

Lesson Update and CRT Addendum	
Lesson/Activity Title: Exploring the Extreme: Fuel Efficiency	ID: 16-718
Product Number: EG-2002-10-001-DFRC	Grade: 7-8
URL for Lesson: https://www.nasa.gov/pdf/382720main_ETE_Lesson_4_Fuel_Efficiency.pdf	
Subject: Graphing, controlling for variables, velocity, drag, thrust, modeling, data collection, unit conversions.	
Summary: Students will calculate the thrust/drag created by the F-15 ACTIVE with the vertical tails on and off. They will graph this information in a bar graph and make conclusions about the amount of fuel needed by both variations of the plane. The calculations can be done both at sea level and at 18,000 feet for additional comparisons.	
Materials for lesson: Graph paper, Colored pencils, Straight edge, Calculators	

Review and Recommendations	
ALIGNMENT TO STANDARDS	
NGSS	ETS1, MS-PS1, MS-PS2, MS-PS3, MS-LS4
Common Core State Standards in Mathematics	7.EE, 8.EE
CULTURAL RESPONSIVE TEACHING (CRT) RECOMMENDATIONS	
5E Lesson/Description	
1. Engage	Students' prior experiences such as the feel of the force of wind against their hand as they extend it out of the window of a moving car, or the observation of the motion of sail boats can be utilized to engage students into the lesson or a step to build students' interest into the lesson.
2. Explore	Data and formalals allow the students to explore the presence of patterns. The lesson is focused on what a jet airplane would do, and not on any language considerations. Students' who speak the same language can be partnered to use their

	native language to discuss and explore ways to approach the activity.
3. Explain	Concepts or procedures are explained for students to complete end-of-lesson questions which focuses on the relationships found by manipulating the raw data that is provided
4. Expand/Enhance	<p>The teacher can instruct students to explore ways that they can apply knowledge learned into their personal lives or ways that the knowledge will be beneficial to their community.</p> <p>Students could build models with various fin configurations and test them for efficiency of flight (distance, speed, stability...).</p>
5. Evaluate	<p>The lesson requires students to use decimals, ratios and linear equations in order to answer a practical problem. The stimulation of deep conceptual understanding would be an outcome of the students' effort in this lesson.</p> <p>Additionally, the lesson provides a straight form and redundancy in the use of formulas would lead to the building of procedural fluency supporting conceptual understanding.</p> <p>A written assessment is included in the lesson and could be used as a pre and post assessment.</p>

Additional Resources:

<https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Exploring.the.Extreme.Guide.html>