**Water is Life: The Earth’s Hydrosphere and Its Impact on Living Systems**

**Grades 6-8 Earth Science Module**

**A CCSS-Aligned Curricular Module for Middle School Science Teachers**

**Developed by Expeditionary Learning in Collaboration with Student Achievement Partners**

**Overview**

This module was developed by Expeditionary Learning (EL) as an exemplar of Common Core aligned instruction. The module was produced to address key questions related to powerful implementation of the Common Core State Standards (CCSS):

* What could it look like to implement the CCSS in a science classroom?
* How do we build the disciplinary literacy skills students need in order to read, write, and think like scientists?
* How do we engage and support *all* learners in meeting the CCSS through careful practice and supportive materials?

The module is NOT meant as a “cookbook” for teachers to follow; we honor teachers as professionals, and expect teachers would modify and refine the lessons to meet the needs of their students and context. This is offered as one concrete example, an invitation, and an inspiration to others to extend this and to do their own work.

**Purpose:** The module was designed with two specific purposes:

**As a professional development resource**: The module serves as a model for teachers, to breathe life into the CCSS so teachers have a clear vision of what this type of instruction can look like, and better understand the powerful role the CCSS can play in building students’ content knowledge.

Teaching notes signal the kind of planning and thinking such instruction requires. Key teaching moves, in particular close reading with complex text, are described in enough detail to make it very clear what is required of students, and how to support students in doing this rigorous work. Specific instructional strategies or protocols are described that support students’ reading and writing with evidence. There is a major effort made to demonstrate ways to select and work with academic language (vocabulary and syntax) in order to make complex text and its wealth of ideas and knowledge accessible to all students. The goal of using the modules as models is for educators to transfer components of this exemplar to apply to *other* curricular units they are designing.

**As curriculum to use, adapt, or build from as you see fit**: This also can be the curriculum that lets you take the CCSS for a test drive within your school or classroom.

The module will help teachers achieve two goals:

* + build students’ content understanding (of the module topic) and
	+ help student develop the content literacy skills needed for College and Career Readiness.

Materials include summative assessments, central texts, key resources - the “story” of the student learning has been fully flushed out. The modules also include lesson level agendas with sufficient detail to show key instructional moves: suggestions of activities, text-dependent questions, and daily assessment give teachers clear guidance on the particulars, while still leaving room for teachers to adapt and make the lessons your own. Note that in some cases, the modules could also be adapted for other grade levels, if the rigor of the text-dependent questions were ratcheted either up or down or alternate materials of greater or lesser complexity were folded in with new questions and tasks developed.

The goals of using the modules as curriculum are to help students master content literacy standards while gaining content knowledge and to build teachers’ capacity to apply CCSS-aligned practices in instruction and assessment.

**A Note on Structure:**

Water is Life: The Earth’s Hydrosphere and Its Impact on Living is designed for middle school science. The module consists of three units over nineteen lessons that address standards from Next Generation Science Standards for Earth Science and the Common Core State Standards for Literacy in Science.

In Unit 1: Water is Life: The Heart and Science Behind the Phrase, students build background knowledge about the central role that water plays in all life. This unit includes a close read of Barbara Kingsolver’s seminal text “Water is Life.”

In Unit 2: Global to Local: My Watershed in the Hydrosphere, students use the US Environmental Protection Agency My WATERS Mapper to explore the specific rivers and streams and watershed boundaries for the major US watersheds and the USGS National Water Information System to examine surface water flow, underground water levels, and water quality parameters for student’s local watershed.

In Unit 3: Scientific Writing: Using Evidence to Explain the Need to Protect “The Water Commons” students write an explanatory essay that incorporates a scientific conceptual model and quotes from the technical articles and videos they have used in the previous two units.

The lessons are designed for a 90-minute block periods, but can be easily divided into 45-minute periods or modified further to fit any school schedule.

**Unit 1: Water is Life: The Heart and Science Behind this Phrase**

**Module Overview:** This module consists of three units. In Unit 1, students build background knowledge about the central role that water plays in all life. This unit includes a close read of Barbara Kingsolver’s seminal text “Water is Life.” In Unit 2 (Global to Local: My Watershed in the Hydrosphere), students use the US Environmental Protection Agency My WATERS Mapper to explore the specific rivers and streams and watershed boundaries for the major US watersheds and the USGS National Water Information System to examine surface water flow, underground water levels, and water quality parameters for student’s local watershed. Unit 3 (Scientific Writing: Using Evidence to Explain the Need to Protect “The Water Commons”) provides scaffolding toward students’ summative writing assessment (see below).

**Module Big Ideas**

* A small portion of the water in the Earth’s hydrosphere is accessible for human consumption. The amount of fresh water that exists and where it is stored affects us all. These fresh water resources are distributed unevenly around the planet as a result of past geologic processes and more recent human actions.
* Scientists and engineers read and review multiple sources of scientific and technical text to evaluate the merit and validity of a claim.
* Scientists communicate information, evidence, and ideas using tables, diagrams, graphs, models, interactive displays, and equations.
* Scientists use models to make and test predictions in order to make sense of the world.

**Module Guiding Questions:**

* How can the properties and movements of water (around the Earth) help us explain the phrase “water is life”? (Units 1, 2, and 3)
* How can we use the water cycle to understand the phrase “water is life?” (Unit 1)
* How and why can water quality issues in one watershed affect the quality of water in other watersheds? (Unit 2)
* How do our increased understanding of the hydrosphere, watersheds, and human uses of water impact our fresh water resources? (Unit 3)

Unit 1 is comprised of eight 90-minute sessions.

**Unit 1 Overview:** When we think about the water cycle, most of us think of a diagram with arrows that represent water flowing from mountaintops though rivers and streams into the big, blue ocean. This idealized diagram does not teach us the importance of water in sustaining life on Earth or what life might be like if this pattern were disrupted. In the first unit of this Earth Science module, students will use close analytical reading strategies to explore these ideas and others as presented in the article “Water is Life” by Barbara Kingsolver. Throughout the unit, student will grapple with the thesis of the article and identify the evidence that Kingsolver uses to support her thesis. To understand the hydrosphere and hydrological cycle, students will study different models scientists use to understand and communicate about these dynamic processes. Students will discuss how scientists use models and how models can change to reflect system dynamics, deeper understanding, and the needs of the audience. The summative assessment for Unit 1 will be a conceptual model of the hydrosphere or hydrologic cycle with an explanatory statement using important scientific vocabulary.

**Summative Assessment Unit 1 Writing Prompt (based on Literacy Design Collaborative Task 11):** After reading “Water is Life”, studying the NASA video on the Earth’s Water Cycle, and studying various texts from the *USGA Water Basics* website, students create a conceptual model of the hydrosphere and write an explanation to go along with their model about why only a small portion of Earth's water is accessible for human consumption.

**Unit 1 Lessons**

This unit is comprised of eight lessons designed to build scientific knowledge and vocabulary about the relationship between the hydrosphere, hydrologic cycle, and the Earth’s living systems. Student will make sense of the article; *Water is Life*, by Barbara Kingsolver, through a sequence of lessons that include close reading, vocabulary support, and text dependent questions. The unit includes a higher level of “scripting” for the initial close reading Lessons 1 through 4, to provide support and guidance for teachers about how to implement these types of reading lessons; teachers can draw on the practices modeled in these early lessons as the student’s continue read this very complex text. The unit also includes earth science instruction to help student understand the complex science concepts addressed in Kingsolver’s article. Throughout the lessons, student will be developing the knowledge, skills, and vocabulary to create conceptual models and explanations of the phenomena being studied. After Lesson 2, the students will create a conceptual model and explanation of the hydrological cycle; after Lesson 4 the students will create a conceptual model and explanation of the relationships among the hydrosphere, atmosphere, lithosphere and the biosphere; and after Lesson 8, the students will create a conceptual model of the hydrosphere with an explanation of the limits of fresh water resources on Earth.

*Understanding the Hydrologic Cycle*

* Lesson 1: Introducing the Big Idea “Water is Life”
* Lesson 2: The Water Cycle

*The Relationship between the Hydrosphere, Atmosphere, Lithosphere and the Biosphere*

* Lesson 3: Distribution of Fresh Water Resources
* Lesson 4: The Impact of Water Scarcity on Living Systems

*Using Models to Understand this Watery Planet*

* Lesson 5: How Scientists Use Models to Make Sense of the World
* Lesson 6: Using Models to Make Sense of the Hydrosphere

*Creating Models to Explain the Limits of Fresh Water Resources in the Hydrosphere*

* Lesson 7: The Water Commons
* Lesson 8: Synthesis, Conceptual Model, and Assessment

**This module addresses the following grades 6-8 Common Core English Language Arts and Literacy standards in Sciences and Technical Subjects and specific content standards drawn from the Next Generation Science Standards (NGSS).**

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| ***Common Core State Standards*** | ***Literacy*** | ***Disciplinary Core Ideas and Standards*** |
| Cite specific textual evidence to support analysis of science and technical texts. (RST.6-8.1) Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (RST.6-8.2)Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.(RST.6-8.4)Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic. (RST.6-8.5)Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text. (RST.6-8.6)* Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (RST.6-8.7)

Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (RST.6-8.9)Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (WST.6-8.2)Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 6 topics, texts, and issues,* building on others’ ideas and expressing their own clearly. (SL.6-8.1) | The student will:* use close reading strategies to make sense of complex text.
* analyze the structure of a complex text to determine how the author uses science, observational evidence, and personal connections to support his/her claim.
* write a supporting explanation for a conceptual model using scientific vocabulary.

***Earth Science**** hydrosphere and the hydrologic cycle.
* describe and diagram the relationship between the hydrosphere, atmosphere, lithosphere, and biosphere.
* explain how an increase in fresh water consumptions has resulted in desertification in some parts of the world.
* create a conceptual model of the hydrosphere.
 | MS-ESS2-1. Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process. * Water’s movements—both on the land and underground—cause weathering and erosion, which change the land’s surface features and create underground formations. (MS-ESS2-2)
* Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students’ own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. (MS-ESS2-2)

MS-ESS2-4. Develop a model to describe the cycling of water through Earth’s systems driven by energy from the sun and the force of gravity. * Develop a model to describe unobservable mechanisms. (MS-ESS2-4)
* Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4)
* Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)

MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. * Develop and use a model to describe phenomena. (MS-ESS2-1),(MS-ESS2-6)
* The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6)
* Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6)
* Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6)
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**Unit 1 Central Texts**

* “Water is Life” by Barbara Kingsolver <http://ngm.nationalgeographic.com/2010/04/water-is-life/kingsolver-text>
* Earth’s Water Cycle NASA Video <http://svs.gsfc.nasa.gov/vis/a010000/a011000/a011054/index.html> (video and transcript)
* The Earth as a System: Earth’s Spheres, Gallaudet University, (Slides 3-7): [sci.gallaudet.edu/MSSDScience/ESSSpheres.ppt](file:///C%3A%5CUsers%5CSilas%5CAppData%5CLocal%5CMicrosoft%5CWindows%5CTemporary%20Internet%20Files%5CContent.Outlook%5CC2J2VRWV%5Csci.gallaudet.edu%5CMSSDScience%5CESSSpheres.ppt)
* Relationship between the atmosphere, hydrosphere, lithosphere, and biosphere diagram: <http://www.britannica.com/EBchecked/media/112176>
* How Water Availability may change, as temperatures, population, and industrialization increase, 1961 – 1990. BBC News, December 2009: <http://news.bbc.co.uk/2/hi/science/nature/7821082.stm>
* Desertification Curriculum from United Nations Education, Scientific, and Cultural Organization: <http://www.unesco.org/mab/doc/ekocd/index_case.html>
* Climate and Water: In the Air and on Land, National Center for Atmospheric Research: <https://spark.ucar.edu/longcontent/climate-and-water-air-and-land>
* Blue Marble Globe Images and Animation Files, NASA: <http://visibleearth.nasa.gov/view.php?id=57723>
* Tropical Rainfall Measuring Mission – Middle School Overview. NASA: <http://trmm.gsfc.nasa.gov/overview_dir/why-ms.html>
* Water Cycle Model. United States Geologic Survey (USGS). <http://ga.water.usgs.gov/edu/watercycle.html>
* Water Cycle Model. Center for Atmospheric Research. <https://www2.ucar.edu/atmosnews/people/aiguo-dai>
* Water Cycle Model. Encyclopedia Britannica. <http://www.britannica.com/EBchecked/topic/278858/hydrologic-cycle>
* Water Cycle Model. U.S. Environmental Protection Agency.

