

# MONSTER TRUCKS

TEACHER'S  
ACTIVITY  
GUIDE  
GRADES  
10-12+

UNIT 3

SANCTIONED BY



PRODUCED BY  
CLEARCHANNEL  
EXHIBITIONS

# Introduction

Welcome to *Monster Trucks: The Science of Extreme Machines!* As an educator, you have the Monster task of turning your students on to learning. We hope that this guide, in combination with the Monster Trucks traveling exhibit, helps fuel your students with a drive to learn.

The big beasts that are Monster Trucks exemplify many concepts and principles that are core components of math, physics, and auto technology classes. As a result, this guide provides a focus on three different units, so you can choose the lessons that best meet your classroom needs:

- ☛ **Math and Science Lessons for Grades 4 – 8**
- ☛ **Physics Lessons for Grades 9 – 12**
- ☛ **Auto Technology Lessons for Grades 10 – 14**

All of the lessons in this guide have been designed to complement the amazing *Monster Trucks: The Science of Extreme Machines* traveling exhibit. The lessons are standalone, using inquiry-based and hands-on approaches that enable students to recognize real-world applications of some of the skills and knowledge that are important to your classroom goals. Additionally, many of the lessons include reproducibles for you to use as handouts or on the overhead.

## Units

### **Math and Science Lesson Plans for Grades 4 – 8**

Covering a wide scope of student ages and abilities, this unit offers multiple tracks for you to take. Each lesson offers explicit suggestions on how to make it more or less challenging to better meet your students' needs. The unit is divided into a mathematics track and a physics track — each consisting of three separate lessons.

The math lessons emphasize skills that relate directly to National Council of Teachers of Mathematics standards including: Numbers and Operations, Algebra, Measurement, and Data Measurement and Probability.

The science lessons tie into the Physical Science standard (Content Standard B) of the National Science Education Standards, specifically the standard's emphasis on Motions and Forces, and on Transfer of Energy. They also tie into Content Standard E on Science and Technology.

### **Physics Lesson Plans for Grades 9 – 12**

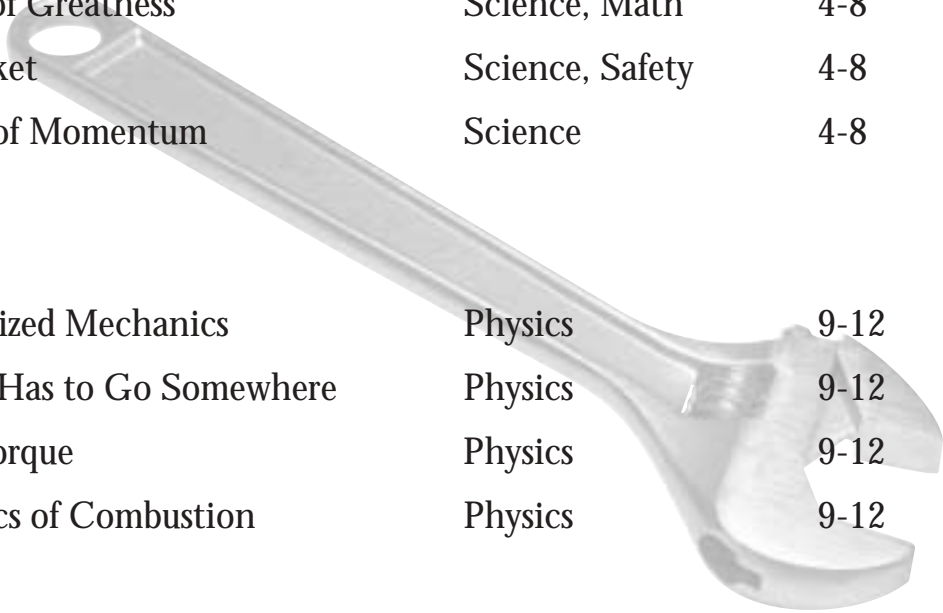
The lessons within this unit build off of many concepts that are important to a physics curriculum. In order to maximize the likelihood of having lessons that would tie into your specific curriculum at the time of the exhibit, the guide presents topics that are introduced at different times within a physics course. However, because the lessons are standalone, you can use them whenever they are most appropriate for your course of study. The lessons tie into the National Science Education Standards' Physical Science (Content Standard B), specifically to the standard's emphasis on chemical reactions, motions and forces, and conservation of energy.

### **Auto Technology Lesson Plans for Grades 10 – 12+**

This unit takes advantage of the similarities and differences between the worlds of an auto shop and a Monster Truck shop. By better understanding those similarities and differences, students will increase their understanding of the two themes at the heart of this section: Engines and Safety. Each of the lessons cites the NATEF Standards for Certification that apply to it, and are appropriate for intro level auto technology classes through a post- high school level program.

