSGLE for SCIENCE 6.6.E)
- n. Explain how adaptations affect a species survival. (CSGLE for SCIENCE 6.3.A)
- o. Challenge prevailing theories and new theories which lead to looking at old observations in a new way. (CSGLE for SCIENCE 6.6.B)

B. Materials

1. White board or chalk board with markers/chalk
2. CD 4: Vivaldi: Nature Concertos
3. CD Player
4. Writing utensils for all students
5. Internet Access
6. Overhead projector or LCD projector
7. Copies of Appendix A: Listening Worksheet for the whole class
8. One copy or overhead of Appendix L: *Noreaster*
9. One copy or overhead of Appendix M: Underwater Acoustics
10. Copies of Appendix N for the whole class
11. Book: *Down to a Sunless Sea*
12. Book: *Deep Water*

C. Key Vocabulary

1. The **primary** producer, or first producer, in the deep sea hydrothermal vent ecosystem is bacteria.
2. Typically used underwater, **sonar** is often used to generate, receive, and measure sound.
3. The science that deals with the study of sound is **acoustics**.

D. Procedures/Activities

1. Prior to the class arriving, write the name of this lesson and the name of the unit on the board.
2. Play track one from CD 4 – Antonio Vivaldi: Nature Concertos as the class enters. Write the composer’s name and the song name, “*La Tempesta Di Mare*” along with its translation (*The Storm at Sea*) on the board.
3. Pass out copies of Appendix A: Listening Worksheet to the whole class. Allow 3-5 minutes for the class to fill out the worksheet and then stop the CD to discuss volunteered answers.
4. Now, display Appendix L: *Noreaster* on an overhead or LCD. Read the questions and comments on the appendix to the class.
5. Transition by explaining again how humans in all fields have had a curiosity and even a fear of the sea since the beginning of time. Explain that it is this precise curiosity that has led to inventions such as “Alvin” and submarines, and sonar.

6. Write the word “sonar” on the board and read the definition of sonar from the vocabulary above.
7. Say, *“Sounds in the ocean are extremely unique. The study of sound is called acoustics (write that on the board) Sound travels through water, but is distorted as it passes through. This distortion leads to strange effects that we quickly associate with underwater scenes. Thanks to advancements in technology, scientists have been recording underwater sounds for us to hear. Let’s check them out!”*
8. Use Appendix M: Underwater Acoustics. Display this appendix on the overhead or projector and visit the suggested sites for the class to listen to. (You will need your computer sound turned on.)
9. Transition by writing the name Alfred Wegener on the board. Explain to the class that it was Wenger who first theorized the idea of continental drift. Born in 1880 in Berlin, he believed that, at one time, all of the continents were together in one large jigsaw puzzle that he called “Pangea” (en.wikipedia.org/wiki/Pangaea). He theorized that as the tectonic plates shifted and expanded, the land masses separated and slowly moved apart, creating the world as we know it today.
10. Explain that these plates still move and expand about as fast as our own fingernails grow, and it is this movement that causes eruptions from things like volcanoes and hydrothermal vents.
11. Say, *“Alfred Wegener is a scientific hero. His theories have helped scientists focus their study of the planet and have advanced our knowledge about our unexplored world deep below the ocean’s surface. Without Wegener’s theories, scientists in the 1960’s and ‘70’s may not have been so quick to assume that vents may exist in the deep ocean.”*
12. Pass out Appendix N: The Letter to the whole class. Use the remainder of class time to begin this letter. Allow students to take this home and finish as an assignment.

E. Assessment/Evaluation

1. Review of Appendix A: Listening Worksheet (Effort-based pass/fail)
2. Appendix N: The Letter

Lesson Five: Unexplored Territory (45 Minutes)

A. Daily Objectives

1. Concept Objective(s)
 - a. Students will understand environmental conditions related to the deep ocean.
 - b. Students will understand how natural processes create or change land forms.
 - c. Students will develop knowledge of the bio-diversity in deep sea ecosystems.
 - d. Students will understand relationships between the deep oceans and music, math, art, history, and language arts.
2. Lesson Content
 - a. Spelling (CK Sequence p. 134)
 - i. Dependent
 - ii. Cooperate
 - iii. Characteristic

- iv. Occurrence
 - b. Poems (CK Sequence p.135)
 - i. If (Rudyard Kipling)
 - ii. Apostrophe to the Ocean [from *Childe Harold's Pilgrimage*, Canto 4, Nos. 178-184] (George Byron)
 - c. Spatial Sense (CK Sequence p. 137)
 - i. Continents and major oceans (CK Sequence p. 137)
 - d. Plate Tectonics (CK Sequence p. 152)
 - i. The surface of the earth
 - ii. Crust movements
 - iii. Evidence for long-term movement of plates. . .
 - e. Oceans (CK Sequence p. 152)
 - i. Surface
 - ii. Subsurface land features
 - iii. Ocean bottom
 - iv. Marine life
 - v. Deepwater life
 - f. Energy
 - i. Sources of energy
- 3. Skill Objective(s)
 - a. Read, respond to, and discuss a variety of poetry. (Adapted from CSGLE 6.6.A)
 - b. Explain how natural processes create or change land forms, and give actual geographic locations as examples. (Adapted from CSGLE for GEO.5-8.3.2.B)
 - c. Explain how adaptations affect a species survival. (CSGLE for SCIENCE 6.3.A)
 - d. Identify unique features of particular art styles and movements. (CSGLE for ART 6.16) (S=4)
 - e. Challenge prevailing theories and new theories which lead to looking at old observations in a new way. (CSGLE for SCIENCE 6.6.B)

B. Materials

1. White board or chalk board with markers/chalk
2. One copy or overhead of Appendix O: Poetry in Motion
3. Book: *Down to a Sunless Sea*
4. Book: *Deep Water*

C. Key Vocabulary

1. Vent crabs are **dependant** on (or rely on) a heat source for survival.
2. Bacteria and Tube Worms **cooperate**, or act and work together to sustain life.
3. A noticeable **characteristic** (or unique feature) of the Deep Sea Viper fish is fierce teeth.
4. Vent eruptions are a regular **occurrence**, happening frequently in the deep ocean.

D. Procedures/Activities

1. Prior to the class arriving, write the name of the lesson and the name of the unit on the board.
2. Next, write two names on the board: George Byron and Rudyard Kipling.

3. As the class arrives, collect the previous day's letter-writing assignment and let them know that today there will not be a musical selection to begin the lesson. Explain that we will be starting the lesson off with poetry.
4. Display Appendix O: Poetry in Motion on an overhead or an LCD projector. Allow students the opportunity to take turns reading the sections out loud for each poem.
5. Take time to allow the students to answer the questions on each page.
6. Transition by writing the word, "cooperate" on the board.
7. Open the book *Down to a Sunless Sea* to page 45. Allow students volunteers to read page 45 – 49. This will take 10 minutes.
8. Now write the remaining vocabulary words on the board and review their definitions as listed above. Ask for student volunteers to use the same word in a different sentence relating to the deep ocean.
9. Open the book *Deep Water* to page 94.
10. Transition with this question: "*We talked about bacteria developing slower, and an apple rotting slower in the deep ocean in our first lesson. With that in mind, could it be that trash and waste decompose slower in the deep ocean as well?*" (Allow for discussion: the answer is yes.)
11. Read page 94 to the class, and then open a brief discussion about student experiences with pollution and water.
12. Read pages 96 and 98 to the class. Use the remainder of the class time to continue the discussion about global warming and pollution affecting our oceans.
13. Finish the lesson with a question and answer review of this lesson's content about poetry, cooperative vent ecosystems, pollution, and global warming.
14. Alert the class to the culminating activities (listed just below) prior to leaving.

F. Assessment/Evaluation

1. In class verbal review with point number 13 above.
2. Collection and grading of Appendix M: The Letter.

VI. CULMINATING ACTIVITY (Two Days: 45 Minutes each)

- A. This unit will end with Appendix O: Final Exam. Following the exam, students will select one of the 32 available reference addresses in the back of the book, *Deep Water* to write letters of support/interest to the foundation of their choice. This letter writing process will be a 2-draft process and will be mailed upon completion.
- B. For more details, see Appendix Q: Culmination.
 1. Additional skill objectives covered in the culmination:
 - a. Students will generate topics and develop ideas for a variety of writing and speaking purposes. (Adapted from Colorado Standards and Grade Level Expectations (CSGLE) for language arts, 6.2.A)
 - b. Students will organize their writing so that there is an introduction, logical arrangement of ideas, and a conclusion. (Adapted from CSGLE 6.2.B)
 - c. Use correct transitions to link ideas. (CSGLE 6.2.C)
 - d. Choose vocabulary that communicates messages clearly and precisely. (CSGLE 6.2.D)
 - e. Revise drafts for coherence, progressions, and logical support. (CSGLE 6.2.F)

- f. Edit drafts for specific purposes such as to ensure standard usage, varied sentence structure, and appropriate word choice. (CSGLE 6.2.G)
- g. Create readable documents with legible handwriting or word processing at the appropriate time. (CSGLE 6.2.H)
- h. Write in complete sentences varying the types such as compound and complex, and using appropriately punctuated dependent clauses (CSGLE 6.3.B)
- i. Know and use correct capitalization, punctuation, and abbreviations.(CSGLE 6.3.E)

VII. HANDOUTS/WORKSHEETS

1. Appendix A: Listening Worksheet
2. Appendix B: *Old Man with Water Studies*
3. Appendix C: Deep Math
4. Appendix D: Deep Math Key
5. Appendix E: First Review
6. Appendix F: *The Chalk Cliffs of Rugen*
7. Appendix G: Going Deep Quiz
8. Appendix H: Going Deep Quiz Key
9. Appendix I: Connections
10. Appendix J: El Greco
11. Appendix K: Scary Review
12. Appendix L: *Noreaster*
13. Appendix M: Underwater Acoustics
14. Appendix N: The Letter
15. Appendix O: Poetry in Motion
16. Appendix P: Final Exam
17. Appendix Q: Final Exam Key
18. Appendix R: Culmination

VIII. BIBLIOGRAPHY

1. Caldecott, J., & Salmon, M. *Deep Water*: London: Ellipsis, 1999. ISBN#: 1-899858-79-2. (Available used at www.amazon.com for less than \$1.00.)
2. Madin, K. *Down to a Sunless Sea: The Strange World of Hydrothermal Vents*: Austin, TX; Raintree Steck-Vaughn, 2000. ISBN#: 0-7398-1238-6. (Available used at www.amazon.com for less than \$2.00.)
3. CD 1 – *Tempest: Classic Storms*. Helsinki Philharmonic Orchestra, Proarte, 1993. ASIN: B000009JAR (Beethoven’s 6th Symphony is in most Core Knowledge Music Libraries: available used on www.amazon.com for \$5.00.)
4. CD 2 – Camille Saint-Seans. *Carnival of the Animals*. London festival Orchestra, Arte Nova Classics, 2006, ASIN: B000E1P24E (In most Core Knowledge Music Libraries. Available used on www.amazon.com for \$4.00.)
5. CD 3 – Handel. *Water Music; Music for the Royal Fireworks*. Aradia Endemble, Naxos, 2006, ASIN: B000CEVU5I (In most Core Knowledge Music Libraries. Available used on www.amazon.com for \$5.00.)
6. CD 4 – Vivaldi: *Nature Concertos*. Sonatori de la Gioiosa Marca, Erato, 2000, ASIN: B00004GP1Y (In most Core Knowledge Music Libraries. Available used on www.amazon.com for \$6.00.)

Appendix A: Listening Worksheet

Name _____

Date _____

Homeroom Teacher _____

Try and name the song and the country it comes from:

Name _____ Song _____

Instructions: *Listen to the music being played. Listen carefully to answer as much as you can from the numbers below. All students MUST answer question #4.*

1. Circle one of the following Italian words that best describe the “tempo” of the music being played for you. Briefly explain your choice in the space to the right.
 - a. Grave
 - b. Largo
 - c. Allegro
 - d. Presto
 - e. Prestissimo
 - f. Legato
 - g. Staccato
 - h. Other (please list) _____

2. Using letters (starting with “A”) try to outline the form of the sections in the music being played for you, and write it in the space below. (For example: AABACA etc.)

3. Name as many instruments/sounds as you can from the music being played for you, and list

4. Do you like the music being played? Why? Justify your reasoning in the space below.

Appendix B: *Old Man with Water Studies*



Source: http://commons.wikimedia.org/wiki/Image:Old_Man_with_Water_Studies.jpg

This is a faithful photographic 2-D reproduction of an original two-dimensional work of art. This reproduction along with the original image comprising the work of art itself is public domain.

1. It is not directly clear if Leonardo da Vinci drew this as a self portrait, but many art historians believe this was a drawing in 1513 by Leonardo da Vinci.
2. Leonardo da Vinci was an artist in the renaissance era. His expert artistic connections to science and mathematics helped define him as a “renaissance man”, or a man of many talents.
3. Leonardo was fascinated with the properties of water, and appears in the picture to be pondering the properties and characteristics of flowing water. With such an expertise in science and an interest in water, Leonardo must have been very curious about the unexplored world that existed in the oceans around him.
4. What other artwork is Leonardo da Vinci famous for?

Appendix C: Deep Math

Rank	Name	Location	Depth (meters)	Depth (feet)	Depth (miles)
1	Mariana Trench	Pacific Ocean	11,000	36090	6.84
2	Tonga Trench	Pacific Ocean	10,882	35,702	6.76
3	Philippine Trench	Pacific Ocean	10,540	34,580	6.55
4	Kuril-Kamchatka Trench	Pacific Ocean	10,500	34,449	6.52
5	Kermadec Trench	Pacific Ocean	10,047	32,963	6.24
6	Japan Trench	Pacific Ocean	9,000	29,527	5.59
*7	Milwaukee Deep	Atlantic Ocean	8,609	28,246	5.35
8	Yap Trench	Pacific Ocean	☺ _____	☺ _____	5.30
9	South Sandwich Trench	Atlantic Ocean	☺ _____	☺ _____	5.24
10	Puerto Rico Trench	Atlantic Ocean	☺ _____	☺ _____	5.22

Look at the chart above. The 10 deepest areas on earth (called trenches) are listed in rank order from deep to shallow. Fun fact: Jet airplanes will often fly at 35,000 feet “above” sea level.

- From the chart above, what is the average depth (in miles) of the 10 deepest oceanic areas on earth? Round to the nearest 10th. Hint: Total miles divided by number of trenches. Answer: _____
- What assumptions can be made about the depths of the Atlantic Ocean compared to the Pacific Ocean? (List answers on back of this paper.)
- Convert the last three trenches from miles to feet and from miles to meters. Round to the nearest tenth. Fill in each blank above next to the question mark. 1 Mile = 1609.344 Meters. 1Meter = 3.281 feet.

EXAMPLE:

*Fact: Trench 7 is 5.35 miles deep.

Step one: 5.35 miles x 1,609.344 = 8,609 meters.

Step two: 8,609 meters x 3.281 is 28,246 feet.

Appendix D: Deep Math Key

Rank	Name	Location	Depth (meters)	Depth (feet)	Depth (miles)
1	Mariana Trench	Pacific Ocean	11,000	36090	6.84
2	Tonga Trench	Pacific Ocean	10,882	35,702	6.76
3	Philippine Trench	Pacific Ocean	10,540	34,580	6.55
4	Kuril-Kamchatka Trench	Pacific Ocean	10,500	34,449	6.52
5	Kermadec Trench	Pacific Ocean	10,047	32,963	6.24
6	Japan Trench	Pacific Ocean	9,000	29,527	5.59
*7	Milwaukee Deep	Atlantic Ocean	8,609	28,246	5.35
8	Yap Trench	Pacific Ocean	8,529.52	27,985.36	5.30
9	South Sandwich Trench	Atlantic Ocean	8,432.96	27,668.54	5.24
10	Puerto Rico Trench	Atlantic Ocean	8,400.78	27,562.96	5.22

Look at the chart above. The 10 deepest areas on earth (called trenches) are listed in rank order from deep to shallow. Fun fact: Jet airplanes will often fly at 35,000 feet “above” sea level.

- From the chart above, what is the average depth (in miles) of the 10 deepest oceanic areas on earth? Round to the nearest tenth. Hint: Total miles divided by number of trenches. *Answer: 5.961 miles.*
- What assumptions can be made about the depths of the Atlantic Ocean compared to the Pacific Ocean? *Answers: Various: Pacific trenches tend to be deeper than Atlantic.*
- Convert the last three trenches from miles to feet and from miles to meters. Round to the nearest tenth. Fill in each blank above next to the question mark. 1 Mile = 1609.344 Meters. 1Meter = 3.281 feet.

EXAMPLE:

**Fact: Trench 7 is 5.35 miles deep.*

Step one: 5.35 miles x 1,609.344 = 8,609 meters.

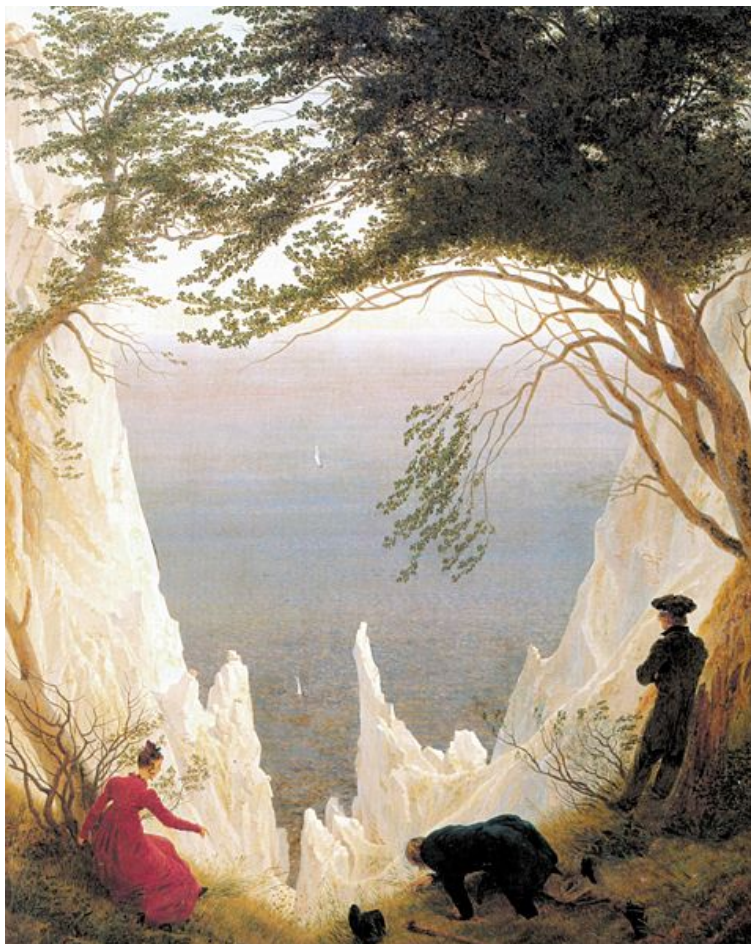
Step two: 8,609 meters x 3.281 is 28,246 feet.

Appendix E: First Review

Instructions: Use the following questions to verbally review with the class. Answers are in italics.

1. Where do the majority of helpful bacteria reside within the human body?
a. Within the large intestine
2. Name two possible reasons why bacteria grow at a slower rate on the deep ocean floor.
a. High Pressure at low depths slows growth
b. Low Temperature slows growth
3. How can a storm on the ocean surface affect the deep ocean floor?
a. Upwelling – wind and currents move surface water aside allowing water from deeper areas to rise to the surface
4. Explain the phrase, “Truth is stranger than fiction.”
a. Sometimes the truth is harder to believe than something untrue.
5. Name a composition by a musical composer that relates to the deep ocean.
a. Varies: Including Beethoven’s “Thunderstorm”
6. Which Renaissance artist showed a clear fascination with the properties of water?
a. Leonardo da Vinci
7. What is the name of the deepest trench in the ocean? *Mariana Trench*
 - How deep is it? *6.84 miles, 11,000 meters*
 - Where is it? *Pacific Ocean (Fun Fact: Between Japan and Australia)*
8. Which ocean contains the deepest trenches in the world? *Pacific Ocean*
9. 1 mile equals how many meters? *1 Mile = 1609.344 Meters*
10. 1 meter equals how many feet? *1 Meter = 3.281 feet*

Appendix F: *The Chalk Cliffs of Rugen*



Source:
http://en.wikipedia.org/wiki/Image:Caspar_David_Friedrich_023.jpg

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Study this painting by Romantic artist Caspar David Friedrich. He painted this piece of art in 1818.

1. Apply the four steps of art criticism:
 - i) Describe the work in your own words.
 - ii) Analyze the work in terms of art elements and design principles.
 - iii) Interpret the work in terms of ideas and emotions.
 - iv) Judge the work as to its success both technically and in either communicating an idea, and emotion, or fulfilling a practical purpose.
2. How does this painting relate to the ocean?
3. How does this painting relate to an aquarium?
4. Where is the focal point of the painting? What is the focus?
5. Would the music for the song “Aquarium”, by Camille Saint-Seans connect with this painting?

Answers are upside down just below:

Answers:

1: Varies: Answers for “it” should focus on color, line, shape, and texture (Elements of Art: CK Sequence p. 31).

2: This painting depicts the Baltic Sea.

3: Notice that the subjects appear to be looking through a window to the sea. They are observing like in an aquarium.

4: One of the greatest factors in this painting is the focal point. Two of the subjects are obviously trying to see something that we cannot see, therefore the focal point/focus is left to the imagination.

5: Experiment with playing Camille Saint-Seans’, “Aquarium” from *Carnival of the Animals* while observing this painting. The style of music seems to make the mystery, distance, and grand perspective in the painting increase.

Appendix G: Going Deep Quiz

Name _____ Date _____

Teacher _____

(10 pts) Answer the following questions by filling in the blank with a short answer.

1. What two musicians studied in this unit connected their art form to the ocean?
2. What was the focus or curiosity in Friedrich's painting, "The Chalk Cliffs of Rugen"?
3. What year did scientists first get visual proof of warm-water life in the deep ocean? _____
4. Name two creatures, previously unknown to science, that were discovered near a hydrothermal vent with the help of "Alvin"?
5. Explain the meaning of the phrase, "Necessity is the mother of invention".
6. (5 points) Fact: The earth's surface is approximately 70% ocean and 30% land. While we have explored almost all of the land on Earth, ninety percent of the planet's deep oceans remain relatively unexplored.

Question: If ninety percent (90%) of the world's oceans are relatively unexplored, what is the percentage of our planet that is relatively unexplored?