<http://www.epa.gov/climatechange/images/impacts-adaptation/WaterCycleChanges.jpg>

* Water Cycle Model. BBC Education Scotland. <http://www.bbc.co.uk/scotland/education/int/geog/rivers/hydrological.shtml>
* Why Care About Water. National Geographic: <http://video.nationalgeographic.com/video/environment/freshwater/env-freshwater-whycare/>

**Unit 1 Teaching Notes**

* This unit has students consistently doing the work of scientists: closely reading and evaluating texts, comparing the information gained from text with information gained from videos and using models to understand how the world works. Initially, students do this with a lot of teacher guidance; as the module continues, they do so with greater independence. Students read closely a seminal text, “Water is Life,” throughout Unit 1. Certain close reading practices are also applied as students analyze other types of scientific texts, including informational text, data tables, maps, and media.
* There are several resources and routines to support implementing close reading of scientific text.
	+ Note that the appendix contains a model for how to analyze a text prior to using it with students. This is for teacher reference only and highlights note that determine where and when science concepts are referred to. These are spots where students will need more support and direct instruction. This document also reflects the vocabulary words which students will most likely need additional support when encountering.
	+ In Unit 1, the agendas provide quite a bit of detail regarding the close reading of a complex text and multiple types of scientific models. All lessons that involve a close reading will utilize two documents: “Water is Life” Student Text with Glossary and a “Water is Life” Text Dependent Question Recording Form (see appendix) specific to that lesson. These documents are designed so students can hold their thinking. It is, of course, possible to just display the recording forms and have students complete the work in their science notebook.
	+ Lessons 1 through 4 are more detailed than Lessons 5 through 8. When necessary, refer to the suggestions in the detailed agendas about vocabulary and text dependent questions, and use the Helping Students Read Closely to plan a close reading lesson that will meet your students’ needs.
* This module represents a shift in how vocabulary instruction has typically proceeded in content area classes. A handful of content specific words that are central to the module (e.g., hydrological cycle, hydrosphere, atmosphere, lithosphere, biosphere) are taught directly, practiced frequently, and assessed. To address the premise of literacy instruction in the Common Core, students will acquire rich vocabularies by frequently thinking about the meanings of the words they encounter while reading complex texts. The lessons also provide opportunities for students to sharpen their capacity to use context clues to determine the meaning of words. In addition, time is included for frequent conversations with students about the words they encounter while reading. The three specific vocabulary strategies used in this module include:
	+ Pre-teaching vocabulary: Teacher provide definitions for a handful of words central to the science concepts being taught and for general academic vocabulary that are central to the text and whose meanings cannot be determined from context.
	+ Instruction and support in using context clues: Teachers provide opportunities for students to discuss the meaning of many more words that they encounter while reading, and the teacher supports them in using word parts and context clues to determine what they mean and gives them the chance to check their hypotheses.
	+ Interactive Word Wall (see appendix): Conceptual understanding in science is built on understanding of and accurate use of scientific vocabulary. In this Unit, students and teachers will document specific science vocabulary and definitions on vocabulary cards that will be used regularly to create conceptual models that reflect the relationships and dynamics of various parts of the Earth’s systems.
	+ These intentional instructional practices expose students to a large number of new words and build the skill that will ultimately increase vocabulary – the ability to learn new words through wide reading. Words that are encountered in this way are rarely directly assessed. The Longman English Dictionary Online is a good source of student-friendly definitions.
* Students use science notebooks throughout this module. Remind students that their notebooks are intended for formative assessment (assessment for learning) purposes only. They use their notebooks to record their thinking and learning. The notebooks are not graded. Consider having students keep their notebooks in the classroom. The teacher should review entries in the science notebooks regularly and offer feedback for students in preparation for future summative assessments. Recording forms can be folded and glued into the science notebook to help the students manage their materials.
* Students need support to increase the quality of their class discussions, whether partnered, in small groups or in whole groups, such as the Science Talk (see appendix). The [Talk Science Primer](http://inquiryproject.terc.edu/shared/pd/TalkScience_Primer.pdf) developed by TERC provides rationale and tips that help teachers to structure in-class discussions. The National Academies Press book *Ready, Set, Science* by Michaels, Shouse, and Schweingruber, includes a vignette on “Establishing Norms for Discussion” in its chapter titled, “Making Thinking Visible.”

**Module Routines**

* Reading: Close reading of complex text
* Reading: Teacher reads aloud short excerpts of complex text to promote fluency. This read aloud should be “pure”: simply read slowly, fluently, without interruption, without stopping to explain or discuss. Students follow along while reading in their heads. After the read alouds, students get to reread, think, and talk about the text, in order to figure out what they can on their own.
* Writing: Use of detail and scientific language to explain conceptual model using Graphic Organizer for Explanatory Text
* Writing: Written response to Literacy Design Collaborative (LDC) tasks (summative assessments)
* Speaking and Listening: Small group synthesis tasks promote ongoing small group discussions
* Language: Interactive World Wall (see appendix). One vocabulary routine used throughout this module is to develop an interactive word wall for scientific (domain-specific terms) Interactive word walls provide students the opportunity to manipulate concepts and processes to synthesize meaning. Students can physically rearrange vocabulary terms to show possible relationships. Time for this is explicitly built into several lessons and this is an excellent strategy to use any time to check understanding or energize the classroom.
* Language: Science vocabulary cards. Each student will create and keep a collection of his/her own scientific vocabulary cards. These will be used to create conceptual models and to explore the relationship among concepts throughout the unit.

**General Lesson Sequence**

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| **Lessons 1-2: Understanding the Importance of Fresh Water (two 90-minute lessons)****Rationale:** These early lessons build a compelling case for considering fresh water as a fundamental ingredient for life on Earth while building students’ academic and content-specific vocabulary. Students read closely paragraphs 1 through 3 of the text, “Water is Life”. Students and teachers develop clear routines using four different vocabulary strategies during the close reading process, respond to text-dependent questions, and use the Interactive Word Wall to develop their first conceptual model of the hydrologic cycle. These lessons address the following skills and activities to develop facility with the targeted standards:* Using close reading strategies to make sense of complex text.
	+ Define and use the content-specific terms below:
		- Atmosphere, Aqueous, aquifer, climate, condensation, cycle, distribution, drought, erosion, evaporation, flood, fresh water, glacier, ground water, hurricane, hydrology, hydrologic, hydrosphere irrigate, lithosphere melt water, nutrient rich, precipitation, physics, saline, water vapor, water table, weather,
* Analyzing the structure of a complex text to determine how the author uses science, observational evidence, and personal connections to support his/her claim.
	+ Discuss why Kingsolver uses her experiences with her daughter in her introduction to the article, “Water is Life”..
	+ Identify how Kingsolver used scientific theory to support her thesis.
* Explaining the hydrosphere and the hydrologic cycle.
	+ Create a conceptual model of the hydrologic cycle.
	+ Use scientific language to describe the hydrologic cycle.
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| **Informal Assessment Options*****Student work or evidence of learning that teachers may use to informally gauge class progress.***  | **Individual Student Assessment Options*****Students’ more formal, individual written assessment that teachers may collect to more formally assess based on mastery of learning objectives above*** |
| Entry Task - Science Notebooks“Water is Life” Text Dependent Question Recording FormInteractive Word Wall exercises related to Hydrologic CycleExit Tickets - Science Notebooks | Hydrologic Cycle Flow chart with brief explanation (Lesson 2) |
| **Lesson 1 - Introducing the Big Idea “Water is Life”****Teaching Notes*** Barbara Kingsolver’s article “Water is Life” is a very difficult text for middle school readers. Read the article in advance to identify academic and scientific vocabulary and grapple with the structures used by the author to support her thesis. You will find an analysis of the text in the appendix (Water is Life Text Analysis), done by Expeditionary Learning in order to plan these lessons. This analysis serves two purposes: first, to heighten teachers’ awareness to the complexity of this particular text; second, to model the type of analysis that science teachers can do with any complex text to determine what concepts, vocabulary, or aspects of text structure are most important or will prove most challenging to students.
* In Lesson 1 and 2, students explore the phrase “Water is Life” through the practice of close analytical reading of paragraphs 1 -5. These lessons provide the first opportunity for students to read and re-read passages from “Water is Life” with attention to vocabulary and central ideas. As they unpack the rich metaphors and images created by Kingsolver, they will explore what she means when she says, “Water is Life.” Note that throughout Unit 1, students will read and re-read sections of the article: they first hear it read aloud, then reread for main ideas, and then respond to text dependent questions. Establishing strong analytical reading practices in these first few lessons will allow lessons to flow smoothly as the unit progresses.
* Because of the complexity of the language used in this article, specific routines related to vocabulary are introduced. Some vocabulary terms are pre-taught. These words were very strategically chosen because they are crucial for understanding and cannot be determined easily from context. Similarly, provide general academic vocabulary that the students will need to understand the complex metaphors and references used by the author After the first reading, student will identify additional unfamiliar science and academic vocabulary and use context clues to figure out the definition of those terms. This focus on vocabulary, with a particular emphasis on using context clues, is important for student to develop their analytical reading skills and deepen comprehension of complex texts.
* The “close read” of the article “Water is Life” is provided in some detail. This routine – having students grapple with the text on their own, then prompting them to reread to figure out new vocabulary and answer text-dependent questions and then debriefing their work – will be repeated throughout the unit, but is described in less detail in later lessons.
* In Lessons 1-2, establish a strong routine for using an Interactive Word Wall (see appendix). You will need a supply of large blank index cards and a supply of Interactive Word Wall Arrow Cards for the conceptual modeling process. Students will need their own supply of small index cards, arrows, a plastic bag, and rubber bands to manage and store their cards. Each time you add a new science word to the Interactive Word Wall, model writing the word on one side of the card and the definition on the back. Students will create their own vocabulary card, also with the word on one side of the card and the definition on the back. During sections of the lesson when you are sorting, creating flow charts, or creating conceptual models, students should use their own cards at their desks or table. As the lessons progress, have students work with their own cards; then use their work to create a class model.
* If you do not use science notebooks, consider how your student will manage the multiple texts, graphic organizers, and recording forms that you will use during this module. In many cases, you will have a choice of either photocopying a worksheet for students or projecting a set of directions and/or questions and having them do work in their notebooks.
* In general, these lessons suggest questions for entry tasks and exit tickets, but do not provide worksheets or handouts for them. We recommend that students complete these tasks in their science notebooks; however you may also create handouts. You should always write the entry task or exit ticker question on the board so students have something to refer to, whether they are doing entry tasks, responding to a reading, or having a discussion.

