**What does Transporting a Military Vehicle have to do with math?**

**Video:** [**https://youtu.be/lEiy4uGhIsQ**](https://youtu.be/lEiy4uGhIsQ)

**Lesson Plan**

**Teacher Note:** Please preview the entire video and pre-work the solutions in order to anticipate students’ needs, misconceptions and materials unique to your classroom.

You will also need to determine the background knowledge of your students regarding the following topics and decide the best method for providing that background in order to support the conceptual understanding of the mathematics shown in the video.

* Order of Operations
* Rates
* Percentages

**Common Core Mathematical Content Standards**

* 6.RP.3c Find a percent of a quantity as a rate per 100
* 6.NS.3 Fluently add subtract, multiply and divide multi digit decimals using the standard algorithm for each operation.
* 7.RP.3 Use proportional relationships to solve multi step ratio and percent problems.
* 7.NS Apply and extend previous understandings of operations with fractions to add, subtract, multiply and divide rational numbers.

**Common Core Mathematical Practice Standards**

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

**Company Information**

At Oshkosh Defense, we stand behind those who dedicate their lives to protecting others. As a tactical vehicle manufacturer, every day we strive to meet or exceed our customers’ ever-changing needs with next-generation defense technologies and advanced systems. We operate with unparalleled commitment to those who depend on our products and services worldwide to perform their missions and return home safely.

**Summary**

Getting needed supplies to troops in remote locations is critical to their success and safety. How the supplies are delivered is one of many decisions that need to be made. That decision involves more math than most people realize! In this video, you will help calculate cargo capacity for delivery of a JLTV (Joint Light Tactical Vehicle) and other cargo to our brave troops.

**Pre-Activity Discussion:**

* Vocabulary
	+ Sling load
	+ Altitude
	+ Sea level
	+ Lift capacity
	+ Air temperature

**Differentiation:**

* The questions on the student handout are scaffolded to meet the needs of students who may need extra support.
* Eliminating some of the added questions, and just posing the questions from the video would be a possible differentiation strategy for students who do not need the extra support.
* Students may also benefit by working with others as part of a partner/group investigation.

**Part 1: (0:00 – 0:36)**

BREAK 1

* Problem posed: *How can JLTV’s be transported to our troops?*
* Have students use part one of student handout to document their brainstorming about possible ways to get these vehicles to our troops efficiently and in the shortest about of time.
* Before showing Part 2, have students share their ideas.

**Part 2: (0:36 – 2:22)**

 BREAK 2

* Problem posed: *How many pounds of ammunition can be transported in the JLTV if it is sling loaded to the battlefield using a cargo helicopter?*
* Information given
	+ JLTV weight = 1700 lb
	+ 1 cargo helicopter can carry 26,000 lb of cargo when flying at sea level
	+ Change in altitude affects the lift capacity of the helicopter
	+ The helicopter loses 300 lb of lift capacity per 750 ft of altitude
	+ 1 gallon of fuel weighs 10 lb
	+ The helicopter fuel use is 15 mpg
	+ The mission is 100 miles and includes a mountain pass that requires a maximum altitude of 6000 ft above sea level.
* Students are asked to answer the question on the student handout.
* Before showing Part 3, have students share their answers and problem solving methods.

**Part 3: (2:25 –** **2:45)**

* Discuss the solution from Part 2 and any calculation errors or misconceptions
* Problem posed: *Air temperature during flight also affects the lift capacity of the helicopter. What is the total lift capacity through the mountain pass?*
* Information given:
	+ The helicopter loses 1% of its lift capacity for every degree over 85 degrees.
	+ The ambient air temperature is 100 degrees.
* Students are asked to answer the question on the student handout.
* Before showing Part 4, have students share their answers and problem solving methods.

**Part 3: (2:45 – 3:39)**

* Discuss the solution from Part 3 and any calculation errors or misconceptions.

