Introduction: Start Your Engines! (10 mins)

Today, we're merging the thrill of RC cars with the power of math! Building and tuning an RC car involves a lot of numbers – from figuring out the best gear ratios for speed or torque, calculating how fast your scaled-down car would be in real life, to budgeting for the coolest parts. We'll use arithmetic concepts like ratios, proportions, percentages, and unit conversions to solve real problems you'd encounter when building or modifying an RC car.

Quick Review: Remember what a ratio is? (Comparing two quantities). How about a percentage? (A part out of 100). We'll use these tools extensively today!

Activity 1: Gear Up! Ratios in Action (15 mins)

The relationship between the pinion gear (on the motor) and the spur gear (connected to the wheels) determines how fast your car can go versus how much power (torque) it has for acceleration and climbing. This is called the Gear Ratio.

Formula: Gear Ratio = Number of Teeth on Spur Gear / Number of Teeth on Pinion Gear

Example: A car has a spur gear with 60 teeth and a pinion gear with 20 teeth. The gear ratio is 60 / 20 = 3. This is often written as 3:1.

- A *lower* gear ratio number (e.g., 2.5:1) generally means higher top speed but less torque.
- A *higher* gear ratio number (e.g., 4:1) generally means lower top speed but more torque.

Your Turn: Calculate the gear ratios for the following combinations:

1. Spur: 55 teeth, Pinion: 25 teeth
2. Spur: 70 teeth, Pinion: 15 teeth
3. Which of the above combinations would likely provide more speed? Which would provide more torque?

Activity 2: How Fast is Fast? Scale Speed (15 mins)

RC cars are scale models, often 1/10th or 1/8th the size of a real car. Their speed needs to be considered in scale.

Concept: If a 1/10th scale car travels at 30 mph, how fast would that be if it were a full-size car?

Calculation (Proportion): Scale Speed = Actual Speed x Scale Factor

Example: For a 1/10 scale car going 30 mph: Scale Speed = 30 mph * 10 = 300 mph. That's super fast!

Unit Conversion Bonus: Let's convert 30 mph to feet per second (fps). (1 mile = 5280 feet, 1 hour = 3600 seconds)

30 miles/hour * (5280 feet / 1 mile) * (1 hour / 3600 seconds) = (30 * 5280) / 3600 feet/second = 44 fps.

Your Turn:

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1. A 1/8 scale RC truck clocks in at 40 mph. What is its scale speed?
2. Convert 40 mph to feet per second.

Activity 3: Powering Up - Battery Life & Cost (20 mins)

Batteries have capacity ratings (like mAh - milliamp hours) and motors draw current (Amps). We can estimate run time.

Concept: Run Time (in hours) ≈ Battery Capacity (in Ah) / Motor Draw (in Amps)

Unit Conversion: 1000 mAh = 1 Ah (Amp hour)

Example: A battery is rated 5000 mAh, and the motor draws 25 Amps under load.

1. Convert capacity: 5000 mAh / 1000 = 5 Ah
2. Estimate Run Time: 5 Ah / 25 A = 0.2 hours
3. Convert to minutes: 0.2 hours * 60 minutes/hour = 12 minutes

Budgeting with Percentages: Let's say you want to buy this 5000 mAh battery online. It costs $60, but there's a 15% off sale! Sales tax in your area is 7%.

1. Discount Amount: $60 * 15% = $60 * 0.15 = $9.00
2. Sale Price: $60 - $9.00 = $51.00
3. Tax Amount: $51.00 * 7% = $51.00 * 0.07 = $3.57
4. Final Cost: $51.00 + $3.57 = $54.57

Your Turn:

1. Calculate the estimated run time in minutes for a 7200 mAh battery with a motor system drawing 30 Amps.
2. You want to buy a new motor costing $85. You find a coupon for 10% off. Calculate the final price if sales tax is 6.5%.

Conclusion & Checkpoint (10 mins)

Great job! You've used ratios to compare gears, proportions for scale speed, unit conversions for battery life and speed, and percentages for budgeting. These are all essential math skills used in the real world, especially in hobbies like RC cars.

Final Challenge: Imagine you change your pinion gear from 20 teeth to 25 teeth (keeping the spur gear at 60 teeth).

1. Calculate the new gear ratio.
2. Did this change likely increase or decrease the car's top speed?
3. If the new motor/gear setup draws 10% more current, how would that affect the run time of the 5000 mAh battery (originally 12 minutes)? Calculate the new estimated run time.

Discuss your answers and any questions you have.

Extension (Optional)

Research different RC motor types (brushed vs. brushless) and KV ratings. How does the KV rating relate to speed and voltage? Explore how tire diameter affects overall speed calculations.