Hint: Convert percentages to decimals and use the information below.

- | | |
|---|-----------------------------------|
| 1. Ocean Surface Percentage = A | 2. Convert A% to decimals _____ |
| 3. Unexplored Deep Ocean Percentage = B | 4. Convert B% to decimals _____ |
| 5. Use Decimals: $A \times B = C$ | 6. C = Answer (in decimals) _____ |

Now convert your answer back to percentage from decimal and insert it below:

Answer: _____ % of the earth is relatively unexplored!

Wow! We still have so much to discover!

Appendix H: Going Deep Quiz Key

Name _____ Date _____

Teacher _____

(10 pts) Answer the following questions by filling in the blank with a short answer.

1. What two musicians studied in this unit connected their art form to the ocean?
Ludwig van Beethoven & Camille Saint-Seans
2. What was the focus or curiosity in Friedrich's painting, "The Chalk Cliffs of Rugen"?
The focus/curiosity was on that which could not be seen.
Alt: The figure on the top right was focused on the sea.
3. What year did scientists first get visual proof of warm-water life in the deep ocean?
1977
4. Name two living creatures, previously unknown to science, that were discovered near a hydrothermal vent with the help of "Alvin"?
Vent Crabs, Tubeworms, Feather Duster Worms, Vent Shrimp, Clams
5. Explain the meaning of the phrase, "Necessity is the mother of invention".
Something that you say which means that if you want to do something very much you will think of a way to do it
6. (5 points) Fact: The earth's surface is approximately 70% ocean and 30% land. While we have explored almost all of the land on Earth, ninety percent of the planet's deep oceans remain relatively unexplored.

Question: If ninety percent (90%) of the world's oceans are relatively unexplored, what is the percentage of our planet that is relatively unexplored?

Hint: Convert percentages to decimals and use the information below.

- | | |
|---|---------------------------------|
| 1. Ocean Surface Percentage = 70% | 2. Convert A% to decimals: .70 |
| 3. Unexplored Deep Ocean Percentage = 90% | 4. Convert B% to decimals: .90 |
| 5. Use Decimals: $.70 \times .90 = .63$ | 6. C = Answer (in decimals) .63 |

Now convert your answer back to percentage from decimal and insert it below:

Answer: 63 % of the earth is relatively unexplored!

Wow! We still have so much to discover!

Appendix I: Connections

This unit contains four musical composer connections and four artist connections. These connections are all from the 6th grade *Core Knowledge Sequence* and help to validate the curiosity and discovery of the world's deep oceans. Classroom teachers are encouraged to enlist the help of their music and art teachers during the days that this unit is being taught in order to ensure that the instruction connects to the specials classroom.

Composers and their music:

- Baroque Era: *Water Music*, George Frederick Handel.
(In most Core Knowledge Music Libraries. Available used on www.amazon.com for \$5.00)
- Baroque Era: “La Tempesta di mare”, Antonio Vivaldi.
(In most Core Knowledge Music Libraries. Available used on www.amazon.com for \$6.00)
- Classical Era: “Thunderstorm”, Final movement of *Beethoven’s 6th Symphony*.
(In most Core Knowledge Music Libraries. Available used on www.amazon.com for \$5.00)
- Romantic Era: “Aquarium”, Camille Saint-Seans, *Carnival of the Animals*.
(In most Core Knowledge Music Libraries. Available used on www.amazon.com for \$4.00)

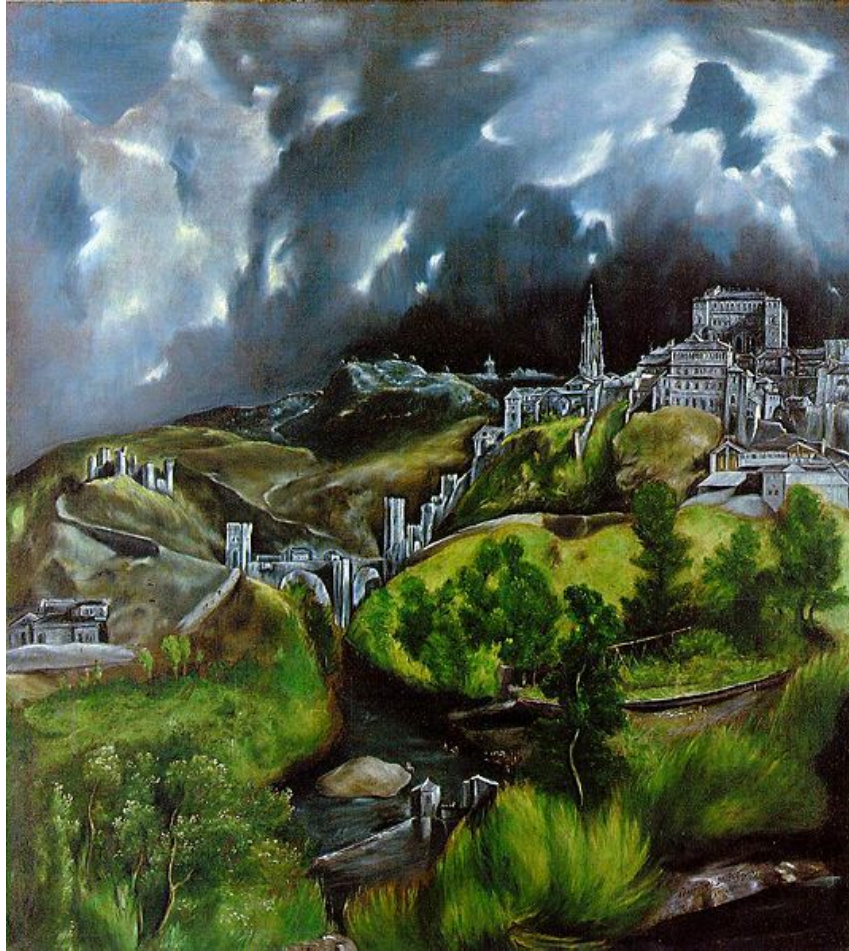
Artists and their paintings:

- *Renaissance Art: Leonardo da Vinci, *Old Man with Water Studies*, c. 1513
- Baroque Art: El Greco: *View of Toledo* – 1597
- Romantic Art: Caspar David Friedrich: *The Chalk Cliffs of Rugen* – 1818-19
- Realism: Winslow Homer: *Noreaster* — 1895

1. Music and art teachers can make additional connections by aligning the instruction of the composers and artists (above) from the Baroque and Romantic periods. This effect can be powerful when aligned on the same day those specific composers/artists are introduced in the classroom with this unit.
2. Art teachers should focus on the four elements of art: Color, line, shape, and texture.
3. Music teachers should focus on the 6th grade “Elements of music” (CK Sequence p. 146)
4. All four artist paintings can be viewed via www.wikipedia.com.

*This art selection is not in the 6th Grade CK Sequence, but represents a connection to water via Renaissance Art, which is a required area of content in the 6th grade CK Sequence.

Appendix J: El Greco



El Greco: *View of Toledo*, 1597

Source: http://en.wikipedia.org/wiki/Image:El_Greco_View_of_Toledo.jpg

This is a faithful photographic 2-D reproduction of an original two-dimensional work of art. This reproduction along with the original image comprising the work of art itself is public domain.

1. Look at the painting above. Explain the painting's use of the four elements of art: Color, line, shape, and texture.
2. This painting is famous for its fantastic sky and contrast to the landscape. How does this Baroque painting connect to water?

Answers: upside down below.

1. Answers vary. Note the contrast, dark tones, and exaggerated perspective.
2. Answers vary, but include:
The sky is dark and potentially stormy.
There is a creek/river central to the painting.
The perspective is warped and skewed similar to views at varying depths underwater, with light and colors fading as the painting's perspective moves farther away.

Appendix K: Scary Review

1. Which Baroque Composer is famous for writing music about water? What was it called?
-George Frederick Handel: Water Music
2. What Baroque painter created the painting, *View of Toledo*?
-El Greco
3. What is chemosynthesis?
-the process of converting hydrogen sulfide (or similar chemical compounds) into food energy
4. How is chemosynthesis like photosynthesis?
-Both processes convert a single source into food energy. Chemosynthesis does not require sunlight.
5. Name a scary-looking deep sea creature.
-Deep Sea Angler Fish, Deep Sea Viper Fish, Deep Sea Swallower, Vent Crab, etc.
6. What is the first primary producer in the deep sea hydrothermal vent ecosystem?
-Bacteria
7. Which region on the planet likely contains the most diverse population of life?
-The deep ocean

Appendix L: *Noreaster*

To view Winslow Homer's painting *Noreaster* visit the New York Metropolitan Museum of Art online at:
http://www.metmuseum.org/TOAH/HD/homr/ho_10.64.5.htm#

Visit the website above and display this painting for the class.

Description: Winslow Homer began a series of paintings in the mid-1890's showing mainly water, coast, and sky. An area called Prouts Neck, Maine was typically the site in these works. This painting was first sold by Homer to Thomas B. Clarke in 1895. Then, in 1899, the painting was returned to Homer and he changed it by removing the two men who were once on the rocks at the left, and by altering the form.

1. Think back to the song you just heard. Would that song title (The Storm at Sea) fit this picture? Does that music fit this picture? Why/Why not?
2. Look at the painting. Can you picture where the two men might have been on the rocks?
3. Explain the painting's use of the four elements of art: Color, line, shape, and texture.
4. This painting is famous for its furious intensity. How does this painting connect to vents in the deep ocean?

Answers will vary

Appendix M: Underwater Acoustics

Take time and visit the following websites with the class. Each site is either government or online news and is safe for all ages to view. You will need to have the computer speakers on, or your PC wired to a stereo to hear the sounds linked below. After reading the paragraph at the bottom of this page to the class, return to the lesson plan.

1. The following website contains sounds from the Fish Sound Archive of the Sciaenid Acoustics Research Team (SART) East Carolina University, Greenville, NC 27858

http://core.ecu.edu/BIOL/luczkovichj/fishsounds/fish_sounds.htm

2. FUN! From CNN: Tuning in to a Deep Sea Monster

<http://archives.cnn.com/2002/TECH/science/06/13/bloop/>

&

<http://www.pmel.noaa.gov/vents/acoustics/sounds/bloop.html>

3. From the NOAA: The Acoustic Monitoring Project of the VENTS Program has performed continuous monitoring of ocean noise since August, 1991 using the U.S. Navy Sound Surveillance System (SOSUS) network and autonomous underwater hydrophones.

<http://www.pmel.noaa.gov/vents/acoustics.html>

4. Read the following paragraph to the class:

This last site (above) dealt with sounds of hydrothermal vents and seismic events such as earthquakes. An earthquake represents a shift in tectonic plates. This shifting movement is responsible for the development of the land and sea as we know it today.

Appendix N: The Letter

Instructions: On the back of this page, choose one of the topics below and write a letter (minimum three paragraphs) to the President of the United States asking for money to prove your scientific theory.

