**Lesson Number 4: Materials Specialist**

**Problem statement:** Space junk is a hazard to space travel and satellites because it can cause major damage if a collision occurs. In this lesson the students will be learning about the different materials spacecraft are built from, and the materials that will be used to model our space junk collecting mechanism.

**Learning objectives:** Students will research different materials used in spacecraft construction and jigsaw their findings in small groups. They will identify the cost and efficiency variables of the different materials available.

**Lesson standards (NGSS, CCSS, CTE)**

[CCSS.ELA-LITERACY.RI.5.7](http://www.corestandards.org/ELA-Literacy/RI/5/7/)

Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.

[CCSS.ELA-LITERACY.RI.5.9](http://www.corestandards.org/ELA-Literacy/RI/5/9/)

Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

**Soft skills:**

* *Collaboration* with other fellow team members
* *Critical Thinking*

**Locally and/or personally relevant for students:**

If students have ever wondered what materials may be included in aircrafts, then this unit lesson will appeal to them! Whether it be airplanes or satellites, students will get a glimpse at some of the basic materials and the associated properties that may be involved in constructing these crafts. In terms of local relevance, Washington state is home to one of the largest airplane manufacturers in the nation. As engineers collaborate to analyze the various materials that compose an aircraft, students will collaborate to dissect the components that they will choose to construct their space junk model.

**Connections to career and educational pathways:**

This unit lesson plan will provide a glimpse of material science and engineering. Students will examine the various components that go into the material selection of their space junk model, including weight properties, associated costs and much more. Refer to the Career Connections section of the guidebook for real life examples of people working in this field.

**Materials:**

* Numbered Materials Posters
* Access to the internet for research purposes
* Blank materials spreadsheet
* Completed materials spreadsheet
* Space Junk summary table from lesson 1, 2, and 3
* Materials Notes document
* Space Junk Video - Bridge Video
* Clipboards or study books

**Lesson preparation:**

Teacher will need to print out the materials posters or recreate them on chart paper and post them around the room.

Teacher will need the summary table from lesson 1, 2, and 3.

Print out the note taking document and blank materials spreadsheet, and the completed materials spreadsheet.

**Time required:**

1 hour approximately

**Grouping of students for instruction:**

The students will be grouped heterogeneously. These are now the groups they will be in for the rest of the unit, now is a good time to make any final swamps between groups.

