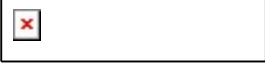


Math-in-CTE Lesson Plan Template

Lesson Title: Understanding Gear Ratios		Lesson #AT-13
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Occupational Area: Automotive. This lesson could be taught in conjunction with Natef task sheet: Remove and Replace axle assembly.		
CTE Concept(s): Gear ratios		
Math Concepts: ratios, fractions, comparisons.		
Lesson Objective:	Students will understand how gear ratios are used in the automotive setting. Students will be able to determine a gear ratio at the end of the lesson as part of the task of removing and replacing a rear assembly.	
Supplies Needed:	A Model of a differential or axle assemblies, Steer box and or rack, 2cycle motor oil.	

THE "7 ELEMENTS"	TEACHER NOTES (and answer key)
<p>1. Introduce the CTE lesson.</p> <p>Today's topic is about gear ratios as it relates to rear axles or final drives.</p> <p>What do you already know about the purpose of a rear axle?</p> <p>What different gears can you think of, and where are they found.</p> <p>Here is a quick example in this video to get a basic understanding of how the gears in the axle or final drive work together.</p>	<p>Point to the display of a rear axle assembly available.</p> <p>Most students might know what a rear axle assembly is used for in vehicle. They may or may not know its purpose is to transfer power.</p> <p>Students may respond with some example like:</p> <p>Bicycle . . . watches . . .fishing pole...4wheels...Dirt bike/go-cart listen to student's responses.</p> <p>So some of you know more than others so lets try to get us all closer together.</p> <p>Show you tube video1. http://www.youtube.com/watch?v=lp6VHIWfsd4</p>

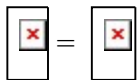
<p>2. Assess students' math awareness as it relates to the CTE lesson.</p> <p>If we need to remove the rear axle to rebuild it or replace it we would need to be sure and get the right parts or part. So we need to know how to determine the gear ratio and so we would need to know how to calculate to find the correct gear ratio?</p> <p>What do you already know about ratios? What does a ratio look like?</p> <p>Lets take a look at another quick video that might help.</p>	<p>Listen to student's responses.</p> <p>Make sure the point is raised that ratios can be written in different ways: 3:1 3 to 1 3/1 or as a word problem.</p> <p>Video 2. http://www.youtube.com/watch?v=ex3PF6Cs4dc&feature=fvsr</p>
<p>3. Work through the math example <i>embedded</i> in the CTE lesson.</p> <p>I have a nice PowerPoint that will help us to get a better understand or ratios.</p>	<p>Start with slide number 6 of the PP. Add comments and answer questions as it relates to the topic.</p> <p>http://www.google.com/search?client=safari&rls=en&q=gears+powerpoint&ie=UTF-8&oe=UTF-8</p> <p>Be sure students see ratios as the comparison of the number of teeth on the driven gear to the number of teeth on the drive gear. If the gear ratio of A to B is 2:1 gear A has half as many teeth as gear B.</p>

<p>4. Work through <i>related, contextual</i> math-in-CTE examples.</p> <p>Let's think about some related examples of ratios that we may find around the shop or in an automotive related setting.</p> <p>Mixing gas to oil for a 2-cycle engine. 20:1 40:1 50:1</p> <p>Steering gear or Box ratio. 2:1 3.5:1 6:1</p> <p>What do these numbers represent?</p>	<p>Discuss with students the relationship of ratios in these other area's: Fuel mixture, Steering.</p> <p>Have some props: 2-cycle motor oil, steering box and or steering rack.</p> <p>Let students respond.</p>
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5. Work through *traditional math examples.*

Here in automotive tech class we worked with gear ratios. There are many examples of ratio outside of our automotive classroom. Often, ratios are used in a proportion— where two ratios are determined to be equal. For example if gear A has 60 teeth and gear B has 20 teeth, what is the ratio of teeth on A to teeth on B? Would that be equal to another gear C that has 30 teeth and gear D has 10 teeth?

We could write that like this:



The diagram shows two rectangular boxes, one on the left and one on the right, separated by an equals sign. Each box contains a small red 'x' in the center, representing a fraction or a value.

If you simplify both fractions you will see that they are both equal.

Please complete the worksheet on ratios and proportions to practice these skills

Answer is YES!

Hand out work sheet AT-13 -WS

Answers to AT-13-WS

$$3 \times 35 = 5 \times 21$$

105=105 yes this is a proportion.

$$4 \times 18 = 20 \times 3$$

72=60 NO – this is not a proportion

$$2 \times 40 = 16 \times 5$$

80= 90 – NO this is not a proportion

Challenge:

$$6 \times 25 = 15 \times n$$

$$150 = 15n$$

$$150/15 = 15n/15$$

$$10 = n$$

10 will make this a proportion.

6. Students demonstrate their understanding

Discuss these ideas with students:

To find the axle ratio, find the gear ratio of the *ring gear* compared to the pinion gear.

Ask: The pinion gear has 12 teeth and the ring gear has 42 teeth. What is the axle ratio?

Ask: if the pinion gear has 14 teeth and the ring gear has 49 teeth, find the differential ratio.

Let's check out a final video that give a better visual understanding of how this plays out on the vehicle. Afterwards you can try this same thing.

Show on board the proper way to set up the ratio problem. Keeping in mind that placement of the numbers if not correct changes the value and also changes the gear ratio.

Ring gear : pinion gear

Answer: 42:12 or written in simplest form, 3.5 : 1

Answer: 49:14 or written in simplest form 3.5:1

For the students with more advanced math skills, we will do this activity.

Using a white board:

Have student work out some math problems relating to mixing oil and gas.

20:1 40:1 fuel mixture

Have students determine steering gear ratios from display models and come up with different ratios of possible gear sets.

Steering gear ratio 3.5:1 6:1

Video 3. http://www.youtube.com/watch?v=i_Enyf67KTs

Have student try this on Display assembly or shop vehicle to demonstrate basic understanding in determining gear ratio.

7. Formal assessment.

Student will remove differential cover of a display assembly or shop vehicle and calculate the gear ratio and verify they finding with manufacturers vehicle specific specification. Their findings must match with the manufactures designation for that vehicle.

Based on your findings, does this ratio lend itself to fuel economy or vehicle performance?

Rate student's competency:

0 - No exposure

Complete training required; No information or practice

Students will access vehicle specific information as your shop provides.

They could also call dealerships direct.

Some prior knowledge of V.I.N.#'s will also enhance the part of the lesson. Or as jump off point to a V.I.N.# lesson and or other related lessons..

Depending on their gear ratio numbers, the higher the ratio the more performance, the lower the ratio, the more economy.

provided during the program.

1 - Exposure only

Additional training required; General information provided with no practice time; close supervision needed.

2 - Limited practice

Additional training is required to develop skill; Has practiced job during training program.

3 - Moderately skilled

Limited additional training may be required; Has performed job independently during training program.

4 – Skilled

No additional training needed; Can perform job independently.

Student signature: _____ **Date:**

Instructor signature: _____ **Date:**

NOTES: