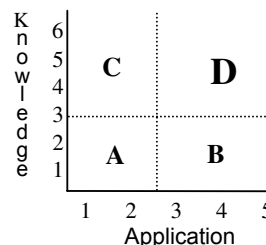




Crash Test Geniuses

Subject(s)
Physics

**Rigor/Relevance
Framework**



Grade Level 11–12

**Instructional
Focus**

Writing: Students write for a variety of purposes and audiences with sophistication and complexity appropriate to the grade level.

Reading: Students read a variety of grade level materials, applying strategies appropriate to various situations.

Number Operation and Concepts: Students use number, number sense, and number relationships in a problem-solving situation. Students communicate the reasoning used in solving these problems.

Algebraic Concepts and Relationships: Students use algebraic methods to investigate, model, and interpret patterns and functions involving numbers, shapes, data, and graphs in a problem-solving situation. Students evaluate and communicate the reasoning used in solving these problems.

Basic Concepts and Knowledge: Students develop an understanding of scientific concepts using facts, theories, principles, and models.

Habits of Mind: Students develop habits of mind including curiosity, open-mindedness, and persistence.

Communication: Students communicate and apply scientific concepts.

Science in Personal and Social Perspectives: Students apply scientific principles to personal and social issues.

**Student
Learning**

- Students will research a vehicle of their choice, specifically looking at the vital statistics of the vehicle.
- Students will evaluate the performance of the vehicle in specific situations and road conditions.
- Students will review and apply the concepts that have been learned throughout the first semester to the performance of their vehicle in given situations, including linear motion, forces, Newton’s laws, momentum and impulse, work and power, potential and kinetic energy, and efficiency.
- Students will make use of mathematical formulas to calculate specific performance quantities of their vehicle.
- Students will present the information they have gained in a written report.
- Students will prepare a Vital Statistics Data Sheet to be given to all other groups to help in preparation of their advertising campaign.
- The group will create a persuasive advertisement highlighting several of the calculations they have made regarding their vehicle.
- Students will critique other vehicles in the same class to compare and contrast performance capabilities to their own vehicle.

**Performance
Task**

Overview
The focus of this activity is to have students review and apply many of the physics concepts (mechanics) they have learned during the physics course. They will accomplish this by choosing a motorized vehicle (car, truck, motorcycle) that is currently in production, getting the specifications of that vehicle (from

Performance Task
(con't)

dealership/Internet), and using those specifications to determine how that vehicle will perform in specific circumstances. To determine performance, students will have to use their knowledge of physics to calculate several quantities (e.g., maximum acceleration, potential energy, power, etc.). Students will then have to communicate their findings in a written report and an advertisement (video, poster, radio announcement) for the vehicle, which highlights and discusses a few of the quantities that were calculated. Students will have 2 weeks to complete this project.

Description

1. Students will form groups of 2–3 students and choose a new model car, truck, or motorcycle to research.
2. They will then research their vehicle by using the Internet or going to a dealership to get the vital statistics about the vehicle.
3. Next the students will be given a set of scenarios that their vehicle will have to perform in, and the group members will be required to calculate specific quantities that indicate how well their vehicle would perform in each situation.
4. Once all calculations are completed, students will create a data sheet of their results to be shared with other groups who are researching vehicles in the same class.
5. Students will write a report that details how the vehicle performed in each scenario using their calculations as evidence for their conclusions.
6. Students will use their data sheets to create an advertisement for their vehicle that highlights the performance of the vehicle overall or in a specific situation. The advertising strategy should argue the virtues of their vehicle over those chosen by the other groups. This can be a poster, a TV commercial, or a radio announcement and will be presented to the class.

Assisting English Language Learners

Using tables to gather and present data might be difficult for English Language Learners who are not accustomed to this method of organizing information. Web sites for car buyers such as edmunds.com offer detailed specifications charts for dimensions and performance data. These would be good models for students' data sheets. Direct students to these charts and help them use strategies for reading charts and tables:

- Read the title, the column headings, and the row headings to learn the type of information presented.
- Read down the far left column first to determine how the table is organized.
- Determine the meaning of abbreviations or symbols used.
- Determine the timeframe of the table (if relevant).
- To find specific information you are looking for, read down the left column until you come to a description of your data; then read across to the column that contains the specific information you need.
- Analyze the patterns you see in the table and the differences from one column to the next.

