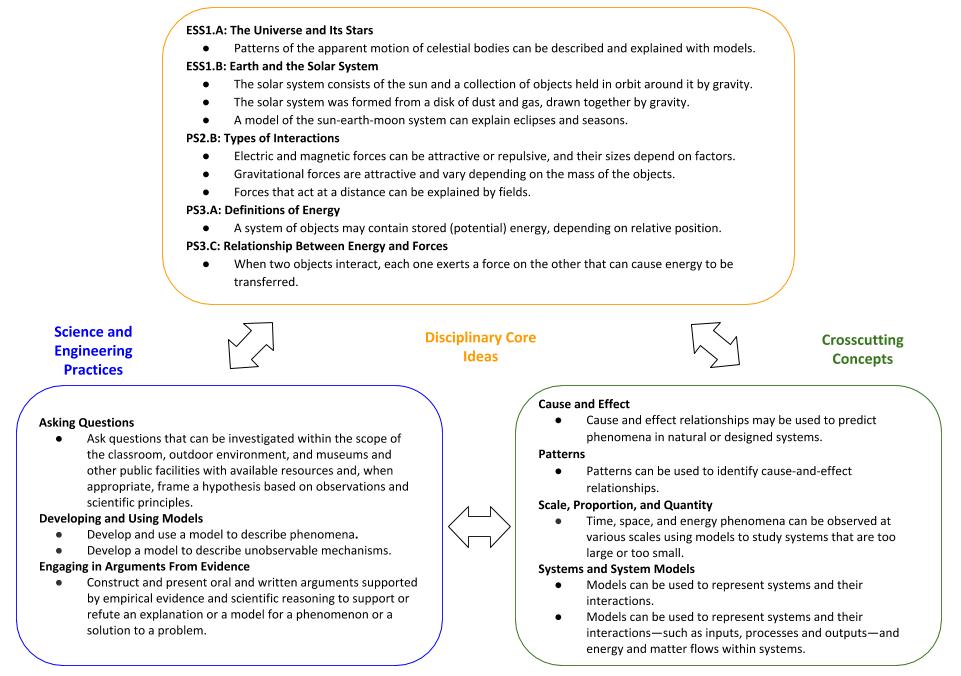
**Unit Essential Question:** *What forces keep the parts of our solar system together and how can we use this knowledge to plot a telescope route through space?*

**Introduction**

Telescopes have played a huge role in our history, opening our eyes to the mysteries of the universe. Telescopes on Earth have revealed new planets, stars, and asteroids and much, much more. However, modern telescopes, like the Hubble Space Telescope, take our technology a step further by launching the actual telescopes into space to study objects up close and look even farther out in the universe.

For this culminating project, students are going to consider the launch of a new telescope, which NASA hopes to launch into the solar system next year. What things will need to be considered to complete this mission efficiently and safely? Throughout the unit, each group will contribute to a class-wide model of our solar system—the phenomenon they were introduced to in the Lift-Off task. Using this model and new scientific concepts they learn, each group will then make an informed decision on the route they think the new telescope should take and how they will protect it as it moves through space. Once all groups have shown their routes within the class model, they will individually create a presentation that pitches their group’s route, describing the forces and energy both used and encountered on this trip and justifying why their route is the best route. The format of this presentation will be up to them (Prezi with a script, Powerpoint with a script, video, videotaped poster presentation, etc.)

**3-Dimensional Assessment**



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

7-8 days at end of unit

* Group Project: 2-3 periods (includes 1 presentation day)
* Individual Project: 5 periods
  + First draft: 3 periods
  + Feedback: 1 period
  + Revision: 1 period

**Materials**

Group Project

\*There are many different options of materials for students to build the planets for the class-wide scale model. We recommend use of any cheap, everyday objects to represent the different-sized planets. Students can even bring in materials from around their house! Some options of materials are below:

* Clay
* Spheres of different sizes (try a craft store for Styrofoam balls, plastic balls, etc.)
* Balloons
* Cotton
* Construction Paper of different colors
* Paint and Brushes
* String or Twine – needed to measure out distances from the sun
* Light Source (Large Lamp) – needed to represent the sun
* Rulers (with cm)
* Optional: magnets if they want to create a telescope model

Individual Project

* Computers with presentation software
* Device with recording capabilities (Ex: phone, tablet, etc)
* Poster Paper
* Markers

**Instructions for the Culminating Project**

1. Introduce the Culminating Project at the end of the Lift-Off task, including both the group and individual components outlined in the Challenge.
2. Read over the Culminating Project Task Card with the students. We recommend reviewing only the Challenge and Group Project Criteria for Success with students at this time in order to not overwhelm students with information.

* Take questions for clarification.

1. Give a brief overview of the Background on the new telescope, especially emphasizing the image and last paragraph.

* This will give students detail on where the new telescope will need to be launched.

1. Remind students that as they go through the Project Organizer, they will be planning pieces of their model and route and recording scientific concepts they will likely need for their individual project. However, there is nothing wrong with going back and changing their ideas over the course of the unit. The students won’t fully design their route until the end of the unit, so change during the processing time is acceptable and often experienced.
2. Make sure the students fill out the Project Organizer after each task, which will help students think about how information about the solar system and non-contact forces can help them plan their telescope route. This process allows students to both apply and document relevant scientific concepts as they move through the unit. This will inform both their group and individual projects.

* We recommend that students complete the Project Organizer individually. They might discuss ideas first as a group, but should then respond individually. This allows students time to process concepts on their own and generate their own ideas, which can be used later when it comes to developing their group project.