**What is the instruction? Consider the PBL Procedure that is being addressed here:**

**Understanding the Problem**

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| --- | --- |
| **Teacher** | **Student** |
| Teacher will show this video clip Space Junk Video - Bridge Video  (5 mins) | Students will watch this intro video clip on how to keep astronauts safe in space. |
| “Before we get into our Materials Specialist lesson today, let’s revisit our last badge quickly: the “PhEt Badge”. Using your Summary Table let’s work together to document our observations, learning, and connections.”  (5 mins) | Students will share out observations, learning, and connections and document them on their own table as well. |
| “Today we are going to learn about the different materials used in building spacecraft. Once we have learned all about what kinds of things spacecraft builders use in space, I am going to show you the items we will be using for our team models.  (1 min) | Students may ask, “When do we get to build our space junk models?” Reassure them that after learning about the materials, making a plan and a budget as a team, they WILL be building! |
| “I am sure you all noticed the posters around the room. These are some of the different materials used to build spacecraft. Your job will be to go on a scavenger hunt around the room. You will each learn about 2 or more of the materials. Then you can take this back to your team to share.You will need to take detailed notes so that you can tell your team about what you discovered.”  Teacher then numbers off team members, or uses cards 1-9 to make sure each team member are assigned to 2-3 numbers. | Students get out their clipboards and materials note page to document their learning. Once they have their numbers they get to work. |
| “We are going to do this systematically. You will have exactly 3 minutes to find one of your materials and learn as much as you can about it. Then you will hear a bell and return to your table groups. Each person at the table group will get exactly 90 seconds to explain everything about their material to the group. We will go around like that until every group member has shared out about 1 material. Then we will do that once more with the second material you were assigned. Then all the groups will have 5 minute to fill out the materials spreadsheet with all 9 materials. This will take us 30 minutes.  “Any questions?”  (1 min) | Students will ask clarifying questions until they understand the directions.  Students take 2 cards each and their eyes start to scan the room for their dealt material. |
| Start the first timer for 3 minutes.  \*There will be multiple students at each poster so the posters should be as spread out as much as possible and printed or charted on large paper. | Students will spread around the room and begin studying their first material as well as taking notes. |
| Keep track of the time and walk around room. Monitor conversations for any potential misconceptions and assisting individuals who need support in note writing. |  |
| After 3 minutes, call time and have students go back to their groups. Instruct students to go around the table and share about their material. You are the only speaker. The other teammates are listening and thinking about what questions they would like to ask. | The students will return to their groups and start to explain the first material. |
| Teacher will call time after 90 seconds. “Now you have 3 minutes. You are going to go around the table. Each person can ask one question each about the material to the speaker. If a question is asked that cannot be answered, even after going back to the poster, the speaker will record that questions for further research. | Students will go around the table to ask one question they have about the material just explained. The speaker will do their best to answer the questions. He/she may even go back to the poster if needed to explain something. |
| Teacher will call time after 3 minutes. | Students will stop discussing the first material. |
| “Now switch to the next material numerically and you have 90 seconds to explain your material.” | Students find the next speaker and listen to them explain the second material. |
| Teacher will call time after 90 seconds. “Now you have 3 minutes to go around the table and ask one question each about the material to the speaker. If a question is asked that cannot be answered even after going back to the poster the speaker will record that questions for further research. | Students will go around the table and ask one question they have about the material just explained. The speaker will do their best to answer the questions. |
| “Now it is time to research your second material. Think about the questions that the group asked you during the first round. How will this change the types of notes you take?”  (3 mins) | Students research their second material by taking notes. Stop at the signal. |
| “Go around the table. The first person has 90 seconds to share about their materials.” | Students find the next speaker and listen to them explain the third material. |
| Teacher will call time after 90 seconds. Now you have 3 minutes to go around the table. Ask one question each about the material to the speaker. If a question is asked that cannot be answered, even after going back to the poster the speaker, will record that questions for further research. | Students will go around the table and ask one question they have about the material just explained. The speaker will do their best to answer the questions, going back to the poster if needed. |
| Teacher will call time after 3 minutes. | Discussions stop. |
| “Now switch to the next material numerically and you have 90 seconds to explain your material.” | Students find the next speaker and listen to them explain the fourth material. |
| Teacher will call time after 90 seconds. “Now you have 3 minutes to go around the table and ask one question each about the material to the speaker. If a question is asked that cannot be answered even after going back to the poster the speaker will record that questions for further research. | Students will go around the table and ask one question they have about the material just explained. The speaker will do their best to answer the questions. |
| Teacher will call time after 3 minutes. | Students will stop discussing the fourth material. |
| \*Repeat process with the second assigned number. | ... |
| “Now that you have all learned about 8 materials, you will have 5 minutes to fill out the materials spreadsheet. When you hand in your completed spreadsheet, you can get a container of some sample classroom equivalent materials.” | Students will fill out the materials spreadsheet. They will assist each other in groups to fill out the spreadsheet thoroughly. |
| Call time after 5 minutes and collect the spreadsheets from the groups. Allow groups to get their sample materials. “While your are examining the materials, talk in your groups. How do you think we can use these materials or their classroom equivalents to build a collection device?” | Students will start discussing and playing with the materials they may use for their craft and how it might work. |
| “Now please get out your guidebooks and answer 1-2 of the following questions for your exit ticket today :   1. Why does it matter what the materials cost? 2. Why do you think materials that go into space need to be lightweight and also strong? 3. What materials are you thinking you might use for your space junk removal system? Why? 4. Did you learn something new about materials used in aerospace?   (5 mins) | Student will record their thinking in their guidebooks to receive their materials specialist badge. |

**Accommodations:** An ELL accommodation could be having the materials word like steel or titanium translated into the EL students home language. Pictures showing common uses of the materials may also help some students understand the materials we are talking about. If a student is absent for this lesson there will be a completed materials chart for them to study.

For classes or students for whom the timing will be stressful, teachers could just have students collect data on all assigned materials, then report out at the end.

For highly capable students it would be beneficial to have them do more research on these aerospace materials and share their findings with the class.

**Extensions:** This lesson could be extended to include a cost analysis and comparison of the different materials. You could also discuss how these materials that we are using to build our craft are the same materials that we are collecting. Teacher could ask, how does this help us understand a way of collecting, removing, or destroying the current space junk.

**Assessment:**

Formative Assessment in the Lessons: The teacher will collect the materials spreadsheet from each group and assess the information collected to make sure the students are understanding and address any misconceptions individually or in small groups.

Formative student data is also available in the student’s summary table, and in their guidebooks with their reflection questions.

**References/Resources:**

**For Class:**

* **Space Junk bridge video:**[**https://www.youtube.com/watch?v=cWx0vdoJ-qc**](https://www.youtube.com/watch?v=cWx0vdoJ-qc)

**Resources used to gather data for materials posters:**

* <https://www.nap.edu/read/2351/chapter/7#48>
* [http://hpf.psu.edu/2014/09/29/mli-blankets/ https://www.nap.edu/read/2351/chapter/7#47](http://hpf.psu.edu/2014/09/29/mli-blankets/)
* <https://www.nasa.gov/centers/johnson/pdf/584733main_Wings-ch4g-pgs270-285.pdf>
* <https://www.nasa.gov/vision/space/gettingtospace/16sep_rightstuff.html>

**For Guidebook**

* <http://www.sciencekids.co.nz/gamesactivities/materialproperties.html>
* <http://tryengineering.org/become-an-engineer/materials-engineering>