![A drawing of a face

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Video:

[**https://youtu.be/B9D7XpAlH80**](https://youtu.be/B9D7XpAlH80)

In this task, students will how much steel it takes to manufacture 25 consumer zero-turn lawn mowers.

**Common Core Mathematical Content Standards:**

7.RP Analyze proportional relationships and use them to solve real-world and mathematical problems.

3. Use proportional relationships to solve real-world and mathematical problems.

**Common Core Mathematical Practice Standards:**

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.

**Background information:**

**Ariens Company**

Ariens Company is a Brillion, Wisconsin-based equipment company which manufactures snow blowers, lawn mowers, and other “chore products” for commercial and high-end consumer markets. This four-generation company has a long history and touts itself as being the “mower of the White House lawn” and “official snow blower of Lambeau Field”.

**Video Summary:**

|  |  |  |
| --- | --- | --- |
| Introduction | (0:00-0:28) | What do lawn mowers have to do with math?  What is the total amount of steel needed for the production of lawn mowers? What operations make sense in the context of this problem?  *Includes Break 1* |
| Information & Estimates | (0:29-1:08) | Are all of the numbers that are given going to be used to find the total amount of steel needed to produce the lawn mowers? If not, what information is extra? What is meant by “without scrap”?  *Includes Break 2* |
| New information | (1:09-1:18) | How are we going to find how much steel will need to be used to include the steel for the lawn mower and the scrap that must be included?  *Includes Break 3* |
| Solution | (1:19-end) | Do you need to know only the total amount of steel needed or would you need to know how much of each type of steel? |
|  |  |  |

**Pre-Activity Discussion & Introduction**  (0:00-0:28)



* Play Video (0:00 – 0:09)
* Pause at (0:10 – 0:12) for class discussion.
* Class discussion: “*What does scrap steel have to do with math?*”

Students should brainstorm regarding what mathematics might be involved in the design, production, and assembly of lawn mowers.

It may be helpful to consider:

* *What does a lawn mower start as at the beginning of the assembly?*
* *What is “the journey” of the sheets of steel? Would they use the same sheets of steel for the entire lawn mower? Why would they need different thicknesses?*
* *What jobs do people have who support this “journey”?*   
  (Examples: engineer, tool and die, human resources manager, production technician, product distribution, etc.)
* *What knowledge and skills might be associated with these fields?*
* Play Video (0:13 – 0:24)
* Pause at Break 1 (0:25 – 0:28) for class discussion.
* Class Discussion*:*

*“Today we are going to calculate how much steel it takes to make 25 of the consumer zero-turn lawn mowers. What information do you think you need?*

* + Amount of steel needed to make 1 lawn mower.
    - When they say “how much steel it takes” are they referring to the area or weight?
  + Do you use all of the steel that enters the cutting machine?
  + Why is would there be 5 different sheet steel sizes needed? Do they all weigh the same?

**Information and Estimates** (0:29-1:05)

* Play Video (0:29-1:05).
* Pause at Break 2 (1:06-1:08).

* Class Discussion:

Prior to solving the problem, create an estimate for the total weight of steel needed to make one lawn mower.

Students should make sense of the information in the table given. If may be helpful to consider:

* + *Are all of the values given in the table used in calculating the weight of one lawn mower?*

No. The thicknesses of the steel just describe what steel is necessary. In this situation it is similar to the name of the steel.

* + *What level of precision do you think is necessary and appropriate?*

**In this case, you will need to make sure that you have enough steel, but there will be scrap steel, so it doesn’t have to be exact. (Of course, you want to try to minimize the amount of scrap, but that is determined by the engineers.)

