**Unit Essential Question:** *What are the effects of an asteroid collision and how can we prevent a future one?*

**Introduction**

It is largely believed that about 65 million years ago, a large asteroid collided with Earth, causing a huge explosion and a cascade of worldwide effects—the most well-known effect being the extinction of dinosaurs from our planet. In this Lift-Off Task, students are introduced to the phenomenon of this historical asteroid collision and asked to generate a list of questions they would ask in order to learn more. As they explore these questions throughout the unit, students will begin to conceptualize the potential impacts of an asteroid collision and start to envision what kinds of solutions they could use to prevent another large-scale collision with Earth, which is their culminating project for this unit.

**Alignment Table**

Because the Lift-Off Tasks focus on student-generated questions, we do not identify specific Disciplinary Core Ideas or Science and Engineering Practices in this table.

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| **Crosscutting Concepts (\*depending upon student-generated questions)**   * Patterns   + Graphs, charts, and images can be used to identify patterns in data. * Scale, Proportion, and Quantity   + Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. * Systems and System Models * Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. * Stability and Change   + Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. |
| **Equity and Groupwork**   * Share and listen to broad and diverse student contributions. * Make connections between each other’s ideas. * Work together to co-construct a concept map. |
| **Language**   * Use connector words to link ideas. * Generate and write questions about the phenomenon. * Organize key questions in a concept map. |

**Learning Goals**

This learning task introduces students to the concept of a species changing over time and begins generating questions that will guide them through this unit. More specifically, the purpose is to:

* Individually generate a list of questions about an asteroid collision.
* Make connections between related questions.
* Generate possible answers to questions, based on prior knowledge.
* Apply prior knowledge of collisions to identify possible negative impacts caused by an asteroid collision with Earth.

**Content Background for Teachers**

All around us, objects are moving and often colliding. Since students experience motion and collision all the time, this is not a new concept to them. However, an asteroid collision with Earth may be new to them. While we do not expect students to know this phenomenon specifically, most will come to this unit with some prior knowledge around collisions (like car or bicycle crashes) and may know some facts about asteroids.

In this task, we are building off of students’ prior knowledge of asteroids and collisions, asking them to generate questions they would need to ask to make sense of the phenomenon for this unit—a possible historical asteroid collision. These might be questions related to asteroids in general, collision of objects, impacts on Earth, and much more.

As students draw off their prior knowledge of collisions, they will likely begin to think about motion, at least implicitly. This is one of the main focuses of this unit. When studying motion, it all revolves around forces. Forces need to act upon an object to begin its motion, end its motion, or change its motion. In later tasks, students will learn about both contact forces and non-contact forces (like gravity), which affect movement. Students will also learn about other factors related to motion, such as the mass of objects, speed, and kinetic energy. All of these concepts not only apply to motion, but collisions as well. Thus, these scientific ideas will not only help students understand the movement of asteroid *Etiam* toward Earth (the culminating project), but will also provide ways to prevent the collision. Additional background information on these specific topics, as well as the ancient asteroid collision will be provided in later tasks.

In this task, students create a concept map, which is a graphical tool that helps to organize and represent knowledge and questions, and is a successful academic language instruction tool. As students learn more about asteroid collisions and associated concepts, they will add more questions and ideas to this concept map. If your students have not had previous experience making concept maps, please see the instructions in Part B below for strategies on teaching this skill.

**Academic Vocabulary**

* Asteroid
* Collision (Collide)
* Impact

\*Additional academic vocabulary will vary by class

**Time Needed (Based on 45-Minute Periods)**

2 Days

* Introduction, Part A and Part B: 1 period
* Class Concept Map, Project Overview, and Project Organizer: 1 period

**Materials**

* Unit 1, Lift-Off Task Student Version

Part B

* Poster paper and markers
* Post-Its (Optional)

Part C

* Class Poster Paper and markers
* \*See Instructions below for other optional materials to use for the class concept map

Connecting to the Culminating Project

* Culminating Project Handout
* Project Organizer Handout

**Instructions**

1. Introduce students to the unit by reading or projecting the Unit Essential Question aloud.
2. Read the short paragraph on page 1 of the student guide aloud, which introduces the phenomenon for the unit: an asteroid collision with Earth 65 million years ago.