1. When Alfred Wegener first introduced his theory of continental drift in 1912, the scientific community did not believe him. By the 1930's his work was almost completely ignored. Wegener had proof of identical fossils from separate continents, but it took until the 1950's for his theory to be accepted. Wegener died in 1931. Pretend you are Alfred Wegener in 1920. You must convince the President who was in office in 1920 that your theory is correct, and that if you had the proper funding, you could help the world understand its past and its future. Support your argument with evidence!
2. You are a scientist in 1967. You have developed a microphone that records sounds underwater. You are hearing what sounds like eruptions. You are convinced that if you could create an underwater vehicle to explore and investigate the sounds, you would find vents in the deep ocean. Convince the President who was in office in 1967 that your project needs funding so you can help discover the world's last unexplored territory. Support your argument with evidence!
3. You are the only person in 1977 inside "Alvin" on the first visit to the deep ocean vent site. When you return to the surface, nobody believes what you have seen. Your boss decides to cancel any future dives and the crew sails home. Convince the President who was in office in 1977 that what you saw on the ocean floor was real. Argue that with additional funding, your crew could return to the site and change the future of science and biology in the deep sea. Support your argument with evidence!

Rules:

- a. Organize the letter so that there is an introduction, logical arrangement of ideas, and a conclusion. (5pts.)
- b. Use correct transitions to link ideas. (5pts.)
- c. Choose words that communicate your message clearly and precisely. (5pts.)
- d. Write in complete sentences, using various types of sentences (such as compound and complex.) (5pts.)
- e. Know and use correct capitalization, punctuation, and abbreviations. (5pts.)
- f. Be creative and have fun! (5pts.)

Appendix O: Poetry in Motion

If **By Rudyard Kipling**

If you can keep your head when all about
you
Are losing theirs and blaming it on you;
If you can trust yourself when all men doubt
you,
But make allowance for their doubting too;
If you can wait and not be tired by waiting,
Or, being lied about, don't deal in lies,
Or, being hated, don't give way to hating,
And yet don't look too good, nor talk too
wise;

If you can dream — and not make dreams
your master;
If you can think — and not make thoughts
your aim;
If you can meet with triumph and disaster
And treat those two imposters just the same;
If you can bear to hear the truth you've
spoken
Twisted by knaves to make a trap for fools,
Or watch the things you gave your life to
broken, And stoop and build 'em up with
wornout tools;

If you can make one heap of all your
winnings
And risk it on one turn of pitch-and-toss,
And lose, and start again at your beginnings
And never breath a word about your loss;
If you can force your heart and nerve and
sinew
To serve your turn long after they are gone,
And so hold on when there is nothing in you
Except the Will which says to them: "Hold
on";

If you can talk with crowds and keep your
virtue,
Or walk with kings — nor lose the common
touch;
If neither foes nor loving friends can hurt
you;
If all men count with you, but none too
much;
If you can fill the unforgiving minute
With sixty seconds' worth of distance run -
Yours is the Earth and everything that's in
it,
And — which is more — you'll be a Man
my son!

1. Read each section. How does the poet feel?
2. What is the mood of this poem?
3. What do you think Kipling is trying to say with the poem?
4. How does this relate to what we have studied about the deep ocean?
5. How does this poem relate to Alfred Wegener?

Appendix O: Poetry in Motion (cont.)

Apostrophe to the Ocean

By George Byron

There is a pleasure in the pathless woods,
There is a rapture on the lonely shore,
There is society where none
intrudes,

By the deep Sea, and music in its roar:
I love not Man the less, but Nature more,
From these our interviews, in which I steal
From all I may be, or have been before,
To mingle with the Universe, and feel
What I can ne'er express, yet cannot all
conceal.

Roll on, thou deep and dark blue Ocean—roll!
Ten thousand fleets sweep over thee in vain;
Man marks the earth with ruin—his control
Stops with the shore;—upon the watery plain
The wrecks are all thy deed, nor doth remain
A shadow of man's ravage, save his own,
When for a moment, like a drop of rain,
He sinks into thy depths with bubbling groan,
Without a grave, unknelled, uncoffined, and
unknown.

His steps are not upon thy paths,—thy fields
Are not a spoil for him,—thou dost arise
And shake him from thee; the vile strength he wields
For earth's destruction thou dost all despise,
Spurning him from thy bosom to the skies,
And send'st him, shivering in thy playful spray
And howling, to his gods, where haply lies
His petty hope in some near port or bay,
And dashest him again to earth: —there let him
lay.

The armaments which thunderstrike the walls
Of rock-built cities, bidding nations quake, And
monarchs tremble in their capitals. The oak
leviathans, whose huge ribs make Their clay creator
the vain title take
Of lord of thee, and arbiter of war;
These are thy toys, and, as the snowy flake,
They melt into thy yeast of waves, which mar
Alike the Armada's pride, or spoils of
Trafalgar.

Thy shores are empires, changed in all save thee -
Assyria, Greece, Rome, Carthage, what are they?
Thy waters wasted them while they were free
And many a tyrant since: their shores obey
The stranger, slave, or savage; their decay
Has dried up realms to deserts: not so thou,
Unchangeable save to thy wild waves' play -
Time writes no wrinkle on thine azure brow -
Such as creation's dawn beheld, thou rollest
now.

Thou glorious mirror, where the Almighty's form
Glasses itself in tempests; in all time,
Calm or convulsed—in breeze, or gale, or storm,
Icing the pole, or in the torrid clime
Dark-heaving;—boundless, endless, and sublime -
The image of Eternity—the throne
Of the Invisible; even from out thy slime
The monsters of the deep are made; each zone
Obeyes thee: thou goest forth, dread, fathomless,
alone.

And I have loved thee, Ocean! And my joy
Of youthful sports was on thy breast to be
Borne like thy bubbles, onward: from a boy
I wantoned with thy breakers—they to me
Were a delight; and if the freshening sea
Made them a terror—'twas a pleasing fear,
For I was as it were a child of thee,
And trusted to thy billows far and near,
And laid my hand upon thy mane—as I do here.

1. Take turns reading each section. How does the poet feel about the ocean?
2. Is this a happy poem?
3. What do you think Byron is trying to say with the poem?
4. How does this relate to what we have studied about the deep ocean?