* + *What does “without scrap” mean?*

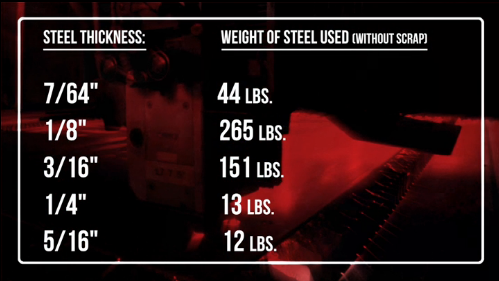
Think about making cut out doughnuts. The dough is rolled out; the cutters are placed on the dough in a way that uses the most amount of dough (least amount of scrap). The cutters are then pressed into the dough. The hole in the middle of the pressed dough that is not part of the doughnut is considered “scrap” (the doughnut hole) as well as the dough between the patterns. The steel is similar. The steel is fed into the machine; the laser efficiently cuts the pattern necessary for the part of the lawn mower. The steel that is not part of the pattern is the scrap steel and cannot be used again.

* + Strategies and Solutions

*What operations make sense in the context of the problem? What strategies would you use to solve the problem?*

Addition and multiplication will be used to find the total weight of steel used in the production of the 25 lawn mowers. The student could either find the total weight for 1 lawn mower (by finding the sum of all the types of steel) and then multiplying it by 25, or they could multiply each type of steel by 25 and then find the sum.

Weight of 1 lawn mower = (44 + 265 + 151 + 13 + 12) = 485 pounds.

 25 lawn mowers = 485 (25) = 12,125 pounds.

**New Information**  (1:09-1:14)

* Play Video (1:09-1:14).
* Pause at Break 3 (1:15 – 1:18) for class discussion.
* Class discussion:

Students should make sense of the new information in the situation.

* + *“15% of what comes off of the laser is scrap.” Why?*

Even a machine cutting with a laser cannot use 100% of the steel. The pattern of the cutout does not allow for that.

* + *If 15% of what goes into making the lawn mower is going to be scrap, what amount will be scrap?*

Scrap: gets “punched” out and not used.

Steel cutting laser machine

Sheet of Steel

Pattern for the lawn mower piece.

15% of the pattern amount is scrap.

* 12,125 pounds of steel become the pattern or the usable amount of steel. Since 15% is scrap or get wasted, then 85% is what the usable amount is.

12,125 = 0.85\*original amount

14,264.71 lbs = original amount – what you need to start off with

\*\*\*Note: In the video he refers to multiplying by 115% percent. This would not get an accurate amount of what to start off with, the steps above would get an accurate amount of what to start off with.

**Solution and Extension:**

* Play Video (1:19-end).
* Class discussion:

*Were your solutions from above correct?*

*Do you need to know only the total amount of steel needed or would you need to know how much of each type of steel that would be necessary?*

**Extension**

If you knew the weight of each sheet of steel, how many whole sheets of each type of steel are required to make 25 lawn mowers?

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Steel Type/Thickness | Pound of each steel type used in a lawn mower (without scrap) | Pounds per sheet of steel | Pounds of each steel type used in 25 lawn mowers (without scrap) | How many pounds of each type of steel are used to make 25 lawn mowers (with scrap)? | How many whole sheets of each steel are required to make 25 lawn mowers? |
| 7/64” | 44 | 92 |  |  |  |
| 1/8” | 265 | 108 |  |  |  |
| 3/16” | 151 | 156 |  |  |  |
| 1/4" | 13 | 210 |  |  |  |
| 5/16” | 12 | 285 |  |  |  |
| Totals |  | N/A |  |  |  |

Solution to above table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Steel Type/Thickness | Pound of each steel type used in a lawn mower (without scrap) | Pounds per sheet of steel | Pounds of each steel type used in 25 lawn mowers (without scrap) | How many pounds of each type of steel are used to make 25 lawn mowers (with scrap)? | How many whole sheets of each steel are required to make 25 lawn mowers? |
| 7/64” | 44 | 92 | (44)(25)=1100 | 1100/.85=1294.12 | 1294.12/92 = 15 rounded up |
| 1/8” | 265 | 108 | 6625 | 7794.12 | 73 |
| 3/16” | 151 | 156 | 3775 | 4441.18 | 29 |
| 1/4" | 13 | 210 | 325 | 382.35 | 2 |
| 5/16” | 12 | 285 | 300 | 352.94 | 2 |
| Totals | 485 | N/A | 12125 | 14,264.71 | 121 |