**Part A**

1. In this Lift-Off task, students will be generating questions to help them make sense of the phenomenon.
2. Have students complete this section individually in their student guide.

* For students who need more support, encourage them to use the picture in the student guide to generate questions.
* Here is a list of some potential questions students might generate: “What is an asteroid? Do asteroids really collide with Earth? How often do they collide with Earth? What are the effects of an asteroid collision? What happened to the Earth when the asteroid hit? How do we know that asteroid collision even happened? What can we do to protect ourselves in the future? Why don’t more people know about this problem?”

**Part B:**

1. In this part of the task, students create a concept map as a group.

* Remind students to refer to the directions on their student guide to help them make their concept map. First, students should compare each member’s list of questions and record/connect key questions on a piece of poster paper. They will then draft possible answers to the questions, using prior knowledge.
* Remind students that there are no right or wrong questions or predictions, so students feel encouraged to contribute any and all questions and ideas they think of.
* Because this is a collaborative task, it is recommended that you remind students of group work norms and assign group roles, such as Resource Manager, Facilitator, Recorder, and Harmonizer (See “How to Use this Curriculum” for more details).

1. Students will post their posters on a wall and then walk around and look at each group’s ideas. One suggestion for gallery walks is for students to interact with the posters in some way. For example, students are required to initial or leave post-its on three questions that they are also excited about on other posters.

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| Macintosh HD:Users:laurenstoll:Downloads:Sample Concept Map (1).jpg**How to Concept Map**  For students who have not had a lot of experience making concept maps, we have detailed a strategy below for introducing concept mapping using more familiar content. An example is also provided, but this will vary depending on what your students come up with as you make your own model.   1. Write the phenomenon in the middle of the poster, in this case “Humans breathe harder when they exercise.” 2. Ask students to share questions they might ask to make sense of this phenomenon and make a list of these questions on the board. 3. Model the process of reviewing the list and finding similarities amongst the questions.    * Place these key questions on the concept map poster, modeling how to put similar questions near each other on the poster. Circle these to signify that these are questions, not content knowledge. 4. Ask students to look at the key questions and see if any of the questions are connected: Would answering one question lead to one of the other questions? Model making these connections by drawing arrows between the circles. 5. In this Lift-Off task, students will only be drafting possible answers to the questions, not actually gathering and recording learned concepts. However, throughout the unit, they will be adding content they have learned. Model this by recording a student’s prior knowledge to one of the questions, using boxes to signify that these are pieces of content knowledge rather than questions.    * Use connector words to identify the relationships between the content boxes (See image above for an example). 6. Optional: To emphasize crosscutting concepts using a concept map, make a key of different colors for the crosscutting concepts emphasized in this unit. Identify questions that clearly show evidence of the different crosscutting concepts and circle them with the corresponding colors. Explain to students how you made that choice by pointing out the language that hints at that crosscutting concept. \*Note: not all boxes and circles will necessarily have a crosscutting concept. |

**Part C**

1. Construct a whole-class concept map that begins to help students make sense of the phenomenon of asteroid collisions.

* Start with the phenomenon in the middle.
* Then ask students to share out the questions that were most common across all the posters in the classroom. As you record questions on the poster, organize them based on connections you see. Draw circles around each question (as you add to the concept map throughout the unit, you’ll also be adding concepts learned, which can be written in boxes to distinguish them from the questions).
* Ask students to identify any connections they see between the questions and record these as lines between the questions.
  + Recommended: Give pairs of students think time to come up with 1-2 connections to add to the class concept map and call on pairs using equity sticks. This encourages more equitable participation in a class-wide activity.
* The purpose of this concept map is to facilitate generation of student questions, promote language development, and support understanding of the science content throughout the unit. Allowing students to ask their own questions and use their own words to make meaning of the concepts will not only help them make deep connections about science content, but will also help their oral and written language development.
* This whole class concept map will be revisited at the end of each subunit, asking students questions like: Are there any new questions you have about the phenomenon? Are there any connections you want to add or change? What is your reason for that addition/revision? Are there more connections we can make between the questions/ideas already on the map? Do you want to add any new ideas/concepts to the map?