**Lesson 1 Materials*** Science Notebooks
* Internet access, video projector, and speakers
* “Water is Life” by Barbara Kingsolver <http://ngm.nationalgeographic.com/2010/04/water-is-life/kingsolver-text>
* Earth’s Water Cycle NASA Video <http://svs.gsfc.nasa.gov/vis/a010000/a011000/a011054/index.html> (video and transcript)
* “Water is Life” Student Text
* “Water is Life” Text Dependent Question Recording Form
* NASA Earth’s Water Cycle Video Text – vocabulary analysis (To be used as needed for ELL or other students with auditory processing difficulties)
* Lingering Questions anchor chart
* Ideas and Vocabulary for Paragraphs 1-3 anchor chart

**Lesson 1 Agenda**1. Entry Task (5 min)1. Explain Entry Task Routine (2 min)
* Identify where students will find the entry task each day
* Expectation that the written response is done individually and is usually brief. Students should write responses in Science Notebooks
1. Complete Entry Task: “The amount of moisture on Earth has not changed. The water the dinosaurs drank millions of years ago is the same water that falls as rain today. But will there be enough for a more crowded world?” (3 min)

2. Opening (10 min)A. Introduce Think/Write-Pair-Share protocol (see Questioning Strategies Protocol in appendix) and text (2 min)* List parts of the protocol; briefly explain purpose of each. You might say something like, “I am looking forward to hearing your thinking about this quote and about other documents we will study. Having time to think alone and time to work with a partner often helps students do their best thinking. We will often use a protocol called Think/Pair/Share where first you think, and often write, by yourself; then you and your seat partner talk about your ideas; and finally, we talk as a whole class. Let’s try it with the quote from our Entry Task.”
* Ask the students to re-read the quote silently and then read what they had written in their notebooks during the entry task.

B. Think/Write-Pair-Share (5 min)* Have the students discuss what they wrote in their notebooks about the picture of the Earth that is projected on the screen.
* Cold call on students to share out.
* Teacher notices and names ways in which students are collaborating effectively during partner talk and share out.

C. Module and Unit Overview and Purpose of Lessons 1-2 (3 min)* Do not go into detail, but do set some purpose for the Module. You might say something like, “We are beginning a unit that explores the water cycle in general and our local watershed in particular. The author of the quote from our Entry Task has provided some basics for us to build on. She has also presented a pretty important question that we will be trying to answer over the next few lessons.”
* Overview for Unit 1: “Over the next eight lessons we are going to be reading an article taken from the April 2010 edition of National Geographic Magazine. This article, “Water is Life” was written by Barbara Kingsolver, a biologist by training, but also a very popular freelance writer and author. (You may add other details if you wish: <http://www.kingsolver.com/biography/>.) Because the article is so complex, and packed with information, we will read the article in chunks and take time to unpack the science that informs her writing.
* Overview for Lesson 1-2: “In the next two lessons, we are going to read the introduction to Kingsolver’s article and learn about the hydrological cycle.”

3. Work Time (70 min)1. Introduce the Interactive Word Wall (12 minutes)
* Before the lesson, write these terms on one side of an index card and the definition of the term on the other side: hydrologic cycle, hydrosphere.
* Introduce students to the Interactive Word Wall by saying something like: “One of the most important strategies to help you understand the science concepts that we will be studying over the next 8 lessons will be our Interactive Word Wall.” In Earth Science, it is very hard to see everything that is going on, many of the processes that shape the earth are too big to see! So, for this Unit, we are going to use the Interactive Word Wall to collect important vocabulary to help us learn about how the hydrological cycle and the hydrosphere.
* Have students create their own cards.
* Once students have created their cards, tell them that it will be important for them to continue to create their own vocabulary cards throughout the module.
* Make sure students have a method and location to store their cards.
1. Introduce Science Notebook (3 minutes)
* Introduce the Science Notebook by saying something like this: “Science requires careful observation and documentation of ideas. Scientists study their notebooks to look for patterns and keep track of their developing ideas. This allows them to be intentional and reflective about their work at the same time. As they document observations, either through diagrams and drawings, numbers, or words, these symbols help them to make sense of the world. In this module, you will be using your Science Notebook to document your thinking, take notes, and to help you identify patterns.” If you have not already done so, explain to students the routine for noting when and how to label the pages of their notebook and other routines. If they do not have a storage place for the vocabulary cards, take the time here to have students create a pocket on the front or back cover to the notebook.
* Make sure that students know that these notebooks are intended for formative assessment (assessment for learning) purposes only. They are to be left in the classroom in a designated space so the teachers can review notebook entries to check understanding. Students need to know that their notebook is a context in which they can do routine writing to explore thoughts and connections, represent their thinking in models and diagrams, and keep track of key concepts and vocabulary and concepts. Students need to trust that their notebook will not be graded for “right” answers.
1. Viewing NASA Earth’s Water Cycle Video – Building Science Vocabulary and Conceptual Knowledge (15 min)
* Prepare students to watch the NASA video, Earth’s Water Cycle. This video is packed with information related to our guiding question. Introduce the video by saying something like: “In many schools, children learn about the water cycle and the properties of water in 2nd or 3rd grade. Often, once we learn something we think we “know everything” about that topic. In science, we know that is not always the case. We know that the more we know about something, the more questions we have! So to prepare ourselves for reading Barbara Kingsolver’s article “Water is Life” and to review the basics about the water cycle, we are going to watch a video from NASA called ‘Earth’s Water Cycle.’ This video is packed with information. I am going to have you create a recording form in your science notebook. We will watch this video today and again in Lesson 2. So what we do not catch in our recording forms today, we will capture then. The guiding question for this Module is “How do the properties and movements of water shape Earth’s surface and affect its systems?” We are going to use this question to frame our first viewing of this video. Take out your notebooks and label the next full page as follows:
	+ Place the date and time at the top of the page
	+ List the name of your class and the time;
	+ Place the Title of the Video on the Top of the page: Earth’s Water Cycle by NASA
* “Now create a recording form that looks like this in your notebook (Model by drawing on the board or projecting your science notebook on the screen. You may engage students in helping you label the columns.)
* Define the term hydrosphere: the space under, over, and, on land where there is water.
* You will want students to use this recording form to focus their attention on where water is found and how it moves.
* At this point, you need to make sure that students understand the three properties of water – solid, liquid, gas.
* Focus their attention on recording words or very short phrases. Some examples are in the boxes to get you started. Inform students that you will be sharing terms at the end of the video.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Property | Storage on land | Storage underground | Storage in the air | Movement on land | Movement underground | Movement over land |
| solid | Glaciers |  |  | Glaciers |  |  |
| liquid | reservoirs | Underground reservoirs |  | Rivers | Underground rivers |  |
| gas |  |  | clouds |  |  | Clouds |

* Show Video: **Earth’s Water Cycle: with narration** [**http://svs.gsfc.nasa.gov/vis/a010000/a011000/a011054/index.html**](http://svs.gsfc.nasa.gov/vis/a010000/a011000/a011054/index.html)
* Add the words student have collected on their recording forms to the Interactive Word Wall and to their Science Notebooks.
* As you capture notes, record other observations and questions that emerge from student on the **Anchor Chart** labeled **“Lingering Questions”** (see appendix). Do not answer these questions at this time. Let students know that as you unpack the Kingsolver article they will also be taking time to learn more about the science related to the hydrological cycle.
* Synthesize the conversation by creating a very simple water cycle using the terms and arrows on the Word Wall.
* Thank students for their diligence in taking notes and sharing vocabulary terms.
1. Introduce Close Reading (25 min)
* Distribute and display **“Water Is Life.”** Read the first three paragraphs once aloud.
* Ask students to underline words that are related to “water” and circle words that are related to “life.” Call on several students to share. (life: daughter, I, spider, heron, frogs, amphibians, snapping turtle. ) (water: aqueous; irrigate, flood, drought, hurricane). Ask the question: “What do these things have in common that might help us understand the phrase “water is life.”
* Define arc, aqueous, hurtle, and primordial as these words are difficult to determine from context.
* Read the 1st paragraph again, and ask students to circle words they are unfamiliar with. Prompt students to write their meanings in the column to the left, near the words. Explain that when readers encounter a word they do not know they often go word-by-word and phrase-by-phrase to make meaning of it. They paraphrase, which is to restate something in their own words, rather than summarize, because it is easy to miss details when you summarize, and the details in the images that Kingsolver creates in this text are important to understand what she is writing about. Tell students that they will do this with the phrase “Water is Life”.
* Use the first sentence to model how to paraphrase and figure out vocabulary in context. You might say something like, “My daughter and I keep an eye out ….I think that means “watch”…. for wonder. Hmmm… I wonder….Ha…I said the word when thinking about the word. What did I mean…the wonder I used means to think or questions. I don’t believe that is what Kingsolver meant. Let me read further to see if I can figure it out. “. . . every morning as we walk down the farm lane (road) to meet the school bus. And whenever we find them, they reflect the magic of water. Aha…that is what she means…magic, beautiful! So now I can put it together: She is saying that she and her daughter look for water and find beauty and magic when they find it!” Write this on the copy you are displaying, and also jot down your definition for wonder.
* Direct students to work with seat partners to do this for the rest of paragraphs 1 through 3.
* Refocus whole class and cold call on students to share answers, noticing and naming strategies students are using to determine the meaning of words in context and to paraphrase a challenging text. For example, students may be rereading, reading past the word to find its meaning, breaking a word into parts, or going phrase-by-phrase.
* As students identify central ideas in the text and key vocabulary words, script the answers on an anchor chart that is title “Ideas and Vocabulary Paragraphs 1 – 3” (see appendix). Write phrases on the document as it is projected, prompt students to correct their own worksheets so they all have an accurate reference moving forward.
1. Text Dependent Questions (15 min)
* Distribute the **“Water is Life” Text Dependent Questions – Lesson 1.”**
* Tell students that another way figure out what a difficult text is saying is use questions to help you focus on specific passages. By answering text dependent questions, either by yourself or with a partner, you can uncover the central ideas of a text.
* Post the first text dependent question, and then model how to think through the question. Explain vocabulary as necessary –and provide an answer that cites textual evidence. As you think aloud, write up your answer, and leave it so students can see a model of strong work.
	+ Based on her description of the wonders that she and her daughter experience, what assumptions can you make about the relationship Kingsolver and her daughter have with water?
	+ When Kingsolver describes how “water changes the face of the land”, what is she talking about? What famous landmark is she describing? (Erosion – add this to Interactive Word Wall.
	+ Kingsolver writes, “. . . humans understand in our bones that she is the boss.” Who is ‘she’ and why does Kingsolver say ‘she’ is the boss?
	+ Why is Kingsolver so concerned about flood, drought, hurricane, rising sea levels, bursting levees?
	+ What does Kingsolver mean by “grave physics lesson?” How does this relate to the next sentence “hot air holds more water molecules than cold”? How can air hold water?
* Students work in pairs to answer the second and third questions, using textual evidence to support their answer.
* Return to the Interactive Word Wall and identify any words that came up in the reading that should be included on the wall.
* Congratulate students on their perseverance and close reading. Assure them that they will continue to work with this phrase and will develop a fuller understanding of the rights that are included.

4. Closing and Assessment (5 min)1. In your science notebook, respond to the following question: Near the end of paragraph 2, Kingsolver writes a very short sentence, which is also the title of the article: “Water is life.” What does she mean?

5. Homework1. Complete definitions on personal vocabulary cards.
2. Learn about the author: Visit Barbara Kingsolver’s website and read her autobiography. <http://www.kingsolver.com/biography/>. Be prepared to share two things about Barbara Kingsolver that has influenced her interest in water.

**Lesson 2 - The Water Cycle****Teaching Notes*** In this lesson you will use the same close reading sequence for paragraphs 4 and 5 that you used in Lesson 1.
* In this section of the article, Kingsolver blends technical language with vivid images to describe the water cycle. Your challenge will be to assist students in understanding the science, the beauty, and the magnitude of the water cycle.
* You will use the Interactive Word Wall to build scientific vocabulary; show your students how to use their own set of vocabulary cards to create their first conceptual model of the hydrologic cycle.
* The exit ticket for this lesson is a formative assessment: a conceptual model with a brief explanation.
* Make sure that students leave their science notebooks in the classroom when they leave or have them complete the assessment on a sheet of paper so you can review it in order to plan instruction.

