Name: ____________________
Period: ____________________

UNIT: AUTONOMOUS VEHICLE

ACT-BASED SCIENCE: ANALYZING SENSOR DATA FOR PERFORMANCE OPTIMIZATION

Here are **ACT-aligned science activities** for the **Robotic Car Kit** that help students apply real-world skills in interpreting sensor functions, analyzing speed and distance data, evaluating ratio and proportion adjustments, and interpreting experimental results related to motion paths, navigation efficiency, and acceleration patterns.

OBJECTIVE:

Students will collect and analyze data on robotic car navigation accuracy.

MATERIALS NEEDED:

- Notebook
- Robotic car
- Measuring tools

STUDENT DIRECTIONS:

Goal:
Students will collect, compare, and analyze navigation data from robotic car tests under different sensor settings to optimize performance and accuracy.

Step 1: Prepare the Navigation Track

1. Use tape or printed paper to create a **defined path** for the robotic car (e.g., a U-shaped or S-curve route with corners and straight segments).
2. Mark **waypoints** or reference points along the path (e.g., every 20 cm) so students can track when and where the car deviates.

Step 2: Program the Car with Baseline Settings

1. Load a **basic navigation program** onto the robotic car, ensuring it uses onboard sensors (e.g., line-following or distance sensors) to guide movement.
2. Note the **default sensor threshold values** used (e.g., light sensitivity level, detection range).

3. Run the car along the track **three times** and record the results for each run.

Step 3: Record Movement Paths and Deviations

1. As the car travels, students observe and record:
   - **Actual path followed** (drawn or described on a diagram)
   - **Waypoints where deviations occurred**
   - **Estimated deviation distance** (how far off-path the car went)
   - **Completion time** for each run
2. Data should be recorded in a structured format like this:

Trial	Sensor Setting	Completion Time (s)	Deviation at Point A (cm)	Deviation at Point B (cm)	Notes
1	Default	15.2	4	7	Drifted on turns
2	Default	14.8	2	6	Slight improvement
3	Default	15.0	3	6.5	Consistent pattern

Step 4: Adjust Variables and Repeat

1. Choose **one variable to adjust**—such as:
   - Increasing or decreasing sensor threshold
   - Changing motor speed
   - Modifying turning radius or braking delay
2. Rerun the robotic car **three times with new settings**.
3. Record the same metrics in the data table.
4. Optionally, test **multiple sensor settings** to compare performance.

Step 5: Analyze and Interpret the Data

After all trials:

1. Calculate the **average deviation** and **average time** for each set of sensor settings.
2. Discuss:
   - Which setting yielded the **least deviation** from the path?
   - Did any changes improve or worsen performance?
   - What might explain inconsistencies across trials?
3. Create a **graph or chart** comparing performance across settings:
   - X-axis: Sensor Settings or Trial Type
   - Y-axis: Average Deviation or Time

Reflection & Application
Students respond to these prompts:

- What adjustments most significantly improved performance?
- Why is it important to test one variable at a time?
- How do real-world engineers use this process in autonomous vehicles?

ACT-STYLE QUESTION:

- What is the best way to improve sensor accuracy in robotic cars?

  A. Increase wheel size
  B. Use higher-resolution sensors
  C. Decrease battery voltage
  D. Add more motors

⚡ Why These Activities and Questions Matter

By engaging in science-based investigations connected to the Robotic Car Kit, students:

✅ Explore real-world scientific concepts such as motion, acceleration, force, and sensor-based navigation.
✅ Practice interpreting data from robotic experiments, including distance-time graphs and sensor feedback.
✅ Strengthen skills in identifying variables, analyzing patterns, evaluating experimental results, and drawing scientific conclusions.

These hands-on, data-driven tasks mirror the ACT Science emphasis on experimental design, data interpretation, and scientific reasoning—preparing students for success on the ACT and in future STEM careers involving robotics, engineering, and technology.