1. Because this concept map will be added to and revised throughout the unit, here are some practical options for implementation.

* If you have access to white board paper, we encourage you to use these for class posters since it will allow you and your students to make revisions throughout the unit.
* Another option is to use smaller pieces of paper for each class and project using a document camera; this will save space as opposed to doing large class posters.
* We highly recommend students keep their own version of this concept map in their notebooks, adding questions and concepts as they go through the unit.

1. Once the draft concept map is complete, introduce students to the crosscutting concepts for this unit. We recommend posting posters of each crosscutting concept in your classroom (See beginning of teacher guide for templates).

* The crosscutting concepts for this unit are: Patterns; Scale, Proportion, and Quantity; Systems and System Models; and Stability and Change. Assign a color for each crosscutting concept that can be used throughout the unit.
* Have students analyze the class concept map for as many examples of the crosscutting concepts as they can find. Depending on the questions they have, they may be able to find an example of each of the crosscutting concepts or perhaps just some.
* We recommend modeling this process by picking a question, identifying the crosscutting concept, and tracing the circle in the corresponding color. Explain the key words that helped you identify the crosscutting concept in this question. Some identifying words that students might look for are:
  + **Patterns**: These could be phrases such as, “is the same as”, “has in common with”, “is similar to”, “shares” etc.
  + **Scale, Proportion, and Quantity**: These could be phrases such as, “is proportional to”, “compared to”, “has a ratio of”, “is bigger/smaller than”, “is longer/shorter than”, etc.
  + **Systems and Systems Models**: These could be phrases such as, “is a part of,” “is related to,” “consists of,” “interacts with,” “works together with,” etc.
  + **Stability and Change**: These could be phrases such as, “remains the same”, “is changed by”, “is disrupted by”, “changes”, “disrupts”, etc.

**Connecting to the Culminating Project**

1. Hand out the Culminating Project Task Card and read the Challenge and Group Project Criteria for Success aloud as a class.
   * Take questions for clarification.
2. Give a brief overview of the Background data on the asteroid, *Etiam*, emphasizing that students will need to return to this data and review it more thoroughly as they get closer to the project.
3. Pass out their Project Organizer and explain that they will complete a section of this after each task in class. Students should independently complete the Lift-Off Task section of the Project Organizer in class. Revisions can be done for homework, depending upon student’s needs and/or class scheduling.

* Students have been tasked with designing a solution to prevent the impending collision of the asteroid *Etiam* with Earth. The student prompt is as follows: In order to develop a solution to an impending collision with ~~a~~steroid *Etiam*, we need to learn everything we can about the impacts of an asteroid collision. Summarize what you already know about collisions, including:
  + - Possible negative consequences.
    - The types of methods humans use to prevent every-day collisions.

**Reflection**

1. At the end of the task, ask students to reflect on what they have learned over the course of this task by answering the following three questions in their student guide:
   * At the beginning of this task, you made a list of all the questions you have about the historical asteroid collision from 65 million years ago. Look back at your list: think about the questions your peers asked that you did not initially write down. How are their questions different from the ones you originally asked?

* In this unit, we will be focusing on four crosscutting concepts: **Patterns:** Graphs, charts, and images can be used to identify patterns in data; **Scale, Proportion, and Quantity**: there are proportional relationships between different types of quantities; **Systems and System Models**: Models can be used to represent systems and their interactions; **Stability and Change:** We can examine changes over time at different scales to explain stability and change. Looking at your class concept map, give one example of how a crosscutting concept came up in today’s task.
  + Now that you understand what project you’ll be working on over the course of this unit, what else do you need to know? What additional questions do you have?

1. There are no right answers, but encourage students to look back at their initial lists and their class concept map. They should not change their initial responses, but rather use this reflection space to add to their questions and ideas based on what they have learned through this task. By generating more of their own questions, students continue to engage in sense-making of the phenomenon and the gathering of knowledge and skills for their final project.