**Lesson 2 Materials*** Science Notebooks
* Internet access, video projector, and speakers
* “Water is Life” by Barbara Kingsolver <http://ngm.nationalgeographic.com/2010/04/water-is-life/kingsolver-text>
* Earth’s Water Cycle NASA Video <http://svs.gsfc.nasa.gov/vis/a010000/a011000/a011054/index.html> (video and transcript)
* “Water is Life” Student Text
* “Water is Life” Text Dependent Question Recording Form
* “Water is Life” Graphic Organizer for Conceptual Model Explanatory Text

**Lesson 2 Agenda**1. Entry Task (5 min)1. In your science notebooks respond to this question, “How does water move around the Earth?”
* As students are writing in their notebooks, circulate to check on completed vocabulary cards.

2. Opening (15 min)A. Overview and Purpose of Lesson 2 (5 minutes)* As in Lesson 1, do not go into too much detail, but do set purpose for Lessons 2. You might say something like, “In today’s lesson, we are going to read and analyze paragraphs 4 and 5 of *Water is Life*. In these paragraphs, Kingsolver shares the science behind her statement “Water is Life.” The focus of our reading will be:
	+ To define and use the terms below:
		- Atmosphere, Aqueous, aquifer, climate, condensation, cycle, distribution, drought, erosion, evaporation, flood, fresh water, glacier, ground water, hurricane, hydrology, hydrologic, hydrosphere irrigate, lithosphere melt water, nutrient rich, precipitation, physics, saline, water vapor, water table, weather,
	+ To identify how Kingsolver used scientific theory to support her thesis.
* Continue setting purpose by saying something like, “After reading the text, we will re-watch the NASA video and use the Interactive Word Wall.

B. Check-in on Homework – Think/Write-Pair-Share (10 min)* Write the following question on the board: “Who is Barbara Kingsolver and why should we be interested in what she has to say? (5 min)
* Introduce the Think-Pair-Share by saying something like, “As scientists, it is important to know a bit about the authors of articles that we read. We are going to spend a lot of time working with the text “Water is Life,” so it is important find out whether the author is credible (define) and what his/her credentials are. Take a minute to think and write about the question on the board.”
* Have the students discuss what they wrote in their notebooks about the picture of the Earth that is projected on the screen.
* Cold call on students to share out. Teacher notices and names ways in which students are collaborating effectively during partner talk and share out.

3. Work Time (60 min)A. Interactive Word Wall (10 min) * Read paragraphs 4 -5 out loud. Tell students to underline all of the words that relate to water.
* Cold call on students to share a water word from the article. Model writing the word on the face of the card and the definition on the back of the card. Ask students where that word would live on the recording form that they created in Lesson 1. If you have the copy of you science notebook with the recording form, have a student add the word to your notebook as you place the word card on the Word Wall.
* Continue to call on student until you have created a card for each of the following words: evaporation, drought, glacier, melt water, flood, storm, arid, saturated ground, weather, and flow.

B. Read Aloud and Rereading Independently: Paragraphs 4-5 (15 min)* Introduce and define the following vocabulary from the text: pummeled, amplify, sustain, dwindle, blight
* Read paragraphs 4 and 5 out loud. While is it not always necessary to do this, it is an important scaffold for very complex texts, and a useful scaffold in supporting struggling readers with grade level text. Have students underline words they do not know.
* Ask students to circle words they are unfamiliar with. Prompt students to write their meanings in the column to the left, near the words. Reinforce the use of context clues to determine meaning. Model if necessary (See Lesson 1)
* Direct students to work with seat partners to do this for the rest of paragraphs 4 and 5.
* Refocus whole class and cold call on students to share answers, noticing and naming strategies students are using to determine the meaning of words in context and to paraphrase a challenging text. For example, students may be rereading, reading past the word to find its meaning, breaking a word into parts, or going phrase-by-phrase.

C. Analysis of Evidence used by Kingsolver to Support her Thesis: Text Dependent Questions (15 min)* Distribute the **“Water is Life” Text Dependent Questions – Lesson 2** document.
* Post the first text dependent question, and then model how to think through the question. Explain vocabulary as necessary –and provide an answer that cites textual evidence. As you think aloud, write up your answer, and leave it so students can see a model of strong work.
* Students work in pairs to answer the second and third questions, using textual evidence to support their answer.
	+ In paragraph 4, Kingsolver writes, “The past decade has brought us more extreme storms than ever before.” What evidence does she cite to support this claim?
	+ In paragraph 5, Kingsolver use the phrase “water will flow from snowcapped mountains, rain and sun will arrive in their proper seasons.” to describe what? Does Kingsolver believe that the water cycle still works?
	+ In paragraph 2, in the final sentence, Kingsolver uses the phrase “pounding circulatory system of the world.” How does this relate to what you now know about the properties and movement of water in the hydrosphere?
* Debrief, noting and naming effective pair conversation and effective use of textual evidence.

D. Return to NASA Earth’s Water Cycle video focusing on vocabulary and models (10 min)* Prepare students to watch the **NASA video, Earth’s Water Cycle.** “Today we are going to watch this video closely to capture vocabulary and concepts related to the hydrological cycle that we have not yet found in the Kingsolver article. I want you to listen closely to the sections that talk about the “temperature”, “atmosphere” and “climate.” Define the terms. Add the terms to the Interactive Word Wall (word on one side of index card, definition on the other).
* Instruct students to take note of additional information and write new words in the column on the page where they have created their **vocabulary organizer.**
* After viewing the video, add additional terms to the Interactive Word Wall, have student create their own vocabulary cards, and add words on their recording form in their Science Notebook.

E. Conceptual Model Demonstration (10 min)* Move all of the words on the Word Wall to one side.
* Start the conceptual model by selecting the terms “Hydrologic” and “Cycle” at the top. As you do this, say, “Scientists use models and flow charts to help them understand how the world works. This conceptual model is about the “Hydrologic Cycle.” While I am up here making the class model, you may use your own cards on your desk to create a model similar to mine!”
* Cold call on a student to define Hydrologic Cycle.
* As you add each word to the chart, use an arrow to represent the movement of water. Discuss whether the arrow represents water movement as solid, liquid, or vapor. If you like, you may write liquid, liquid, and vapor on some of the arrows. This will help student understand that when water is solid state, it is rarely moving! The exceptions are snow and ice. And these only occur at very low temperatures.
* While you are creating the model, be very intentional about the connections between temperature, climate, and atmosphere. These three concepts will help students understand the uneven distribution of water that will be discussed in the next lessons.
* Clarify terms as you add each one to the model.

4. Closing and Assessment (10 min)1. Formative Assessment
* Provide an overview of the task: Create your own conceptual model of the hydrological cycle with a 1-2 sentence explanation using terms form the Interactive Word Wall.
* Provide 5 minutes from student to work with their vocabulary cards to create a cycle and record their cycle in their notebook.
* Distribute the **“Water is Life” Graphic Organizer for Conceptual Model Explanatory Text.**
* Have students glue the organizer into their Notebook on the next page.
* Have students use the Graphic Organizer to identify three details they want to use in their explanation and then transfer those details into their science notebook to describe their conceptual model.
* Circulate to observe what students are recording.

5. Homework1. Complete definitions on all word cards.
2. Complete Conceptual Model of Hydrological Cycle with Explanation.
 |
| **Lessons 3-4: The Relationship between the Hydrosphere, Atmosphere and Humans in Desertification (two 90-minute lessons)****Rationale:** Students build their conceptual understanding of how and why the movement of water on Earth determines whether living organisms can survive. They use the Kingsolver article (paragraphs 6-9) as the main text, but will also use maps and other resources to explore why Kingsolver has used desertification as her example of the importance of water in this section of the article. By examining the process of desertification, students will learn how the hydrosphere (water on, over, and under the surface), the atmosphere (layer of gases surrounding the earth), and the lithosphere (the land) influence the biosphere (where life can survive). These lessons address the following skills and activities to develop facility with the targeted standards:* Using close reading strategies to make sense of complex text.
	+ define and use the terms below:
		- Atmosphere, biosphere, conservation. climate, desertification, Holocene, Hydrosphere, lithosphere, reforestation, microcosm, El Nino, irrigation
* Analyzing the structure of a complex text to determine how the author uses science and observational evidence to support his/her claim.
* Describing and diagramming the relationship between the hydrosphere, atmosphere, lithosphere, and biosphere.
 |
| **Informal Assessment Options*****Student work or evidence of learning that teachers may use to informally gauge class progress.***  | **Individual Student Assessment Options*****Students’ more formal, individual written assessments that*** ***teachers may collect to more formally assess based on mastery of*** ***learning objectives above.*** |
| Entry Task“Water is Life” Text Dependent Question Recording FormsInteractive Word WallExit Tickets | Diagram of hydrosphere, atmosphere, lithosphere, biosphere with explanation (end of Lesson 4) |
| **Lesson 3 - Distribution of Fresh Water Resources****Teaching Notes*** In Lessons 3 and 4, students explore the phrase “Water is Life” by reading closely paragraphs 6-9 to understand what life would be like without water. Kingsolver describes the difficulties of surviving in an environment without water. She also introduces conservation efforts to restore vegetation in the desert. As we wonder why she used this example, we will dig more deeply into the relationship between the hydrosphere, lithosphere, and the atmosphere in creating extreme weather events. These lessons will also integrate maps, tables, charts, and photographs to help students understand the magnitude of desertification and uneven distribution of water on human health and survival.
* The “close read” of the article “Water is Life” continues to be somewhat scripted in these lessons. By now, you should be familiar with the routine – having students grapple with the text on their own, prompting them to reread to figure out new vocabulary and answer text-dependent questions, and debriefing their work.
* For Lesson 3, gather maps, photos, and other materials for a Gallery Walk (see appendix). Use “Desertification Curriculum from United Nations Education, Scientific, and Cultural Organization” at <http://www.unesco.org/mab/doc/ekocd/index_case.html> for your reference. This curriculum has excellent case studies and photos that can be used to create this Gallery Walk. This curriculum is a public domain document but can also be purchased through the link provided.
* In Lesson 4, you will walk students through a close analysis of a sequence of maps. This lesson will use the same sequence of steps as the close reading process: introduce important vocabulary; review the maps slowly; study the maps and paraphrase the information from the map; use of a series of map dependent questions to ensure key concepts are learned. The maps provided will allow student to see the impact of temperature and distribution of water over time.
* You will continue to use the Interactive Word Wall and modeling process to help student understand more complex concepts (weather, climate) and increase the number of variables (over use, population, pumping, drilling) that influence where and how water is distributed on earth. Be sure to have enough index cards and arrows for your work!
* Continue to build routines to help students keep their recording forms and other texts organized.

**Lesson 3 Materials*** Science Notebooks
* Internet access, video projector, and speakers
* “Water is Life” by Barbara Kingsolver <http://ngm.nationalgeographic.com/2010/04/water-is-life/kingsolver-text>
* Earth’s Water Cycle NASA Video <http://svs.gsfc.nasa.gov/vis/a010000/a011000/a011054/index.html> (video and transcript)
* “Water is Life” Student Text
* “Water is Life” Text Dependent Question Recording Form
* “Water is Life” Graphic Organizer for Conceptual Model Explanatory Text (Lesson 2)
* The Earth as a System: Earth’s Spheres, Gallaudet University, (Slides 3-7): [sci.gallaudet.edu/MSSDScience/ESSSpheres.ppt](file:///C%3A%5CUsers%5CJSeydel%5CDownloads%5Csci.gallaudet.edu%5CMSSDScience%5CESSSpheres.ppt)
* Relationship between the atmosphere, hydrosphere, lithosphere, and biosphere diagram: <http://www.britannica.com/EBchecked/media/112176>
* How Water Availability may change, as temperatures, population, and industrialization increase, 1961 – 1990. BBC News, December 2009: <http://news.bbc.co.uk/2/hi/science/nature/7821082.stm>

**Lesson 3 Agenda**1. Entry Task (10 min)1. In the following statement, from the end of the video that we watched yesterday, the narrator makes this statement: “Sensors on a suite of NASA satellites observe and measure water on land, in the ocean and in the atmosphere. These measurements are important to understanding the availability and distribution of Earth's water, which is both vital to life and vulnerable to the impacts of climate change and a growing world population.” What does this mean to you? Why should anyone be interested in the availability and distribution of Earth’s water? (5 min)
* Circulate and collect conceptual model of the hydrologic cycle with explanations from students who did not complete the task during the previous lesson.
1. Think/Write-Pair-Share (5 min)
* When students are done writing in their notebook, have them discuss their response with a partner.
* Cold calls students to share out. Teacher notices and names ways in which students are collaborating effectively during partner talk and share out.

