| Name:  Sea Level Change | Class/Period:  10th grade Chemistry |
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| Date/Time:  Fall Semester, Unit 1 | Unit:  KMT & Climate Change |
| **Central Focus/Big idea** (core concepts students will develop)**:**  Energy transfer, kinetic molecular theory (KMT), and density changes due to thermal expansion | |

**Content Standards:** (Include the number and text of each standard. If only a portion of a standard is being addressed, only list the part(s) that are relevant.)

[**HSPS3-2**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-PS3-2%20Evidence%20Statements%20June%202015%20asterisks.pdf) **AST1.1** - Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects)

[**HS-ESS3-5**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-5%20Evidence%20Statements%20June%202015%20asterisks.pdf) **AST 1.4** - Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

[**HS-ESS3-6**](https://www.nextgenscience.org/sites/default/files/evidence_statement/black_white/HS-ESS3-6%20Evidence%20Statements%20June%202015%20asterisks.pdf) **AST 1.5** - Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

**What do you want students to know and be able to do at the end of this lesson? (Learning Objectives)**

Learning Goal: Students will understand that sea level change is a result of a change in the kinetic energy of ocean water and these changes are a result of human caused climate change.

Students will be able to:

1. Describe how heat is transferred between the system and the surroundings.
2. Define Kinetic Molecular Theory.
3. Describe how a change in temperature affects the molecules/atoms of an object.
4. Explain the relationship between number of particles, volume, and temperature.
5. Define thermal expansion.
6. Explain how phase change and thermal expansion are related to rising sea levels caused by human caused climate change.

**What evidence of learning will you collect at the end of the lesson? How will you know what students have learned? (Assessment)**

After direct instruction and group discussions, the students will choose a region and describe one way the community is impacted by sea level change and must include a data visualization.

Students will include evidence of understanding about the relationships between thermal expansion, sea level change, climate change, and kinetic molecular theory.

| **Vocabulary** | **Support:** |
| --- | --- |
| Endothermic  Exothermic  Convection  Conduction  Kinetic Energy  Kinetic Molecular Theory  Density  Thermal Expansion  Sea Level Rise  Climate Change | To support vocabulary development:   * Videos * Readings * Defining in own terms * Used in models to explain phenomenon |

**Prior Activities:**

| **Time** | | **The teacher will…** | **The student will…** | **Materials/Resources** |
| --- | --- | --- | --- | --- |
| 90 minutes | | Lab Activities | The students will complete several lab activities prior to the sea level change final project. | Density  Transfer of Energy- Ice Cubes & Different Materials (insulators, conductors)  Thermal Expansion- Ice Cubes & Fresh/Salt Water |
| 40 minutes | | Direct instruction- KMT & Phase Change Presentation | Take guided notes and complete practice problems at the end of the notes. | Student Guided Notes  Notes Slides |
| 20 minutes | | Data Visualization Analysis- Checks in with individual groups as they examine the visualizations | Students will analyze two data visualizations | Data Visualizations |

**Detailed Lesson Sequence** (What will you do? What will students do? Include a variety of activities that include active participation, integrating literacy and helping students apply their learning.)