**Extension:**

* Our calculations were based on flying at an altitude of 6000 ft for the whole 100 mi trip to reach our troops even though they may not fly at that altitude the whole time. Why is that? Can you think of any other situations where this kind of largest/smallest scenario thinking would occur?
* How would a 5 degree drop in air temperature change the lift capacity? A 5-degree increase in air temperature?
* Investigate why attitude affects the lift capacity of an aircraft.
* Investigate why air temperature affects the lift capacity of an aircraft.
* Are there any other considerations that could affect the lift capacity of the helicopter?

**Student Handout - *What does transporting a military vehicle have to do with math?***

Name(s):

**Pre-Video Discussion:**  *Notes on important background information.*

**Break 1:** **Problem:** *How can JLTV’s be transported to our troops?*

1. Brainstorm ideas for transporting a military vehicle efficiently and in the shortest about of time. List the advantages and disadvantages of each of your ideas.

**Break 2: Problem:** *How many pounds of ammunition can be transported in the JLTV if it is sling loaded to the battlefield using a cargo helicopter?*

 4. List the information given to you in the video.

5. Use the information that was given to you to calculate a solution to the problem.

**Break 3: Problem:** *Air temperature during flight also affects the lift capacity of the helicopter. What is the helicopter’s new lift capacity if the air temperature is now factored into the calculation?*

 6. List the new information given to you in the video.

 7. Calculate the new lift capacity of the cargo helicopter taking into consideration the air temperature.

 8. Calculate the new solution to the original problem: *How many pounds of ammunition can be transported to the troops*?

**Answer Key *What does transporting a military vehicle have to do with math?***

**Break 1:** **Problem:** *How can JLTV’s be transported to our troops?*

1. Brainstorm ideas for transporting a military vehicle efficiently and in the shortest about of time. List the advantages and disadvantages of each of your ideas.

**Answers vary**

**Break 2: Problem:** *How many pounds of ammunition can be transported in the JLTV if it is sling loaded to the battlefield using a cargo helicopter?*

 4. List the information given to you in the video.

* + **JLTV weight = 1700 lb**
	+ **1 cargo helicopter can carry 26,000 lb of cargo when flying at sea level**
	+ **Change in altitude affects the lift capacity of the helicopter**
	+ **The helicopter loses 300 lb of lift capacity per 750 ft of altitude**
	+ **1 gallon of fuel weighs 10 lb**
	+ **The helicopter fuel use is 15 mpg**
	+ **The mission is 100 miles and includes a mountain pass that requires a maximum altitude of 6000 ft above sea level.**

5. Use the information that was given to you to calculate a solution to the problem.

**Helicopter Lift Capacity = 26,000 lb**

**Reduction in capacity due to altitude**

 **6000 ft / 750ft = 8 reductions of 300 lb = 2400 lb reduction in lift capacity due to altitude**

 **Weight of required items:**

**Vehicle = 17000 lb**

**Fuel round trip = 2(100 mi /15 mpg) x 10 lb/gal = 133.33lb**

 **Calculation**

**26000 – 2400 – 17000 – 133.33 = 6466.67 lbs of capacity left for ammunition**

**Break 3: Problem:** *Air temperature during flight also affects the lift capacity of the helicopter. What is the helicopter’s new lift capacity if the air temperature is now factored into the calculation?*

 6. List the new information given to you in the video.

* + **The helicopter loses 1% of its lift capacity for every degree over 85 degrees**
	+ **The ambient air temperature is 100 degrees**

 7. Calculate the new lift capacity of the cargo helicopter taking into consideration the air temperature.

**100 degrees – 85 degrees = 15 degrees**

 **1% x 15 = 15% loss of lift capacity**

 **26000 x 0.15 = 3900 lb loss**

 **26,000 – 3900 = 22,100 lbs of cargo at 100 degrees F**

 8. Calculate the new solution to the original problem: *How many pounds of ammunition can be transported to the troops*?

 **6466.67 – 3900 = 2566.67 lb of ammunition**