Essential Skills

- E1 Apply in writing the rules and conventions of grammar, usage, punctuation, paragraphing, and spelling.
 - E4 Use resources (dictionary, grammar books, thesaurus, online references, etc.) as needed to edit.
 - E7 Research information from a variety of sources and draft a well-organized, accurate, and informative report or essay that engages an audience and addresses its needs
 - E9 Organize supporting detail in logical and convincing patterns that focus on audience and purpose
 - E14 Write clear and concise directions or procedures.
 - M7 Simplify and solve algebraic equations by identifying and using the correct order of operations and techniques necessary to carry out the solution.
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Essential Skills

(con't)

- S61 Understand and apply kinematics (i.e., the mathematical methods of describing motion, including velocity, acceleration, and displacement, without regard to the forces that produce it) to solve problems.
- S17 Investigate and apply Newton's three laws of motion to determine the relationships between the forces acting on a body and the resulting motion of the body.
- S63 Understand and apply statics (the relation between forces acting on an object at rest) and dynamics (the relation between the forces acting on an object and the resulting motion) to solve problems.
- S21A Compare and investigate various types of energy (e.g., heat, light, electromagnetic, nuclear, internal, wave, potential vs. kinetic) and energy transfer and know how to apply measurements of energy.
- S39A Understand and apply the concepts of work and power and how they relate to energy.

Submitted by: Sean Duncan, Galt High School

Scoring Guide

| | 0 | 1 | 2 | 3 |
|--|--|--|---|--|
| Vital statistics (7) | | | | |
| New vehicle | Did not choose a new vehicle | Chose a new vehicle | | |
| All stats found | Did not find any vital statistics | Found only a few vital statistics | Found most vital statistics | Found all vital statistics |
| Documentation | No documentation | Some information documented | Most information documented | All information documented |
| Totals | | | | |
| Scenarios/ Calculations (10) | | | | |
| Complete | No calculations/scenarios complete | Some calculations/scenarios complete | All calculations/scenarios complete | |
| Correct | No calculations done correctly | Some calculations done correctly | Most calculations done correctly | All calculations done correctly |
| Work Shown | No work shown | Some work shown | Most work shown | All work shown |
| Significant Digits | Significant digits not used in answers | Significant digits used in answers | | |
| Units | Units not shown in answers | Units shown in answers | | |
| Totals | | | | |
| Written Report (15) | | | | |
| Description of each Scenario | Scenarios not described | Some scenarios described | All scenarios described | |
| Calculations Included | No calculations included in paper | Some calculations included in paper | All calculations included in paper | |
| Conclusions about performance in scenario | No conclusions made about vehicle's performance in scenarios | Some conclusions missing, or conclusions do not follow from data | Conclusions follow from data but there are some flaws in rationale | Conclusions follow strongly from data |
| Supporting statements using calculations | No information/data given to support conclusions | Information/data given is not complete or inappropriate | Information/data given supports conclusions but there are some flaws in rationale | Information/data given strongly supports conclusions |
| Overall all statement about performance | No statement made about vehicle's overall performance | Statement about overall performance is incomplete or inappropriate | Statement about overall performance is accurate and follows strongly from data | |
| Supporting statements using calculations | No information/data given to support statement about overall performance | Information/data given is not complete or is inappropriate | Information/data given supports statement but there are some flaws in rationale | Information/data given strongly supports statement |
| Totals | | | | |

| Advertisement (15) | | | | |
|--|--|---|--|--|
| Vehicle Identification Information | Information about vehicle's identity is not given | Some information about vehicle's identity is missing | All information about vehicle's identity is present | |
| Image of vehicle | No image of vehicle | Image of vehicle present | | |
| Originality/ Creativity/ Effort | Little to no effort is put into the advertisement | Little effort is shown; or, creativity is lacking | Effort is obvious; some creativity shown | Advertisement is truly original/ creative |
| Highlights positive performance marks | Ad does not highlight the areas where the vehicle performed well | Ad highlights some areas where vehicle performed well | Ad highlights most areas where vehicle performed well | Ad highlights all areas where vehicle performed well |
| Gives supporting data | Ad provides no supporting data | Ad has little or inappropriate supporting data | Ad has supporting data but is not clear in showing data | Ad clearly shows supporting data |
| Provides accurate information without distracting from sellability of vehicle | Ad's information is not accurate | Ad's information has flaws or distracts from the value of the vehicle | Ad's information is accurate, but distracts slightly from value of vehicle | Ad's information is accurate and enhances the value of the vehicle |
| Totals | | | | |

| | Raw Score | Multiplier | Scaled Score |
|-------------------------------------|------------------|-------------------|---------------------|
| Vital Statistics (7) | | x 2 | |
| Scenarios/ Calculations (10) | | x 3 | |
| Written Report (15) | | x 2 | |
| Advertisement (15) | | x 2 | |
| | | | |
| Total Score (104) | | | |
| Grade | | | |