| **Time** | | **The teacher will…** | **The student will…** | **Materials/Resources** |
| --- | --- | --- | --- | --- |
| 5-10 minutes | | Warm-up- Climate Data Visualization Analysis. Sea Level Rise Presentation.  Teacher gives students time to examine the data visualizations and then asks students to share their responses. This allows the teacher to provide a formative assessment and measure student ability to evaluate their understanding of data visualization. | Students will analyze and discuss data visualizations about global temperature and sea level change- what they noticed, what they wonder, and how the visualizations relate to other data they’ve observed. The students will share their responses with their lab groups and then share as a whole group. | [Sea Level Rise Presentation](https://docs.google.com/presentation/d/1bBnyKOqtpA8jSt9VPEo1zCANWNRqnh2ylZyQCMQ3DRI/edit?usp=sharing), white boards & markers |
| 10-15 minutes | | Review Prior Knowledge - Density & Thermal Expansion. Sea Level Rise Presentation.  The teacher will use direct instruction to review the science content before the sea level rise activity. The students will be asked to collaborate and write their answers on the white board, and the teacher can assess and reteach if needed. | Students will review density and thermal expansion. These are vocabulary terms and topics taught earlier in the unit and are needed to understand sea level rise differences. They will answer the blue questions from the presentations on their white boards and be prepared to share as a whole group discussion. | [Sea Level Rise Presentation](https://docs.google.com/presentation/d/1bBnyKOqtpA8jSt9VPEo1zCANWNRqnh2ylZyQCMQ3DRI/edit?usp=sharing), white boards & markers |
| 15-20 minutes | | Introduction- Causes of Sea Level Change- Sea Level Rise Presentation.  The teacher will use direct instruction to help the students learn about the major factors that contribute to sea level rise. Can assess student understanding using responses on the white board and responses to the group discussion. | Students will learn about the two major factors that contribute to sea level rise (density/thermal expansion and melting ice) and how oceans help to regulate global temperature. Students will write responses on white boards and discuss with other groups. | [Sea Level Rise Presentation](https://docs.google.com/presentation/d/1bBnyKOqtpA8jSt9VPEo1zCANWNRqnh2ylZyQCMQ3DRI/edit?usp=sharing), white  boards & markers |
| 10 minutes | | Phenomenon- Sinking Cities- Sea Level Rise Presentation.  Teacher will show the video clip and discuss the Portland sea level rise map. Could have students point out their neighborhood or the location of the school. The teacher should help facilitate students to formulate questions about the phenomenon. | Students will watch the video clip about sea level rise and how Portland/Oregon (the location could be changed to be relevant to students in other locations) would be impacted by changes in sea level. Discuss with lab tables and then review as a whole group. | [Sinking Cities Introduction Video Clip](https://www.youtube.com/watch?v=pnt94HTeSNY)  [Sea Level Rise Presentation](https://docs.google.com/presentation/d/1bBnyKOqtpA8jSt9VPEo1zCANWNRqnh2ylZyQCMQ3DRI/edit?usp=sharing) |
| 20-30 minutes | | Data Analysis- Similar Latitude Sea Level Rise Comparison, Data Visualizations, and Coding (language R) Video- Sea Level Rise Presentation.  Teacher will introduce the data sets and how to use code to create visualizations. Either play the video about using R or have the LC student explain. Teacher will facilitate student questions and predictions. | Students will examine differences in sea level rise for coast lines and students will learn about how data visualizations are produced. They will learn about the language R and how coding is used to take information in large data sets and produce visualizations. They will make predictions for the reasons for differences in sea level change in various locations. | [Sea Level Rise Presentation](https://docs.google.com/presentation/d/1bBnyKOqtpA8jSt9VPEo1zCANWNRqnh2ylZyQCMQ3DRI/edit?usp=sharing) |
| 90 minutes | | Summative Assessment- Individual Student Worksheet  Teacher will explain the project to students and will provide examples to model expectations. The teacher will be a resource to help students navigate the summative assessment. | Students will select a region to research the impact of sea level rise due to climate change.  *ELL Students and students with IEPs can be provided the Graphic Organizer that can either be used as a template for a final project or as a tool to assist students develop their own final project.*  *TAG students should be given the Extension Opportunity Student Handout.* | [Student Assessment Worksheet](https://docs.google.com/document/d/1XJ5FokilPuSpMBRggo8mK5AZ89UnO7bSEvpgAo-30AE/edit?usp=sharing)  [Student Resources](https://docs.google.com/document/d/1eI48agf0g01_K6NyVHgPxxk2pvnYApYB_3oSlHbBg2U/edit?usp=sharing)  [Student Assessment Worksheet Graphic Organizer](https://docs.google.com/presentation/d/1iTuwqaw17Uc3OLX06TVeXoy7uyGsQDXG0tyMw37-1Vs/edit?usp=sharing)  [Extension Opportunity](https://docs.google.com/presentation/d/15FYRp4d2TmMz3FILv92VCnEvvNqz1Ha4j8pBfWv5xxg/edit#slide=id.p)  Student needs for final project: Online access for research, poster paper, markers, colored pencils, rulers |

**Adaptations/Modifications** (What adjustments will you make for students with special needs? This includes ELLs, students with IEPs, and any other special considerations you should use when planning and carrying out instruction. *Use italics in lesson sequence description to indicate where these supports will be implemented.*):

| **Emergent Bilingual** | Graphic organizer and leading questions/sentence starters to provide scaffolding for students to complete the summative assessment. |
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| **TAG** | An extension opportunity is to compare and contrast their selected location with another location of a similar latitude. |
| **Special Needs** | Graphic organizer with leading questions/sentence starters to provide scaffolding for students to complete the summative assessment. |
| **Other** |  |