Lunar Lander Data Game

Teacher Facilitation Guidelines

If you have not done so already, please watch the short student and teacher videos, and play *Lunar Lander* before or as you read these notes. Also, you should look at the student worksheet for *Lunar Lander*.

Learning Goals

- Students strengthen their understanding of the behavior of polynomial and rational expressions. (The relevant CCSSM standards are listed at the end of this document.)

Prior to Students Playing

- In most games the task is to get the highest score possible. But in *Lunar Lander*, no score is provided, and students have to create an algebraic expression that produces what they think is a reasonable score. They will consider the data for impact, speed, and fuel, and decide which values are most important. If Sylvia lands more gently than Derek, but takes more time, they will decide who made the better landing. Students will decide what they value most, and then invent a formula for the landing score that reflects those values.
- Some teachers introduce this game by discussing real-world jobs that involve creating scores or formulas. For example, a key aspect of designing many video games is devising a formula to calculate the score. Also, sports statisticians evaluate players using statistical formulas, such as quarterback ratings.
- The student worksheet guides students in working on *Lunar Lander* with two students per computer, with each person controlling a rocket, but you may modify this if you'd like.
- For suggestions on how to prepare to play Data Games with students, go to the Teacher FAQ section of the Data Games website (http://play.ccssgames.com/faq-page).

During Gameplay

- Students can customize their ships, pilots, and controls by clicking the *Setup* button on the game screen, but they shouldn't spend too much time on this.
- Software performance is slower when making a flight with the Table and Graph open, but it is also valuable for students to see the data appear in real time with the flight.
- Students do not need to use the *Clear Data* button between flights. But since the game generates a lot of data, they may want to use that button at some point to remove data clutter and possibly improve software performance.
- The approach the video and worksheet take is to start students with a "bad" formula for *score*, such as:

  $score = fuel\_remaining + total\_time + impact$

  Then students explore why that formula doesn't work well, and try to improve it.

- The second video shows students how to create a score formula using the Gear menu in the Table, but they might need support with this.
- After students have developed a score formula and tried it out, the worksheet suggests they compare their formulas with others, decide which they like best, and explain why.

Answers to Student Worksheet Questions

- "(Q1) What do you think makes a landing a "good" one?" – **Answers will vary.**
- "(Q2) What does the graph look like for a "good" landing? Be specific." – **Answers will vary, but should probably include that the graph should not be very steep as the altitude approaches 0.**
- "(Q3) When is it obvious that someone has a better landing?" – **Answers will vary, but might include: One student has a less steep graph upon impact or one student has a greater value for *fuel_remaining* and smaller values for *total_time* and *impact*.**
- "(Q4) When is it hard to tell which player has a better landing?" – **Answers will vary, but might include: It was hard to tell which graph was less steep upon impact or a greater value for *fuel_remaining*, and smaller values for *total_time* and *impact* were split between the two students.**
- "(Q5) Explain briefly why this formula is not a good one." – **Answers will vary, but should include: Smaller values for *fuel_remaining* and *total_time* make this score higher, whereas we want the score to be higher when those values are smaller.**
- "(Q6) For a "good" landing to have a high score, which variable(s) do you want to have large values?" – **We want large values for *fuel_remaining*.**
- "(Q7) For a "good" landing to have a high score, which variable(s) do you want to have small values?" – **We want small values for *total_time* and *impact*.**
- "(Q8–Q10) What is your score formula? Write down one other student's score formulas?" Compare them. – **Answers will vary, but students should explain the best formula is one where *fuel_remaining* contributes to raising the score (e.g., it might have a positive coefficient, a large exponent, and reside in the numerator), while *total_time* and *impact* contribute to lowering the score (e.g., it might have a negative coefficient, a small exponent, and reside in denominator).**

Challenges Introduced on Each Level

- There is only one level in *Lunar Lander*.

Relevant Common Core State Standards for Mathematics

- Apply and extend previous understandings of numbers to the system of rational numbers (6.NS.5)
- Apply and extend previous understandings of arithmetic to algebraic expressions (6.EE.1, 6.EE.2)