1. The table below summarizes how the Project Organizer guides students through developing different components of their model, route, and pitch presentation.

|  |  |  |
| --- | --- | --- |
| **Task** | **Project Organizer** | **Group and Individual Culminating Project** |
| **Lift Off**  Our Solar System | * What do you think our solar system consists of? | * Parts of a solar system included in class model. * Pitch presentation shows model of solar system with all parts. |
| **Task 1**  A Sun-Earth-Moon Model | * Draw a sketch of a Sun-Earth-Moon model. * Use a model to describe at least two of the phenomena explored in this task. * What are the limitations of the model? | * Pitch presentation has two relevant depictions of a sun-earth-moon model and uses them to describe seasons, lunar phases, eclipses and/or the apparent motion of the sun, moon, or stars. |
| **Task 2**  A Solar System Model | * Draw a sketch of the class solar system model. * Explain the scale used for your assigned planet. What data did you use? How does it compare to other planets? | * Group contributes a planet to the class-wide model of the solar system, created to scale. * Pitch presentation identifies data on properties of objects in the solar system that led to the scale of the class model, using their assigned planet as an example. |
| **Task 3**  Gravity In The Galaxies | * Draw a potential route for the new telescope. * What is the role of gravity in the solar system? * How can gravity affect the new telescope in space? * How does your understanding of gravity inform why the telescope must stay farther away from some planets, but not others? | * Group shows a potential route for the telescope through the class-wide model of the solar system. * Pitch presentation explains gravity’s role in the birth and layout of the solar system. It also shows and describes the group’s proposed route for the telescope and justifies their choice by using gravity to explain planets it must stay away from. |
| **Task 4**  Invisible Forces | * What evidence is there that magnetic fields exist? * What kinds of factors affect the strength of magnetic fields? What questions did you have to investigate to find out that information? * How might the telescope be affected as it passes planets with different magnetic fields? | * Group recommends the best way to create a protective magnetic field around the telescope and explains how passing by different planets might affect the telescope. * Pitch presentation cites data as evidence that magnetic fields are real and identifies best ways to strengthen one around the telescope. It also contains a model that shows and explains how and why passing by magnetic planets would affect the telescope. |

1. After all the learning tasks are completed, and the Project Organizers are completed, groups can start to refine the design of their route and the protection of their telescope.

* As always, we recommend the use of group roles for Culminating Project work time (See “How to Use This Curriculum” for details). We recommend changing the roles every work day.

1. This project differs from other Culminating Projects in that students are combining class-wide work and group work.

* The reasoning behind a class-wide solar system model is that space and time constraints would make individual group models very difficult. By creating a class-wide solar system model in which each group is assigned one piece to contribute, students are still responsible for the cognitive load of engaging in data analysis and computational thinking, but are not bogged down with busy work.
* Also unlike other units, the group project component of this unit is heavily focused on the *design* of the class model and route proposal, and the presentation of these products is secondary.
* As students prepare their models, routes, and brief group presentations, the Project Organizers and Group Project Criteria for Success should be used as reference for the students to remind them of all components to include.

1. For presentation day, have all students help to set up their class solar system model at the start of class. We recommend use of group roles, so that the Materials Manager is in charge of actually placing the group’s planet in place. This avoids the excess chaos of too many students constructing the class model at the same time.
   * Call up student groups one by one to show their telescope route and explain the points identified in their Group Project Criteria for Success checklist.
   * When presenting their proposals of the telescope routes, student groups may choose to kinesthetically model their telescope route (walking through) or they may use a physical material such as string to model their route. As a teacher, you may assign a method or leave it up to student choice.
2. Once the presentations are complete, students are ready to move on to their individual project. Students will create a presentation that pitches their route and describes the science behind it, meeting all the criteria in the student handout. The format of the presentation is up to them (Prezi with a script, Powerpoint with a script, video, videotaped poster presentation, etc.).
3. Conduct a peer review of the presentations after students have completed a first draft.

* Copy the Pitch Presentation Peer Review Feedback form found in the Student Instructions. Another option is to use the Student 3-Dimensional Individual Project Rubric.
* Assign each student a partner, preferably a partner from a different group.
* Students switch drafts and assess them using the peer review feedback form or 3-Dimensional Rubric.
* Remind each student to give one positive comment and one constructive comment for each section on the checklist.
* Allow students time to present their feedback to their partner, so their partner may ask clarifying questions if needed.

1. After receiving feedback, allow students time to complete a final draft based on the feedback they received.

**Assessment**

The Project Organizer can be formatively assessed using:

* *Criteria of your choice.* We recommend using the 3-Dimensional Assessment matrix from the Unit Overview to inform your criteria.

The Group Culminating Project will be summatively assessed using:

* The *Group Project Criteria for Success* Checklist

The Individual Culminating Project will be summatively assessed using:

* The *3-Dimensional Individual Project Rubric*.
* Keep in mind that the Proficient level indicates that the student has successfully demonstrated understanding of the criteria. Because we are in the early stages of NGSS adoption, it may take multiple opportunities throughout the course of the year for students to reach Proficient.
* If you wish to give students a numeric score, you could take the average score of all of their rubrics or add up rubric scores to give students a summation out of the total. Because of the note above, this scoring may not correlate to traditional grading systems.
* While we recommend scoring all of the project criteria with the rubrics for each student, we understand the burden of that level of scoring.
  + One option is to select the rubrics that you wish to focus on for this project and use those to assess each student’s individual project.
  + Another option is to review the Proficient level of each of the project’s rubrics and use the descriptions to generally analyze all student work for trends.