



UNDERSTANDING CAR CRASHES: IT'S BASIC PHYSICS

## **PENNY FOR YOUR THOUGHTS ON INERTIA**

*IIHS in the Classroom NGSS Standards Alignment*

### **Middle School**

#### **MS-PS2-2**

*Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.*

### **Grades 3-5**

#### **3-PS2-1**

*Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.*

#### **5-PS1-3**

*Make observations and measurements to identify materials based on their properties.*

#### **5-PS2-1**

*Support an argument that the gravitational force exerted by Earth on objects is directed down.*

#### **3-5-ETS1-1**

*Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.*



## MOMENTUM BASHING

IIHS in the Classroom NGSS Standards Alignment

### High School

#### DCI PS2.A

*Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object.*

#### HS-PS2-1

*Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.*

### Middle School

#### MS-PS2-2

*Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.*

### Grades 3-5

#### 5-PS2-1

*Support an argument that the gravitational force exerted by Earth on objects is directed down.*

#### 3-PS2-2

*Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.*

#### 3-PS2-1

*Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.*



## MOMENTUM BASHING 2

### IIHS in the Classroom NGSS Standards Alignment

#### High School

##### HS-PS2-1

Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

#### Middle School

##### MS-PS2-2

Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

##### MS-ETS1-1

Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

#### Grades 3-5

##### 3-5-ETS1-1

Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

##### 3-5-ETS1-2

Generate and compare multiple solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

##### 3-5-ETS1-3

Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

##### 3-PS2-2

Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

##### 3-PS2-1

Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.



## EGG CRASH! DESIGNING A COLLISION SAFETY DEVICE

IIHS in the Classroom NGSS Standards Alignment

### High School

#### HS-PS2-3

*Apply scientific and engineering ideas to design, evaluate and refine a device that minimizes the force on a macroscopic object during a collision.*

#### HS-PS2-1

*Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.*

#### HS-ETS1-2

*Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.*

#### HS-ETS1-3

*Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.*

### Middle School

#### MS-PS2-2

*Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.*

#### MS-ETS1-1

*Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.*

#### MS-ETS1-2

*Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.*

#### MS-ETS1-3

*Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.*

#### MS-ETS1-4

*Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved*



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## EGG CRASH! DESIGNING A COLLISION SAFETY DEVICE

IIHS in the Classroom NGSS Standards Alignment

### Grades 3-5

#### 5-PS2-1

*Support an argument that the gravitational force exerted by Earth on objects is directed down.*

#### 3-5-ETS1-1

*Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.*

#### 3-5-ETS1-2

*Generate and compare multiple solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.*

#### 3-5-ETS1-3

*Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.*



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## **CONSERVATION - IT'S THE LAW!**

*IIHS in the Classroom NGSS Standards Alignment*

### **High School**

#### **HS-PS2-2**

*Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.*

#### **HS-PS3-2**

*Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).*

#### **HS-PS3-3**

*Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*

### **Middle School**

#### **MS-PS3-5**

*Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.*

#### **MS-PS2-2**

*Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.*

### **Grades 3-5**

#### **4-PS3-1**

*Use evidence to construct an explanation relating the speed of an object to the energy of that object.*

#### **4-PS3-3**

*Ask questions and predict outcomes about the changes in energy that occur when objects collide.*



UNDERSTANDING CAR CRASHES: IT'S BASIC PHYSICS

## **BALL OF ENERGY**

*IIHS in the Classroom NGSS Standards Alignment*

### **High School**

#### **HS-PS3-1**

*Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.*

#### **HS-PS3-2**

*Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).*

#### **HS-PS2-2**

*Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.*

### **Middle School**

#### **MS-PS3-5**

*Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.*



## THINK FAST, ACT FAST

### IIHS in the Classroom NGSS Standards Alignment

#### High School

##### HS-PS2-1

Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

##### HS-LS1-2

Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

#### Middle School

##### MS-LS1-8

Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

#### Grades 3-5

##### 3-PS2-1

Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

##### 4-LS1-2

Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.



## **DISTRACTED DRIVING DANGERS**

*IIHS in the Classroom NGSS Standards Alignment*

### **High School**

#### **HS-ETS1-3**

*Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.*

#### **HS-ETS-1**

*Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.*

#### **HS-ETS-2**

*Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.*

### **Middle School**

#### **MS-LS1-8**

*Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.*

#### **MS-ETS1-1**

*Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.*



## STRESSING SILLY PUTTY

IIHS in the Classroom NGSS Standards Alignment

### High School

#### HS-PS2-6

*Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*

#### HS-ETS1-2

*Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.*

### Middle School

#### MS-PS2-2

*Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.*

#### MS-ETS1-3

*Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.*

#### MS-ETS1-4

*Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved*

### Grades 3-5

#### 5-PS1-3

*Make observations and measurements to identify materials based on their properties.*

#### 5-PS1-4

*Conduct an investigation to determine whether the mixing of two or more substances results in new substances.*

#### 5-PS2-1

*Support an argument that the gravitational force exerted by Earth on objects is directed down.*

#### MS-ETS1-3

*Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.*

#### 3-5-ETS1-3

*Plan and carry out in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.*



UNDERSTANDING CAR CRASHES: WHEN PHYSICS MEETS BIOLOGY

## **STRESSING OVER PENCIL PRESSURE**

*IIHS in the Classroom NGSS Standards Alignment*

### **High School**

#### **HS-ETS-2**

*Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.*

### **Middle School**

#### **MS-ETS1-3**

*Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.*



## PAPER CAR CRASH

### IIHS in the Classroom NGSS Standards Alignment

#### High School

##### HS-PS2-1

Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

##### HS-PS2-3

Apply scientific and engineering ideas to design, evaluate and refine a device that minimizes the force on a macroscopic object during a collision.

##### HS-ETS1-2

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

#### Middle School

##### MS-ETS1-1

Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

##### MS-ETS1-2

Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

##### MS-ETS1-3

Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

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Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved

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##### 5-PS2-1

Support an argument that the gravitational force exerted by Earth on objects is directed down.

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