2. Opening (5 min)1. Overview and Purpose of Lessons 3-4
* Frame the next two lessons for the students, but do not give too much away. Say something like the following: “In the previous two lessons, we used close reading to understand the meaning behind the title of Barbara Kingsolver’s article. As we discussed, Ms. Kingsolver believes that water is the physical face of climate change and we need to learn to live within the limits of our fresh water resources. She makes the case that the extreme weather events that we are seeing are a result of both climate change and our misuse of water resources. She developed her argument by using personal experiences with her daughter to let us know how “magical” and important water is for life. She also used the water cycle as the backdrop for her overview of extreme weather events. In the next two lessons, we will continue our close read of Kingsolver by learning about another personal experience she has had that she uses as evidence to support her argument. As we did in yesterday’s lesson, we will look at the science behind her story.”

3. Work Time (70 min)1. Close Reading of Paragraphs 6-9 of **“Water is Life”** (30 min)
* Tell students that we will use the close reading process with paragraphs 6-9 to learn about life in an extreme water stress environment.
* Terms to define: El Nino; hollow, endemic, refugee, desertification, reforestation, conservation
* Ask students if they know where Bajo Piura Valley is. If not, identify where the Piura River is in Peru on a map or globe.
* Use the maps to point out the region that Kingsolver mentions in her article.
	+ Puru
	+ Ecuador
	+ Piura Desert
	+ Sub-Saharan Africa
	+ Australia
* Read paragraphs 6-9 aloud.
* Have students review the paragraphs and circle unfamiliar words and code each one with an “S” for a word that is related to science and an “A” for academic words. Model using context to determine the meaning of words.
* Add new words to Interactive Word Wall
* Have students take about 15 minutes to make meaning of paragraphs 6-9 on their own. Encourage them to annotate by jotting notes in the margins to help them keep track of what they are figuring out.
* Refocus whole class and cold call on students to share answers, noticing and naming strategies students are using to determine the meaning of words in context and to paraphrase a challenging text. For example, students may be rereading, reading past the word to find its meaning, breaking a word into parts, or going phrase-by-phrase.
* As students identify central ideas in the text and key vocabulary words, script the answers on an anchor chart, write phrases on the document as it is projected, and prompt students to correct their own worksheets so they all have an accurate reference moving forward.
1. Analysis of Fresh Water Distribution Maps (30 min)
* Introduce the next section of the lesson by saying something like, “As we are learning, scientists use models to understand the world. To fully understand the science behind the story that Kingsolver shares with us in paragraphs 6-9, we need to understand the science behind desertification. Desertification, as we said before, is when the soil is no longer able to hold water and sustain life. Kingsolver did not identify the reasons for this, but instead shared a story about the difficulties of living in dry and arid lands. To fully understand the dynamics of desertification, we need to understand the life support systems of the earth.”
* Provide or reinforce definitions of the four spheres: atmosphere, hydrosphere, lithosphere, and biosphere. Create a word card for the Word Wall for each term that has not yet been posted. Have students create their own word cards.
* Project a **slide of showing the relationship between the atmosphere, hydrosphere, lithosphere, and biosphere.** (any number of slides can be found on the web) <http://www.britannica.com/EBchecked/media/112176> or use slides 3-7 from the powerpoint created by Galllaudet University: The Earth as a System: Earth’s Spheres: [sci.gallaudet.edu/MSSDScience/ESSSpheres.ppt](file:///C%3A%5CUsers%5CJSeydel%5CDownloads%5Csci.gallaudet.edu%5CMSSDScience%5CESSSpheres.ppt)
* Provide an overview of how the atmosphere and hydrosphere work together to create climate; the lithosphere, atmosphere and hydrosphere work together to sustain plant, animal, and human life. This life zone is called the biosphere.
* Tell students that today we will examine how climate (atmosphere and hydrosphere) and human activity (biosphere) can impact the land (lithosphere) and result in desertification. This model projects how water availability may change as temperatures, populations, and industrialization increase around the world. In the case of these maps, when we refer to temperature, we are referring to the climate. Make sure students understand the following terms.
	+ Climate
	+ Temperature
	+ Population
* Explain that the maps you will study were created by a computer model of climate change developed by scientists in England to generate projections of future temperature and rainfall. These projections were then used to predict model fresh water flow in river basins.
* State purpose for students, saying something like: “I would like to you study the images that I am going to show you, and write your observations in your Science Notebook. Open your notebook and label the page “Water Availability.” Leave a space at the top of the page and label that space “Big Questions – Map Overview.” Now, create a large table on the page with five rows and 3 columns. Label the first Column, “Map”, the second column “Notice,” and the third column, “Wonder.” Label each row as follows:

Water AvailabilityBig Questions from Map OverviewClose Review of Maps

|  |  |  |
| --- | --- | --- |
| Map | Notice | Wonder |
| Map 1 |  |  |
| Map 2 |  |  |
| Map 3 |  |  |
| Map 4 |  |  |

* Project the **first image:** <http://news.bbc.co.uk/2/hi/science/nature/7821082.stm>
* Allow students 2 minutes to study the image and jot notes in the first row.
* Cold call on 1 or 2 students to share a notice and wonder. Reinforce their observations. If the question is related to vocabulary or content that you have already introduced reference back to the article, document, or word wall to help the students make connections with previous lessons. If they mention appropriate vocabulary for the Word Wall, stop, and create the card, and move on.
* Ask students one or two text dependent questions to make sure they are focusing on specific aspects of the map.
	+ What does the term “stress” mean in the key on the map?
	+ From looking at this map, what is the relationship between water availability and stress?
	+ How do the colors used on the map reinforce the word “stress.”
	+ Find where we live on the map, what level of “stress” are we experiencing between 1960 and 1990? (If they have not notices, point to the dates in the upper left corner.”
* Project the **second image**: <http://news.bbc.co.uk/2/hi/science/nature/7821082.stm>
* Allow students 2-3 minutes to study the image and jot notes in the second row of the table they created.
* Cold call on 1 or 2 students to share a notice and wonder. Reinforce their observations. If the question is related to vocabulary or content that you have already introduced reference back to the article, document, or word wall to help the students make connections with previous lessons.
* Use the same process to project images 3 and 4. Use rows 3 and 4 on the chart to write two “gist statement” and two questions about the maps.
* Cold call on 1 or 2 student to share. If you believe they need to study the maps further, use some map dependent questions, with the Think-Pair-Share protocol (see appendix)
	+ What extreme weather events might occur in 2050 in the red zones of the map?
	+ Which continents and/or countries will have the greatest water stress in 2050?
	+ What parts of the US experienced water stress in 1960-1990?
1. Conceptual Model Demonstration (10 min)
* Return to the word wall to create a conceptual model that reflects the processes that result in desertification. Include all four spheres, climate, temperature, and desertification and other terms as necessary.

4. Closing and Assessment (5 min)1. In your science notebook, create a diagram and label the four spheres: Lithosphere, hydrosphere, atmosphere, biosphere

**Lesson 4 – The Impact of Water Scarcity on Living Systems****Teaching Notes*** In Advance: This lesson opens with a Silent Gallery Walk (see appendix) of photos and texts related to desertification. Photos and text have been provided from the Desertification Curriculum from United Nations Education, Scientific, and Cultural Organization on five topics: Lesson 4 Gallery Part 1 - Definition of Desertification; Lesson 4 Gallery Part 2 - The Causes of Desertification; Lesson 4 Gallery Part 3 - Water and Desertification; Lesson 4 Gallery Part 4 - Environmental Consequences of Desertification; Lesson 4 Gallery Part 5 - Consequences of Desertification on Human. You will need to print the photos and text in advance and post them around the classroom. It would be best to post the photos and text in the four groupings as they are provided to you. The purpose of this Silent Gallery Walk is to challenge students to think about the importance of water and the difficulties of living in arid, semi-arid lands. It is not necessary for them to fully comprehend all aspects of desertification; however, you do want them to gain a sense of the causes and effects of the process. This background knowledge will help them to better understand the area in Peru that is referenced by Kingsolver.
* Students will create a conceptual model that represents the relationship between atmosphere, lithosphere, hydrosphere, and biosphere. They may use the example of desertification if they desire.

**Lesson 4 Materials*** Science Notebooks
* Internet access, video projector, and speakers
* “Water is Life” by Barbara Kingsolver <http://ngm.nationalgeographic.com/2010/04/water-is-life/kingsolver-text>
* Earth’s Water Cycle NASA Video <http://svs.gsfc.nasa.gov/vis/a010000/a011000/a011054/index.html> (video and transcript)
* “Water is Life” Student Text
* “Water is Life” Text Dependent Question Recording Form
* “Water is Life” Graphic Organizer for Conceptual Model Explanatory Text
* Desertification Curriculum from United Nations Education, Scientific, and Cultural Organization: <http://www.unesco.org/mab/doc/ekocd/index_case.html>
* Climate and Water: In the Air and on Land, National Center for Atmospheric Research: <https://spark.ucar.edu/longcontent/climate-and-water-air-and-land>

**Lesson 4 Agenda**1. Entry Task (5 min)1. In your science notebooks respond to this question, “What is the impact of desertification on life? On the land? On the local hydrological cycle? On humans?”

2. Opening (5 min)1. Set purpose for Lesson 4
* Set purpose for students, saying something like, “Because Kingsolver address so many concepts related to our science learning objectives indirectly, we will spend time with paragraphs 6- 9 again today. But before we dig back in to the reading, we are going to build some more background knowledge through a Gallery Walk.”