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# ENGINE OF THE BEAST

## Objectives:

Using the illustration provided, students will identify the four strokes of an automobile engine. Students will understand and be able to explain how the four strokes, in the appropriate order, will cause an engine to run.

## Curriculum Connection:

This supplemental activity is best used during the study of engine fundamentals. The lesson can serve as an introduction to the concept of the four-stroke engine, or as a review activity. The lesson corresponds to the NATEF Task List, Section I on Engine Repair.

## Class Time:

60 minutes

## Materials Needed:

- ☐ reproducible containing an illustration of the four strokes of an automobile engine
- ☐ demonstration engine where students can examine and view the four strokes demonstrated
- ☐ demonstration vehicle that can easily be prepared for students to see the operation of the four strokes [optional]

## Lesson Steps:

1. **Present students with the illustration of the four strokes, out of order and unlabeled.** Then challenge students to arrange and label them correctly.
2. **Have students share the order of strokes they chose, explaining why they were arranged that way.**
3. **Reinforce student answers that are correct and/or correct their misconceptions.** Be sure to explain the reasons for the strokes being in a certain order, particularly if student answers in **Step 2** do not adequately address the reasons.
4. **Move students to the automotive lab to see the four strokes on an actual engine.** If possible, use an engine in a demonstration vehicle to show how the four strokes actually operate. Be sure to explain to students that the engines used in Monster Trucks utilize this same four-stroke process.
5. **To close the lesson and to help assess students' understanding, ask students to explain the process and function of each of the strokes on the engine you use.** Challenge students to explain what might happen if one of the strokes were to fail—how would this halt the process of the engine? The discussion questions can also serve as effective ways to close the lesson and assess students' understanding.

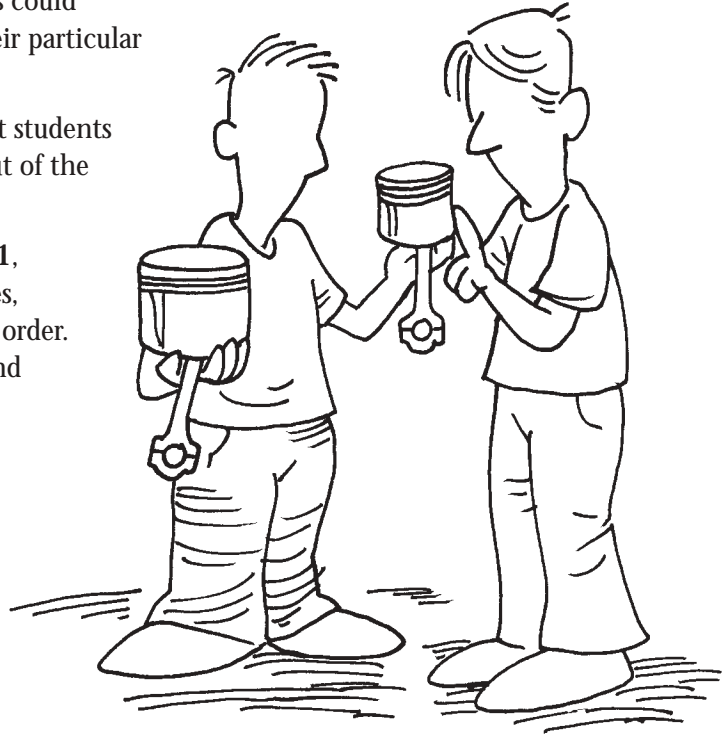
**Important Terms:** camshaft, crankshaft, engine block, exhaust valve, pistons, intake valve, spark plugs, timing chain or belt

## Exhibit Link:

This lesson serves as an informative pre-exhibit activity. The exhibit's Shop area examines the modifications and specifications for Monster Truck engines. Upon visiting the exhibit, students will be able to identify the Monster Truck engine as one that operates in a similar way to the engine in an automobile—i.e., the four strokes are the same. They will notice, however, that modifications have been made to the truck engine to increase horsepower and performance.

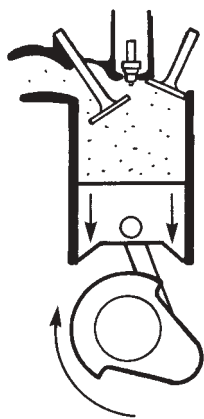
### Academic Extensions/Modifications:

- ☛ Divide the class into four groups and assign each group a stroke from the reproducible to explain or demonstrate. Groups could actually simulate the action taking place by their particular stroke.
- ☛ Remove the spark plugs from the engine so that students can hear the compressed air actually coming out of the spark plug hole.
- ☛ If you worry that students will struggle in **Step 1**, provide them with the labels for the four strokes, challenging students to put them in the proper order. Or, place the four strokes in the proper order and challenge students to label them correctly.

