**Lesson 5: Title:** Costly Mistakes

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| **Lesson** | **Title & Short Description:** | **Learning Outcome:** |
| #5 | Costly Mistakes:  Students will be given a cost-analysis sheet to determine the most cost-effective way to solve the problem.  How would you solve this airline’s problem?  Taking apart parts to find the debris and reinstall the parts. | Students will learn how the change in systems has helped to save money and cause less problems. |

**Problem statement: *How can we improve our production process so that we have less debris (foreign object debris or FOD) left on the airplane during the build stage and can deliver a clean, safe airplane? What turns an object into a FOD?***

**Learning objectives:**. I can evaluate the cost of various systems to eventually create a quote to reduce the overall cost associated with troubles caused by FOD.

**Standards:** Next Generation Science Standards (NGSS), Common Core Standards (CCSS)

**NGSS:**

**5-PS1-3:** Make observations and measurements to identify materials based on their properties.

**3-5-ETS1-1:**

Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

**3-5-ETS1-2:**

Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem

**3-5-ETS1-3:**

Plan and carry out fair tests in which variables our controlled and failure points are considered to identify aspects of a model or prototype that can be improved

**CCSS**

CCSS.Math.5.NBT.B.7

Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.

[ELA-LITERACY.SL.5.1](http://www.corestandards.org/ELA-Literacy/SL/5/1/)

Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 5 topics and texts*, building on others' ideas and expressing their own clearly.

[CCSS.ELA-LITERACY.SL.5.1.A](http://www.corestandards.org/ELA-Literacy/SL/5/1/a/)

Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.

[CCSS.ELA-LITERACY.SL.5.1.A](http://www.corestandards.org/ELA-Literacy/SL/5/1/a/)

Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.

[CCSS.ELA-LITERACY.SL.5.1.C](http://www.corestandards.org/ELA-Literacy/SL/5/1/c/)

Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others.

[CCSS.ELA-LITERACY.SL.5.1.C](http://www.corestandards.org/ELA-Literacy/SL/5/1/c/)

Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others.

**Soft Skills:**

Listening, Critical Thinking, Collaboration, Communication (written and oral), Creativity & Innovation

**Materials:**

* Lesson 5 Slides
* Student Data Sheet: Hercules 2200
* Student Data Sheet: Pacific Airline Pay Scale
* Student Data Sheet: Quote Template
* Rubric
* Student Data: Email template

**Lesson preparation:** Either digital or paper resources for student access

**Time required:** Up to 3 class periods, for collaboration and writing

**Grouping of students for instruction:** Whole group and partners

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

**Understanding the Problem**

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| **Teacher** | **Student** |
| Review the Scenario from early lessons (story of clank and request from Airline , ([FOD Lesson 5 Slides](https://docs.google.com/presentation/d/1p7kUGOk_50qg1_O5NFBVQL-OwGF0_3WxakMrk46OCvw/edit?usp=sharing)Slides 2-3) | Listening |
| Present the next step in the scenario, “The Report from the engineers has just come in and now we need you to figure out which solution should be used to fix the FOD problem in the Hercules 2200 aircraft. Calculate each solution’s cost to help you decide which solution to go with and explain in an e-mail to the project manager.” (Slide 4) | Listening |
| Introduce the term “Cost - Benefit Analysis” What does cost mean? What is a benefit? What are you doing when you analyse? (Slide 5) | Share thoughts on what cost, benefit, and analyse mean. |
| Show video on slide 6, Ask; what were the choices? What was the cost of going to the movies? What is the benefit of going to the movies? What is the cost of studying? What is the benefit of studying? Record answers on slide 7 | Watch and Discuss |
| Going back to the original problem, what might some of the cost be to repair the clanking noise in the plane? Have students brainstorm possible costs, ideally they should get beyond just parts and include labour and time. Record their ideas on this slide. | Brainstorm costs |
| A number talk is when you verbalize your thought process for completing a math problem and compare with other ways to arrive at the answer. The goal is that through this number talk students will understand what a “per hour” wage is.  To start, read the problem aloud a couple of times and invite the students time to think about how they could solve this problem. When they have an idea they can do a “thumbs up” sign in front of their chest so it doesn’t distract the other learners. After 75% or more of the class has their thumb up, call on someone to raise their hand and explain their thinking. As they describe, you can write/draw notes on their thinking (even if it is incorrect). Then ask for another way to solve the problem (even if the first solution was correct). If the student says “240 x 4” or “240 + 240 + 240 + 240” make sure you ask “How do you know?” You are looking to get them to explain how they know that is the way to calculate “per hour” wages. Repeat for screw cost. More info about number talks can be found here:<https://www.oercommons.org/courseware/lesson/79069/overview> | Students first work in their head to solve the number talk problems, then they share their thinking. If time allows students can pair up and share or a few students can share with the whole group. |
| Provide each group a copy of the FOD Report, Pacific Airline Pay Scale, Hercules 2200 Parts Price Sheet. Explain what a Quote is and use the example quote slide and the number talk examples to show how to fill in the quote. Model filling in the quote with a few parts and positions from the Hercules 2200 Parts Price Sheet and Pacific Airline Payscale. Example: If you needed a Mechanical Engineer Level 1 for 4 hours, how would you record that here? If you need 15 phillips screws, how would you record that? What would your subtotals be? What would the total cost be? | Students use the FOD Report, Pacific Airline Pay Scale, Hercules 2200 Parts Price Sheet to find the data for the example quote (slide 11) |
| Support students as they do the quote template | Students can work in a group and calculate each solution together or they can assign each solution to one group member and then check and compare at the end. |
| Have the students write an email to the project manager (you as the teacher) explaining their conclusion. Their email should include the final cost of each solution. Students can write an actual email or use the email template.  Support the students as they work on an email to the project manager | Each group writes an email to the project manager (the teacher) explaining their conclusion. The email should include the final cost of each solution. Students can write an actual email or use the email template. |

**Accommodations:** Some data could be used to get students started that might need more scaffolding. Calculators or other devices could be used for students that need support with computations. Students could also be given options to video record their messages to tell about their findings rather than writing an email.

**Extensions:**

**Assessment:**

**References/Resources:**

*Number talks:* [*https://www.oercommons.org/courseware/lesson/79069/overview*](https://www.oercommons.org/courseware/lesson/79069/overview)