



Gold Seal:

Copernicus Education Gateway

<b>Author(s):</b> Thomas Venzio			<b>Lesson Title:</b> Highway Safety Design			
<b>Grade Span</b>			<b>ICLE Application Model</b>			
K-4	5-8	9-12 XX	A	B	C	D XX

**Instructional Focus:**

**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.

**Science as Inquiry**

Students demonstrate knowledge and skills necessary to perform scientific inquiry.

**Science in Personal and Social Perspectives**

Students apply scientific principles to personal and social issues.

**Writing**

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

**Performance Task**

The lesson will begin with a review of Newton's Second Law which can be state as  $F=md$ . ( $F$  = Force;  $m$  = mass;  $d$  = deceleration)

Deceleration is the change in velocity over time and can be stated as initial velocity – final velocity/time.

Resulting formula:  $F = m \times \frac{v_i - v_f}{t}$

Calculations will then be done to demonstrate that one way to minimize the force of an accident is to increase the time over which the vehicle goes from its highway speed to a complete stop.

Students would then be asked to identify several highway or automobile design features that address this issue. Answers should include: air bags, bumpers, breakaway light poles and signs, crush zones, impact attenuators

Students could then be challenged to design other devices that they think would help address this issue. Typically, a design report including an explanation and defense would be required along with a drawing or model. The report must include reference to Newton's Law and how it impacts the design.

**ICLE Essential Skills**

Know and apply the principles of scientific inquiry. (*Implicit in this statement are the processes of prediction, estimation, developing hypotheses, drawing conclusions, evaluation, and following ethical principles and professional procedures.*) (Not Ranked s114)

Understand the impact upon society and the environment of scientific and technological discoveries and the contributions of scientists. Understand how society may accept or reject scientific discoveries based upon need or refusal to change. (Not Ranked s116)

Understand and apply statics (i.e., the relation between forces acting on an object at rest) and dynamics (i.e., the relation between the forces acting on an object and the resulting motion). (s84)

Understand **basic algebraic properties** (i.e., commutative:  $ab = ba$ ; associative:  $ab(c) = a(bc)$ ; and distributive:  $a(b+c) = (ab)+(ac)$ ). (m3)

Understand the **use of variables** in expressions such as  $4x$ ,  $x+2$ , and  $2x-1$ , solve for the variable, and know how to

represent expressions such as "twice the number" or "four more than the number" using variables. (m7)

Use addition and multiplication to **simplify an algebraic expression** by identifying the order of operations and techniques necessary to carry out the operations (e.g.,  $5-3(x-2) = 5-3x+6 = 11-3x$ ). (m11)

Present information in well-organized fashion that will be clear to the target audience. (ela 11)

**Scoring Guide:**

**See: Highway Safety Design Scoring Guide**

**Keywords**

<b>English Language Arts</b>	<b>Mathematics</b>	<b>Science</b>
<b>Reading</b>	<b>Algebra Algebraic Operations</b>	<b>Earth Science</b>
<b>Writing Technical Writing</b>	<b>Geometry</b>	<b>Life Science</b>
<b>Communications</b>	<b>Statistics</b>	<b>Chemistry</b>
<b>Literature</b>	<b>Calculus</b>	<b>Physics Newton's Law Motion</b>
<b>Other</b>	<b>Trigonometry</b>	<b>Other</b>
	<b>Other</b>	

## Scoring Guide

Student(s): \_\_\_\_\_

Score each of the following characteristics on a scale of 4 to 0,

4 = surpasses expectations

3 = high quality performance

2 = satisfactory quality performance

1 = minimum quality performance

0 = does not meet expectations.

Characteristic	Criteria	Score
Apply algebraic operations and mathematical computations	<ul style="list-style-type: none"><li>Accurately calculates Force as it relates to automobile impacts</li></ul>	
Transfer information to highways	<ul style="list-style-type: none"><li>Identifies at least two highway safety features that are effective as a results of Newton's 2<sup>nd</sup> law</li></ul>	
Engineering Design	<ul style="list-style-type: none"><li>Proposes a potential design feature that is plausible</li><li>Design is explains in the context of Newton's 2<sup>nd</sup> Law of Physics</li></ul>	
Written explanation and defense	<ul style="list-style-type: none"><li>The written defense is technically correct in grammar and spelling</li><li>The written defense effectively explains and defends the design</li></ul>	
Drawings/Models	<ul style="list-style-type: none"><li>The drawings/models effectively describes the proposed design feature</li></ul>	
	<b>Total Points</b>	