Work Time (70 min)1. Gallery Walk (25 min)
* Introduce and explain the Silent Gallery Walk to students (see appendix)
* Students will have about 15 minutes to move from photo to photo placing sticky notes near each photo indicating something they notice and something wonder. The gallery walk is done in complete silence.
* When time is called, assign each picture or artifact to a different person. Have them bring the item and all of the sticky notes that go with it to a community circle meeting. Have students take turns showing the picture or artifact and reading what was noticed and wondered.
* Teacher may or may not summarize student observations: desertification in a global concern; increasing temperatures are increasing the need for irrigation which in turn increases demands on local water resources and decreases the amount of water on the surface and in underground aquifers; increasing trees and indigenous plants can help to restore land; irrigation practices need to be monitored and managed.
1. Close Reading (20 min)
* Be sure students have their “Water is Life” text from previous lessons. Remind them that they will stay focused on paragraphs 6-9 today, which they began in Lesson 3.
* Revisit science vocabulary: Hydrosphere, biosphere, atmosphere, lithosphere, Halocene (current geologic epoch), climate, desertification, reforestation, conservation, microcosm, El Nino, irrigation.
* Have students review the article for any words that should be added to the word wall and personal vocabulary card selection. Take the time needed to add new works and allow students to make their vocabulary cards.
* Read paragraphs 6-9 aloud again as students follow along silently.
* Tell students that they likely understand more of the text now, after the Gallery Walk. Ask students to return to the text to underline words they now recognize or have greater meaning after learning more about desertification from the Gallery Walk.
* Think-Pair-Share:
	+ Have students reread paragraph 6 -9 on their own. Take notations and write a gist statement in the column.
	+ Share gist with a partner. Discuss similarities and differences.
1. Students Answer Text-dependent Questions (15 min)
* Distribute the **“Water is Life” Text Dependent Questions**
* Post the first text dependent question, and then model how to think through the question. Explain vocabulary as necessary – and provide an answer that cites textual evidence. As you think aloud, write up your answer, and leave it so students can see a model of strong work.
* Students work in pairs to answer the second and third questions, using textual evidence to support their answer.
	+ In paragraphs 6, 7, and 8, Kingsolver describes one example of people, plants, and animals living in the Piura Desert in order to show what it is like to live in an area of extreme drought. Underline in the text examples of the challenged they face?
	+ Kingsolver came to the desert to learn about “an innovative reforestation project.” What was the purpose of the project? Why do you think reforestation in a desert is innovative?
	+ Reread paragraph 1 of the text. Compare the images that Kingsolver writes about in that paragraph with the images that she creates in paragraph 6 -9. What are the similarities? What are the differences?
* Debrief, noting and naming effective pair conversation and effective use of textual evidence.
1. Conceptual Model Demonstration at Interactive Word Wall (10 min)
* Move all of the words on the Word Wall to one side.
* Start the conceptual model by selecting the terms “Hydrosphere” “Atmosphere” “Biosphere” and using the arrows to describe how they are connected.
* Ask the students these questions and use arrows and other words to formulate your answer. Model on the Word Wall with on the follow questions:
	+ How does the biosphere influence the hydrosphere? (well water withdrawal, over use of land so land cannot hold water and support life)
	+ How does the atmosphere influence the hydrosphere? (heat caused evaporation; water vapor moves through the atmosphere; the heat in the atmosphere determines as the oceans warm the air currents change)
* Have students replicate your model with their cards.
* Think-Pair Share:
	+ Post another question. Have each student work alone with cards. Then Share with a partner.
		- What are the dynamics between the atmosphere, biosphere, lithosphere and hydrosphere when there is a drought? A flood? A snowstorm?
	+ Repeat

4. Closing and Assessment (10 min)1. Formative Assessment
* Provide an overview of the task: Create your own conceptual model of the atmosphere, biosphere, lithosphere and hydrosphere with a 1-2 sentence explanation using terms form the Interactive Word Wall.
* Provide 5 minutes from student to work with their vocabulary cards to create a cycle and record their cycle in their notebook.
* Distribute another copy of **“Water is Life” Graphic Organizer for Conceptual Model Explanatory Text.**
* Have students glue the organizer into their Notebook and use the graphic organizer to identify three details they want to use in their explanation and then transfer those details into their science notebook to describe their conceptual model.
* Circulate to observe what students are recording.

5. Homework1. Complete definitions on all word cards.
2. Complete Conceptual Model of atmosphere, biosphere, lithosphere and hydrosphere with explanation.
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| **Lesson 5 – 6: Using Models to Understand this Watery Planet (two 90-minute lessons)****Rationale:** In Lessons 5-6, students continue their close reading of Barbara Kingsolver’s “Water is Life,” focusing on how access to fresh water is the determining factor in planetary and human health. Students will apply reading and vocabulary strategies developed in Lessons 1-4 to their analysis of computer-based and conceptual models of the hydrosphere. As they compare what they learn from computer and conceptual models to the evidence that Kingsolver used in her article, they will begin to discuss the qualities of conceptual models and the text that supports them. These lessons address the following skills and activities to develop facility with the targeted standards:* Using close reading strategies to make sense of complex text.
	+ define and use the terms below:
		- Aristotle, computer model, satellite, illusion
* Analyzing the structure of a complex text to determine how the author uses science and observational evidence to support his/her claim.
* Writing a supporting explanation for a conceptual model using scientific vocabulary.
* Creating a conceptual model of the hydrosphere.
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| **Informal Assessment Options*****Student work or evidence of learning that teachers may use to informally gauge class progress.***  | **Individual Student Assessment Options*****Students’ more formal, individual written assessments that*** ***teachers may collect to more formally assess based on mastery of*** ***learning objectives above.*** |
| Entry Task“Water is Life” Text Dependent Question Recording Form“Water is Life” Graphic Organizer for Conceptual Model Explanatory TextExit Tickets |   |
| **Lesson 5 - How Scientists Use Models to Make Sense of the World****Teaching Notes*** Lessons 5 and 6 will focus on just two paragraphs of Barbara Kingsolver’s article. In these paragraphs, she challenges the reader to let go of any perceptions that humans are the center of the universe and that Earth’s resources are infinite. The assumptions that Kingsolver makes about how the reader’s understanding of the history of science and how scientific theory is shaped is far beyond the background of a middle school student. In these lessons, we take advantage of Kingsolver’s assumptions to fill in the background related to how scientists use data to understand the world and create models and how models can be used to help us understand phenomena we cannot see.
* In Lesson 5, you will need to provide background information related to Kingsolver’s reference to Artistotle. We have provided a brief outline that provides visuals of the early models of the Earth as the center of the universe that Kingsolver references. This outline could easily be converted into a power point and is a perfect segue for exploring the characteristics of scientific models.
* Students should continue to use the steps outlined in Lessons 1-4 for close reading; however, teachers will also notice a slightly “pulling away” from the text to examine how models help us understand the world; the criteria for scientific models and how the text that accompanies a model is also important in explaining scientific phenomena.
* At the end of Lessons 5 and 6, teachers should have a list of criteria for models and for explanatory text. These will be recorded on Anchor Charts and will stay posted through the remainder of the unit.
	+ *The model explains relationships:* The model accurately explains or describes the interactions various components of earth systems
	+ *The model and explanation is scientifically sound:* testable; adaptable (responsive to new information); states limitations; research bases.
	+ *The model and explanation is easy to understand:* The focus of the model can easily be identified; The information portrayed makes sense
	+ The model and explanation is simple and elegant: The model is understandable; the model is elegant
* Teachers will need to help students make the connection between the Interactive Word Wall conceptual models, computer models, and conceptual models that are introduced in these two lessons. If at any point students appear to be confused by the concepts being presented in the models; pull out of the lesson as designed and revisit the needed vocabulary by using the Interactive Word Wall.
* Continue having students create their own vocabulary cards. These will be needed in Units 2 and 3.
* Always encourage students to record their diagrams and conceptual models in their Science Notebooks so they have a record of their developing understanding of the concepts being taught.

**Lesson 5 Materials*** Science Notebooks
* Computer, internet access, video projector, and document camera
* “Water is Life” by Barbara Kingsolver <http://ngm.nationalgeographic.com/2010/04/water-is-life/kingsolver-text>
* Earth’s Water Cycle NASA Video <http://svs.gsfc.nasa.gov/vis/a010000/a011000/a011054/index.html> (video and transcript)
* “Water is Life” Student Text
* “Water is Life” Text Dependent Question Recording Form
* “Water is Life” Graphic Organizer for Conceptual Model Explanatory Text
* Criteria for Strong Conceptual Models and Explanation
* Outline for Universe Models – Aristotle through Kepler (see appendix)
* Blue Marble Globe Images and Animation Files, NASA: <http://visibleearth.nasa.gov/view.php?id=57723>
* Tropical Rainfall Measuring Mission – Middle School Overview. NASA: <http://trmm.gsfc.nasa.gov/overview_dir/why-ms.html>

**Lesson 5 Agenda**1. Entry Task (10 min)1. Project **Blue Marble Image:** <http://visibleearth.nasa.gov/view.php?id=57723>
* Students write in their Science Notebooks based on the following prompt: “As you look at this photo of the Earth from space, use the following terms in a description of what you see: hydrosphere, lithosphere, atmosphere, biosphere. (5 min)
* Circulate while student are writing to collect the conceptual model with explanation created in Lesson 4.
1. Think/Write-Pair-Share (5 min)
* When students are done writing in their notebook, have them discuss their response with a partner.
* Cold calls students to share out. Teacher notices and names ways in which students are collaborating effectively during partner talk and share out.

2. Opening (5 min)1. Overview of Lessons 5-8
* Continue projecting photo of the Blue Marble: <http://visibleearth.nasa.gov/view.php?id=57723>
* Frame the next two lessons for the students
	+ Summarize the previous lessons by saying something like, “In the previous four lessons, we used close reading to explore Barbara Kingsolver’s claims in her article and the science behind the evidence she selected to support these claims. As we discussed, Ms. Kingsolver believes that water is the physical face of climate change and we need to learn to live within the limits of our fresh water resources…but how does she really know this? We learned about the hydrosphere. We learned that climate (long-term atmospheric conditions) and weather (current atmospheric conditions) are a result of the interaction between the hydrosphere and atmosphere. And we have learned how human impact on the land (lithosphere) can impact the relationship between the lithosphere and the hydrosphere and result in long-term climate and localized changes in weather and climate. Whew….that is a lot. But there is more!”
	+ Introduce the next two lessons by saying something like, “In the next two lessons we are going to explore various models that have helped scientists come to the conclusions shared by Kingsolver. Earth Systems science is a relatively new field. Since about 1980, a huge shift has occurred in the earth sciences. Since that time, "Earth System Science" acknowledges that changes in the solid earth (land - lithosphere or geosphere) result from interactions among the atmosphere (air), hydrosphere (water, including oceans, rivers, ice), biosphere (life).  In the next four lessons, we are going to learn about the role that models play in shaping scientific theory. The shift started with one photo. Something similar to the one you see on the screen. The picture was taken on December 7, 1972, as the Apollo 17 crew left Earth’s orbit for the moon. With the sun at their backs, the crew had a perfectly lit view of the blue planet. We are still feeling the impact of this new view of the Earth.”