Appendix P: Final Exam

Name _____ Date _____

Teacher _____

(10 pts.) True/False: Mark “T” for true and “F” for false for the questions below.

1. ___ The Deep Ocean wasn't seen until 1977.
2. ___ Alfred Wegener invented “Alvin”.
3. ___ An apple can last 10 months while stored in the deep sea without rotting.
4. ___ Bacteria develop rapidly in the deep sea.
5. ___ All bacteria need sunlight to live.
6. ___ Upwelling is the process of deep water rising to the surface.
7. ___ Leonardo da Vinci was not interested in water.
8. ___ The theory of continental drift was never accepted by scientists.
9. ___ Tube Worms must have hot water to survive.
10. ___ There are thousands, perhaps millions of new species in the deep oceans.

(10 pts. Each) Complete the following tasks using complete sentences. Use correct spelling and punctuation.

1. Briefly explain how the works of one of the following people related to the deep ocean: Ludwig van Beethoven, George Byron, Caspar David Freidrich, or Leonardo da Vinci.

2. Describe the accomplishment of scientific hero, Alfred Wegener.

3. Describe the environment of the deep sea in areas where there are no hydrothermal vents.

4. Describe the environment of the deep sea in areas where there “are” hydrothermal vents.

Appendix Q: Final Exam Key

NOTE: For higher level modifications, students can rewrite the incorrect T/F questions as a correct sentence.

(10 pts.) True/False: Mark “T” for true and “F” for false for the questions below.

1. T The Deep Ocean wasn't seen until 1977.
2. F Alfred Wegener invented “Alvin”.
3. T An apple can last 10 months while stored in the deep sea without rotting.
4. F Bacteria develop rapidly in the deep sea.
5. F All bacteria need sunlight to live.
6. T Upwelling is the process of deep water rising to the surface.
7. F Leonardo da Vinci was not interested in water.
8. F The theory of continental drift was never accepted by scientists.
9. T Tube Worms must have hot water to survive.
10. T There are thousands, perhaps millions of new species in the deep oceans.

(10 pts. Each) Complete the following tasks using complete sentences. Use correct spelling and punctuation.

1. Briefly explain how the works of one of the following people related to the deep ocean: Ludwig van Beethoven, George Byron, Caspar David Freidrich, or Leonardo da Vinci.

-Answers will vary: Beethoven – “Thunderstorm”, Byron – Apostrophe to the Ocean – shows an admiration, respect, and bond to the ocean, Freidrich – looking at the Baltic Sea – The Chalk Cliffs of Rugen – seeing what can't be seen, Leonardo – studied water intently – Old Man with Water Studies.

2. Describe the accomplishment of scientific hero, Alfred Wegener.

-Theorized continental drift and Pangea

3. Describe the environment of the deep sea in areas where there are no hydrothermal vents.

-Dark, Cold, Desolate, etc.

4. Describe the environment of the deep sea in areas where there “are” hydrothermal vents.

-Hot, erupting, thriving with life

Appendix R: Culmination

- I.** Following the exam, each student will select one of the 32 reference/organization global addresses on page 120 of the book, *Deep Water* to write letters of support/interest. To aid in this process, copy page 120 and 121 from the book for all students. This letter writing process will be a 2-draft process and will be mailed to the organization the student chooses upon completion. This should be started following the final exam and complete the following day.

Rules:

1. Generate a topic to write about related to the reference chosen.
2. Create an outline with a beginning, middle, and end for a letter.
3. Organize the letter so that there is an introduction, logical arrangement of ideas, and a conclusion.
4. Write in complete sentences varying the types of sentences.
5. Know and use correct capitalization, punctuation, and abbreviations.
6. Use correct transitions to link ideas.
7. Choose words that communicate messages clearly and precisely.
8. Create a readable letter with legible handwriting or word processing.
9. Be respectful and courteous!
10. Revise a first draft and submit it for suggestions to the teacher.
11. Edit the corrected first draft to create a final draft.

The classroom teacher should mail the letter upon successful completion!

II. Additional Culmination Connection Options:

A. *STUNNING DVD VIDEOS AVAILABLE ON AMAZON.COM:*

1. "The Blue Planet" DVD series – "Seas of Life, Part II": The Deep
2. "Aliens of the Deep" DVD

B. FOR MUSIC: The history of water-related music is quite complex. Music teachers may create their own culmination with a study of water-music relationships. The topics below all relate to water:

1. Water as a Musical Tool: The Hydraulis or Water Organ, Water Drums, Ocean Harp, Conch
2. Musical Theater and Opera connected to Water: John Adams--- *The Death of Klinghoffer*, Gilbert and Sullivan--- *Gondolier*, *H.M.S. Pinafore*, *Pirates of Penzance*, Rodgers and Hammerstein--- *South Pacific*
3. Musical Imagery of Water: Frederic Chopin--- *Prelude, op. 28, no. 15, "The Raindrop"*, Claude Debussy--- *La cathédral englouté*, *La Mer*, *Reflets de l'eau*, Ferde Grofe--- *Mississippi Suite*, Jacques Ibert--- *Escales*, Todd Levin--- *Swirl*, Richard Rodgers--- *Victory at Sea*, Ralph Vaughan Williams--- *Sea Symphony*
4. Music that Imitates the Sounds of Water: Ludwig van Beethoven--- Symphony No. 6, movement 4 "The Thunderstorm", Jonathan Green--- Symphony No. 3, movement 4 "Water"
5. Water as Cultural Icon in Music: Bedrich Smetana--- "The Moldau" from *Ma Vlast* [My Country]

C. FOR TECHNOLOGY: For connecting acoustics to waves of water with technology: the "Toriton Plus" is a fascinating study: <http://www.techeblog.com/index.php/tech-gadget/toriton-plus-water-surface-as-music-controller>