3. Work Time (70 min)1. Close Reading Paragraphs 10-11 (20 min)
* Tell students that they will use the close reading process with paragraphs 10 and 11 to explore how and why scientist use models to understand how the Earth systems work together to support life.
* Define and provide background on the following names: Aristotle, Charles Dickens
* Read Paragraphs 10 and 11 out loud as students read silently.
* Tell students that the focus of the lesson today will be paragraph 10. Have students reread paragraph 10 only. Circle unfamiliar words. Model using context to determine the meaning of words.
* Refocus whole class and cold call on students to share answers, noticing and naming strategies students are using to determine the meaning of words in context and to paraphrase a challenging text.
* As students identify central ideas in the text and key vocabulary words, script the answers on an anchor chart, write phrases on the document as it is projected, prompt students to correct their own worksheets so they all have an accurate reference moving forward.
1. Text Dependent Questions (15 min)
* Distribute the **“Water is Life” Text Dependent Questions for Lesson 5**
* Post the first text dependent question, and then model how to think through the question. Explain vocabulary as necessary –and provide an answer that cites textual evidence. As you think aloud, write up your answer, and leave it so students can see a model of strong work.
* Students work in pairs to answer the second and third questions, using textual evidence to support their answer.
	+ When Kingsolver uses the phrase “that round slip of sky with stars has comforted me.” What do you think she is talking about? What is it about stars in the sky that can comfort someone?
	+ Kingsolver uses the phrase “look up from the bottom of a well and see the stars, even in daylight” to describe how people once viewed the Earth. She also mentions Aristotle as a clue to help us understand how people understood the relationship between the stars and the Earth. Do these clues help you? If not, what questions do they make you ask yourself?
	+ Aristotle, a Greek philosopher is known as the “father of science.” Challenged humans to question common assumptions about nature by asking questions and making observations to find the truth rather than the “folklore.” Because this paragraph is about how people once viewed the Earth, what “discovery” do you think that astronomers made that dashed our illusion about being the center of the universe? Why is this important to Kingsolver’s thesis?
* Students work in pairs to answer the second and third questions, using textual evidence to support their answer.
* Debrief, recording students’ responses. Note and name effective pair conversation and effective use of textual evidence.
1. Why and How Scientists Use Models: Journey through our expanding universe (10 min)
* Point out Kingsolver’s reference to Aristotle as a transition to presenting an overview of how and why scientists use models. Because Kingsolver mentions Aristotle, this is an excellent opportunity to share with students how our perception of the universe has changed.
* The presentation, **Universe Models: Aristotle through Kepler**, provides an excellent overview with a script and photos of original models that philosophers and scientists used to understand the relationship between the sun, the earth, the moon, and the stars. You may use this to help students understand that models and theories change when scientists gather enough hard evidence to confirm their observations. The entire presentation can be found here: What is provided in this unit appendix is an outline that could be converted into a power point.
* After your presentation, return to the third text dependent question to determine if students would like to revise their answer.
1. Identifying Criteria for Scientific Models and the explanations that accompany them (20 min)
* Review the model in the NASA video from Lessons 1 and 2, by saying something like, “In the NASA video that we watched in Lessons 1 and 2, the video included a number of models. Because it was a NASA video, the producers used models that compiled data collected from satellites and sensors around the globe to create the images used in the video. Those images helped the narrator tell the story of the Earths Water Cycle. They also helped us to understand the science behind the Kingsolver article. But, how do we know that this information, these theories, is accurate and true? All good scientists are also skeptics at heart and should never take any data or image they see for the absolute truth.”
* Introduce the first model, by viewing **2:56-3:23 in the NASA Video the Earth’s Water Cycle** <http://svs.gsfc.nasa.gov/vis/a010000/a011000/a011054/index.html>.
* Project one frame from the video on the screen.
* Using the Think-Pair-Share Protocol, ask, “Is this video clip is of an actual video of the Earth or a model of the Earth? Why?” Ask the students to think silently and then read their response. After two minutes of silent thought and writing, have the students discuss what they wrote in their notebooks about the picture of the Earth that is projected on the screen.
* Cold call on students to share out. Notice and name ideas and words you heard them using to help determine whether you are watching a video or a model. i.e. the label that said model; the “digitization of data” phrase, etc.
* Project the **TRMM website:** <http://trmm.gsfc.nasa.gov/overview_dir/why-ms.html>and share provide students an overview of TRMM.
* Provide an overview of the Criteria for a Scientific Model. You may project the criteria or create your own anchor chart as you share each criterion.
* Have students think about the model they just observed while you are identifying these criteria.
	+ *The model explains relationships:* The model accurately explains or describes the interactions various components of earth systems
	+ *The model and explanation is scientifically sound:* testable; adaptable (responsive to new information); states limitations; research bases.
	+ *The model and explanation is easy to understand:* The focus of the model can easily be identified; The information portrayed makes sense
	+ *The model and explanation is simple and elegant:* The model is understandable; the model is elegant
* Distribute another copy of “**Water is Life” Graphic Organizer for Conceptual Model Explanatory Text**
* Explain to students that the explanation that goes with the model is just as important as the model itself.
* Watch the video again and listen to the text accompanying the model. Use the graphic organizer with students to identify the key ideas presented in the model:
	+ data about rainfall;
	+ tropics and sub tropics;
	+ amount of rain in that region shared weather and climate around the world.
* Model completing the graphic organizer with these three ideas.
* Have students complete the ideas with you. Identify scientific language that is important. Identify the citation.
* Have students work with a partner to write their explanation of why the detail is important to understand this model.
* Have students record their study of the TRMM Model in their Science Notebooks. Demonstrate how to record this information:
	+ The Tropical Rainfall Measuring Mission (or TRMM) is a NASA satellite collects data about the rainfall in the tropics and subtropics of the Earth. Information collected from these regions is important because these areas determine weather and climate around the world.
	+ Citation: NASA Tropical Rainfall Measuring Mission: <http://trmm.gsfc.nasa.gov/overview_dir/why-ms.html>
* If time permits, review one or two of the other models used in the video:
	+ MODIS Blue Marble:
	+ AIRS Models Atmospheric Infrared Sounder (AIRS)
	+ Quick Scat are Satellite-based sensors that provide measurements over the entire globe
* Summarize key criteria for strong models
1. Synthesis (5 min)
* Think-Pair-Share: In paragraph 10, Kingsolver states, “Western Civilization was in no great hurry to give up this folklore; astronomers believed it for centuries, but a few of them eventually thought to test it and had their illusions dashed by simple observations.” How does collecting data from space and using it to create computer models challenge us to think about the earth, the water, the land, and the air? How might these models be influencing Kingsolver’s challenge to rethink the way we understand our relationship with water?

4. Closing and Assessment (5 min)1. Exit Ticket: What is the criteria for a strong scientific model?

**Lesson 6 - Using Models to Make Sense of the Hydrosphere****Teaching Notes*** This lesson builds directly on Lesson 5. Students use the Close Reading protocol (see appendix) with increasing independence to build and share expertise about Kingsolver’s article.
* In advance: review the Jigsaw protocol (see appendix). The Jigsaw protocol lets small groups engage in an effective, time-efficient comprehension of multiple conceptual models – print the appropriate number of each Conceptual Model 1, 2, 3 & 4 and create a packet that includes one of each model for each group of four students. Create thoughtful groupings of four for the strategy by placing ELLs with native speakers of English who will provide models of language. Print one Graphic Organizer per student. These will be used by students to analyze the conceptual models. If at any point student appear to be confused by the concepts being presented in the models being used; pull out of the lesson as designed and revisit the needed vocabulary by using the Interactive Word Wall.
* Continue to have students create their own vocabulary cards. These will be needed in Units 2 and 3.
* Always encourage students to record their diagrams, conceptual models, and other graphic organizers in their Science Notebooks, so they have a record of their developing understanding of the concepts being taught.

**Lesson 6 Materials*** Science Notebooks
* Computer, internet access, video projector, and document camera
* “Water is Life” by Barbara Kingsolver <http://ngm.nationalgeographic.com/2010/04/water-is-life/kingsolver-text>
* Earth’s Water Cycle NASA Video <http://svs.gsfc.nasa.gov/vis/a010000/a011000/a011054/index.html> (video and transcript)
* “Water is Life” Student Text
* “Water is Life” Text Dependent Question Recording Form
* “Water is Life” Graphic Organizer for Conceptual Model Explanatory Text
* Water Cycle Model. United States Geologic Survey (USGS). <http://ga.water.usgs.gov/edu/watercycle.html>
* Water Cycle Model. Center for Atmospheric Research. <https://www2.ucar.edu/atmosnews/people/aiguo-dai>
* Water Cycle Model. Encyclopedia Britannica. <http://www.britannica.com/EBchecked/topic/278858/hydrologic-cycle>
* Water Cycle Model. U.S. Environmental Protection Agency.

<http://www.epa.gov/climatechange/images/impacts-adaptation/WaterCycleChanges.jpg>* Water Cycle Model. BBC Education Scotland. <http://www.bbc.co.uk/scotland/education/int/geog/rivers/hydrological.shtml>

**Lesson 6 Agenda**1. Entry Task (8 min)1. Project the conceptual model of the Water Cycle from USGS: <http://ga.water.usgs.gov/edu/watercycle.html>
* Students write in their Science Notebooks based on the following prompt: “Look at this model. Is there any important information missing about how water moves through the hydrosphere? If so what? How might you change this model to reflect that information?” (3 min)
1. Think/Write-Pair-Share (5 min)
* When students are done writing in their notebook, have them discuss their response with a partner.
* Cold calls students to share out. Teacher notices and names ways in which students are collaborating effectively during partner talk and share out.

2. Opening (2 min)1. Set purpose for Lesson 6
* Continue Projecting photo of the Water Cycle conceptual model: <http://ga.water.usgs.gov/edu/watercycle.html>).
* Frame Lesson 6 by saying something like, “Yesterday we read a very important paragraph from Kingsolver’s article. In the article, she provided some historical context that required us to think about how scientists use models and when old models need to be replaced by new models. We used the models from Aristotle and Copernicus to see how long it took for scientists to rethink there understanding of the relationship between the earth and the sun. Then, we looked at some computer models that are reshaping how scientists understand the systems of the Earth and discussed the importance of using models that are based on accurate information and from reliable sources. In your Exit Ticket you reflected on how these models have informed Kingsolver’s work. Today, we are going to dig into Paragraph 11 and think about conceptual models. Conceptual models are much simpler models, but are just as important to help us make sense of the world.”

3. Work Time (75 min)1. Close Reading Paragraph 11 only (20 min)
* Tell students they will use the close reading process with paragraphs 11 to discuss the conditions that require scientists to change a theory or model
* Define and provide background on the following terms: contrary, infinite, unrestrained.
* Reread Paragraphs 10 and 11 out loud.
* Tell students that the focus of the lesson today will be paragraph 11. Have students review paragraph 11 only. Circle unfamiliar words. Model using context to determine the meaning of words.
* Refocus whole class and cold call on students to share answers, noticing and naming strategies students are using to determine the meaning of words in context and to paraphrase a challenging text. As students identify central ideas in the text and key vocabulary words, script the answers on an anchor chart, write phrases on the document as it is projected, prompt students to correct their own worksheets so they all have an accurate reference moving forward.
1. Text Dependent Questions (15 min)
* Distribute the **“Water is Life” Text Dependent Questions for Lesson 6**
* Post the first text dependent question, and then model how to think through the question. Explain vocabulary as necessary – and provide an answer that cites textual evidence. As you think aloud, write up your answer, and leave it so students can see a model of strong work.
* Students work in pairs to answer the second and third questions, using textual evidence to support their answer.
	+ Kingsolver challenges us to “give up on our myth of the Earth’s infinite generosity.” How does this challenge relate to water? What “myth” do humans have about water?
	+ What “evidence” does Kingsolver use to support her claim that we need to give up our perception that water is an infinite resource?
	+ When Kingsolver tells us that we have “overdrawn our accounts” what account is she talking about? What evidence did she provide in this article that support this claim?
* Students work in pairs to answer the second and third questions, using textual evidence to support their answer.
* Debrief, noting and naming effective pair conversation and effective use of textual evidence.
1. Conceptual Model Jigsaw, Part 1 (20 min)
* Tell students that today they will work in groups to become experts on specific articles. They will then share what they learned with classmates who read different articles.
* Divide the students into groups of four. Consider assigning the longer passages to stronger readers.
* Distribute copies of **“Water is Life” Graphic Organizer for Conceptual Model Explanatory Text**
* Provide each group with a collection of 4 conceptual models with worksheets attached. In each group, assign students as follows:
	+ Reader 1: <https://www2.ucar.edu/atmosnews/people/aiguo-dai>
	+ Reader 2: <http://www.britannica.com/EBchecked/topic/278858/hydrologic-cycle>
	+ Reader 3: <http://www.epa.gov/climatechange/images/impacts-adaptation/WaterCycleChanges.jpg>
	+ Reader 4: <http://www.bbc.co.uk/scotland/education/int/geog/rivers/hydrological.shtml>
* Ask students to follow the instructions are on their worksheet as they study the model.
	+ Study the model.
	+ Identify one - three important details and corresponding scientific vocabulary; in own words explain how the detail supports the model.
	+ Write a gist statement about your model.
	+ Add your citation.
* Give students about 10 minutes for independent reading and thinking.
* Then ask students to get together with three others from his/her expert groups (all Model 1s, all Model 2s, etc.). Ask them to take about 5 minutes to share with others who studied the same model, so collectively they can become experts on their assigned model. Each member of the expert group shares his or her answers. Others in the group should record any new learning on their recording form.
1. Conceptual Model Jigsaw, Part 2 (20 minutes)
* Following the Jigsaw Protocol, ask students to return to their original groups of four (so each original group has a Reader 1, 2, 3, and 4).
* Give students 15 minutes to share what they learned about his/her conceptual model.
* Encourage groups to set a timer: 3 minutes per student to share while peers ask questions and take notes.
* For the last 3 minutes, students discuss and identify the common criteria they found in their models and what made them easy to understand.

4. Closing and Assessment (5 min)* Exit Ticket: List three reasons scientists use models; two things that you learned from a peer and one question you still have.

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| **Lesson 7 – 8: Creating Models to Explain the Limits of Fresh Water Resources in the Hydrosphere****Rationale:** In Lessons 7-8 students complete their close reading of Barbara Kingsolver’s article “Water is Life” and complete the summative assessment for this unit, the creation of a conceptual model of the hydrosphere with an explanatory paragraph using scientific and technical vocabulary to describe their model. These lessons address the following skills and activities to develop facility with the targeted standards:* Using close reading strategies to make sense of complex text.
* Creating a conceptual model of the hydrosphere that explains the limits of fresh water resources in the hydrosphere.
* Writing a supporting explanation for a conceptual model using scientific vocabulary.
 |
| **Informal Assessment Options*****Student work or evidence of learning that teachers may use to informally gauge class progress.***  | **Individual Student Assessment Options*****Students’ more formal, individual written assessments that teachers*** ***may collect to more formally assess based on mastery of learning*** ***objectives above.*** |
| Entry Task“Water is Life” Text Dependent Question Recording Form “Water is Life” Graphic Organizer for Conceptual Model Explanatory TextExit Tickets | Conceptual model of the hydrosphere that explains the limits of fresh water resources in the hydrosphere with explanatory paragraph  |
| **Lesson 7 - The Water Commons****Teaching Notes*** In advance: Review the video “Why Care About Water”
* In advance: Prepare for the Chalk Talk (see appendix). Create five charts, for these six quotes from the video Why Care about Water:
* We live at a time in history where over a billion people do not have access to safe drinking water and over 3 billion do not have access to sanitation.
* Water is a global issue but it also is a very local issue…
* Water that runs in the Ganges could also end up in the Hudson, or fall over the plains of Africa, or could make a cup of tea for the Queen of England.
* We are using and abusing our water resources and unless we take action at an individual level, I do not see how we can overcome the issues we will face in the next 50 years.
* 70% of the water extracted from rivers, lakes, and aquifers goes to irrigated agriculture. To some extent we are using some of tomorrow’s water to meet today’s food demands.
* The great American lawn is a great example of the myriad of ways people in the US take water for granted.
* For ELLs or struggling readers, consider asking them to focus on one chart.

**Lesson 7 Materials*** Science Notebooks
* Internet access, video projector, and speakers
* “Water is Life” by Barbara Kingsolver <http://ngm.nationalgeographic.com/2010/04/water-is-life/kingsolver-text>
* Why Care About Water. National Geographic: <http://video.nationalgeographic.com/video/environment/freshwater/env-freshwater-whycare/>
* “Water is Life” Student Text
* “Water is Life” Text Dependent Question Recording Form
* “Water is Life” Graphic Organizer for Conceptual Model Explanatory Text
* Lesson 8: Human Impacts on the Water Cycle
* Chalk Talk Recording Form
* Chart paper (6 sheets)
* Markers (1 marker per group – each a different color)

**Lesson 7 Agenda**1. Entry Task (8 min)1. Have students respond to this question in their Science Notebooks: “Why care about water?” (3 min)
2. Think/Write-Pair-Share (5 min)
* When students are done writing in their notebook, have them discuss their response with a partner.
* Cold calls students to share out.
* Teacher notices and names ways in which students are collaborating effectively during partner talk and share out.

2. Opening (2 min)1. Set purpose for Lesson 7
* Frame Lesson 7 by saying something like, “Yesterday we read a very important paragraph from Kingsolver’s article. In the article, she challenged us to rethink the models we use to understand the water. Then, we looked at conceptual models that scientist use to help us understand how water cycles through the hydrosphere and talked about how these models might need to change to help us understand the limits to the amount of fresh water available to support life on earth. In your Exit Ticket you created your own conceptual model. Today, we are going to dig into Paragraphs 12 – 14, the last three paragraphs of Kingsolver’s article.”

3. Work Time (75 min)1. Video and Chalk Talk (30 Minutes)
* Distribute the **Chalk Talk Recording Form** and tell students that they will be watching a video made by the National Geographic Society titled: “Freshwater: Why Care About Water”. After they watch the video, they will participate in a Chalk Talk to discuss the key points posted on chart paper around the room:
* We live at a time in history where over a billion people do not have access to safe drinking water and over 3 billion do not have access to sanitation.
* Water is a global issue but it also is a very local issue…
* Water that runs in the Ganges could also end up in the Hudson, or fall over the plains of Africa, or could make a cup of tea for the Queen of England.
* We are using and abusing our water resources and unless we take action at an individual level, I do not see how we can overcome the issues we will face in the next 50 years.
* 70% of the water extracted from rivers, lakes, and aquifers goes to irrigated agriculture. To some extent, we are using some of tomorrow’s water to meet today’s food demands.
* The great American lawn is a great example of the myriad of ways people in the US take water for granted.
* View the video: Why Care About Water. National Geographic: <http://video.nationalgeographic.com/video/environment/freshwater/env-freshwater-whycare/>
* After viewing the video, distribute markers (a different color for each small group of students -- this way it is clear which group has gone to which chart). Before students begin, remind them to start their writing at the top of the chart so other groups have room to add their comments.
* Provide about 3 minutes for students to work on each chart, then rotate.
* As students work, circulate to support and probe as necessary, pushing students to cite evidence and consider the “so what” of the big ideas from the video.
* After each group has gone to every chart, refocus the class whole group. Ask students to share key learning from the Chalk Talk: Why care about water?
1. Close Reading (30 min)
* Have students retrieve their copy of **“Water Is Life” Text and Glossary.**
* Introduce key words: Commons, morality, collective, self-imposed, flourish, fate, watershed
* Read the paragraphs 12 – 14 out loud
* Ask students to underline words they do not recognize. Model using context clues to make sense of unknown words. If needed, model paraphrasing sections of the text.
* Direct students to work with seat partners to do this for the rest of paragraphs 12 through 14.
* Refocus whole class and cold call on students to share answers, noticing and naming strategies students are using to determine the meaning of words in context and to paraphrase a challenging text. For example, students may be rereading, reading past the word to find its meaning, breaking a word into parts, or going phrase-by-phrase.
* As students identify central ideas in the text and key vocabulary words, script the answers and phrases on a copy of “Water Is Life” Text and Glossary that is projected; prompt students to correct their own worksheets so they all have an accurate reference moving forward.
1. Text Dependent Questions (15 min)
* Distribute the **“Water is Life” Text Dependent Questions for Lesson 7**
* Post the first text dependent question, and then model how to think through the question. Explain vocabulary as necessary –and provide an answer that cites textual evidence. As you think aloud, write up your answer, and leave it so students can see a model of strong work.
* Students work in pairs to answer the second and third questions, using textual evidence to support their answer.
	+ In these paragraphs, Kingsolver summarizes her thesis statement. Earlier in the text she used the phrase “Water is Life.” In this section she uses the phrase “Water is the ultimate commons.” How are these two phrases similar? What makes water the “ultimate commons?”
	+ In the first paragraph, Kingsolver uses the phrase “Surely it was no sin, once upon a time, to shoot and make pies of passenger pigeons” to forgive people for not understanding that once the passenger pigeon was gone, there would be no more. Because of the loss of the passenger pigeon we now have laws to protect animals. Why does Kingsolver use that as an example in her article about water?
	+ In the final paragraph, Kingsolver used the image “a glass of water has caught the afternoon light, and I am still looking for wonders.” How did she refer to wonders at the beginning of this article? What level of wonder is she looking for at the end of the article?
	+ What does the phrase “good news” refer to in the fifth sentence? What connections can you make to “good news” in this article? Where else does Kingsolver talk about conservation?
	+ To protect the commons, Kingsolver recommends that we have “tools of a new century.” What tools is she referring to?
* Debrief, noting and naming effective pair conversation and effective use of textual evidence.

4. Closing and Assessment (5 min)1. In your science notebook, respond to the following question using 3 pieces of evidence from Kingsolver’s text: Why care about water?

**Lesson 8 - Synthesis, Conceptual Model, and Assessment****Teaching Notes*** In advance: Collect and review the Science Notebooks.
* Select a Conceptual Model with Explanation and prepare analysis.
* Gather the sets of the four conceptual models used in Lesson 6. Make sure that you have one complete set for every four students.
* Arrange seating so that desks are in pods of four.

**Lesson 8 Materials*** Science Notebooks
* Internet access, video projector, and speakers
* “Water is Life” Student Text
* Criteria for Strong Conceptual Models and Explanation
* “Water is Life” Graphic Organizer for Conceptual Model Explanatory Text.
* Sets of the four conceptual models used in Lesson 6.
* Human Impacts on the Water Cycle <http://www.sswm.info/category/concept/water-cycle>
* Human Impacts on the Water Cycle

**Lesson 8 Agenda**1. Entry Task (3 min)1. Have students respond to the following prompt in their science notebooks: What are the qualities of a good scientific model?

2. Opening (2 min)A. Set purpose for Lesson 8* Frame Lesson 8 by saying something like, “We have been learning about models over the past three lessons and have examined both computer models and conceptual models. Today, you will be creating your own conceptual model of the hydrosphere and writing a brief description of the hydrosphere using your model.”

3. Work Time (85 min)1. Analyzing A Labeled Conceptual Model using Criteria (15 min)
* Project a copy of a conceptual model with explanation or use the Impacts on the Water Cycle: <http://www.sswm.info/category/concept/water-cycle> or distribute the **Human Impacts on the Water Cycle** handout
* Explain that drawing and creating a labeled conceptual model is an important skill for scientists and they will be analyzing this conceptual model against the criteria from Lessons 5-6.
* Provide 5 minutes for students to review the model and discuss among themselves the qualities of why or why it does not meet the criteria. Ask them to list reason why and reasons why not.
* After five minutes of discussion, ask the class to share the criteria they identified. Transcribe these reasons onto an anchor chart.
* Listen for students to note qualities such as “They are accurate,” “They are simple,” and “They have labels identify important features.”
* Explain to students that they will be analyzing the explanation against the criteria from Lessons 5-6.
* Provide 5 minutes for students to review the model and discuss among themselves the qualities of why or why it does not meet the criteria. Ask them to list reason why and reasons why not.
* After five minutes of discussion, ask the class to share the criteria they identified.
* Listen for students to note for qualities such as “They are accurate,” “They are simple,” and “They have labels identify important features.”
1. Creating the Conceptual Model (35 minutes)
* Give students 20 minutes to work on their own conceptual model. Circulate to support students as they work. Look for key concepts and arrows that show the movement of water. When you see exemplary work, share it with others. If you do not see students producing water moving from land to water to air or solid, liquid and gas state, provide individual, small group, or large group coaching.
* After approximately 20 minutes, ask students to come to a stopping point. Have students compare their drawings to the criteria, noticing areas that need improvement.
* Give students 5-10 more minutes to continue drawing, this time revising their drawings according to the criteria they felt needed improvement. Circulate among students providing descriptive feedback, clarification or redirection as needed.
1. Writing an Explanation to accompany the Conceptual Model (25 Min)
* Distribute the **“Water is Life” Graphic Organizer for Conceptual Model Explanatory Text.**
* Have students turn to the conceptual model they have created and identify the specific ideas they want to explain. Use previous models, words from the Word Wall, etc. to identify the ideas for the explanation statement.
* After 20 minutes, have students compare their explanation to the criteria, noticing areas that need improvement.
* Allow students to continue writing, this time revising their explanatory statement according to the criteria they felt needed improvement. Circulate among students.
1. Celebration Gallery Walk and Debrief (10 min)
* Celebrate the students’ work by displaying their conceptual models with descriptions on tables or desks around the room. Invite the students review their classmates’ hard work.
* Gather the students for a last opportunity to debrief what they have learned about the hydrological cycle and the importance of freshwater. Give students a prompt such as “I used to think … but now I know.”
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