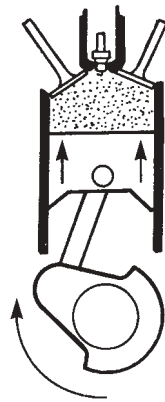


### Potential Discussion Questions:

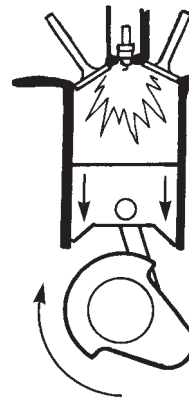
1. Why do the four strokes have to be in this order?
2. What device operates the valves?
3. Which stroke actually causes the crankshaft to turn?
4. Why does a Monster Truck also require four strokes?



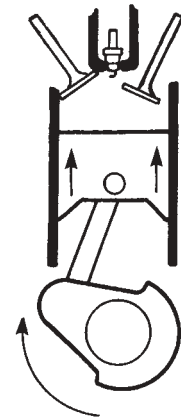
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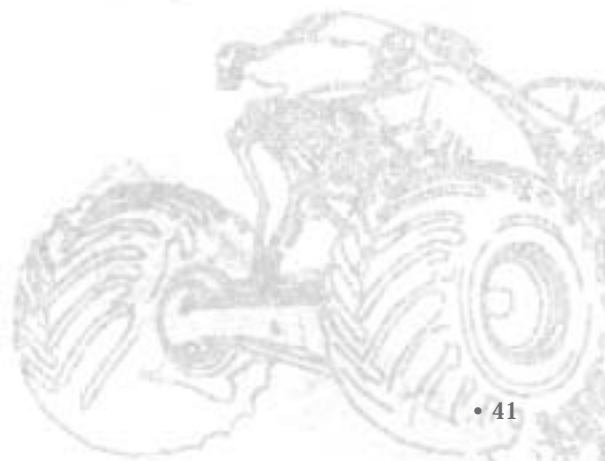
Compression



Power

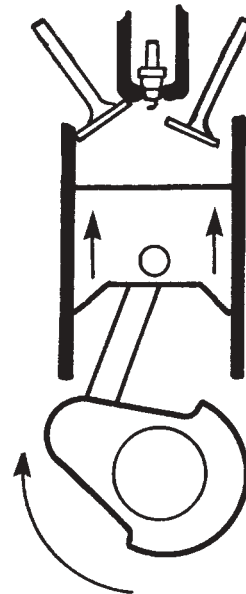
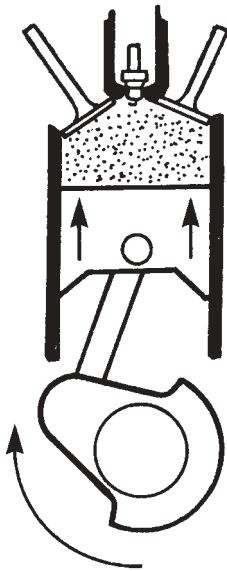
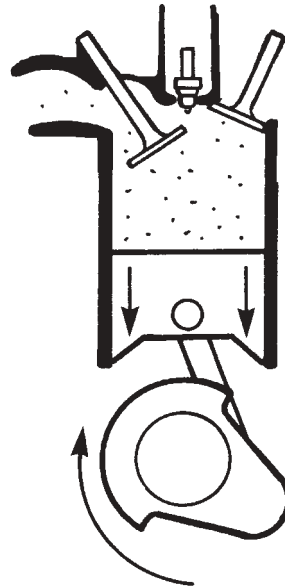
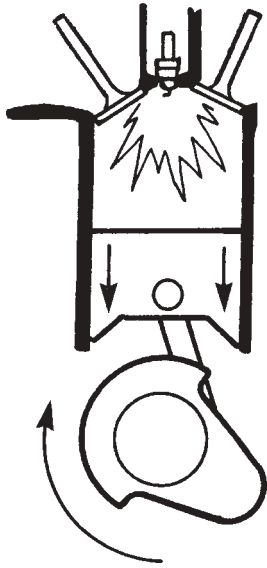


Exhaust



# The Power Behind Engines

Label the strokes below and place them in the correct order.



# • A MONSTER TRUCK ENGINE IN MY CAR?

## Objectives:

Students will learn why it is important to know displacement, and will practice using the formula for calculating it. Students will also examine how to calculate engine size using rulers and precision measuring tools.

## Curriculum Connection

Engine repair and engine performance are key topics that any auto technology class must cover. As part of a study of performance, it is imperative that a technician understands how an engine generates horsepower as it relates to the displacement. In this lesson, students will practice using the formula provided to calculate engine displacement of various motors. This lesson corresponds to the NATEF Task List, Section I on Engine Repair.

## Class Time:

60 minutes

## Materials Needed:

- engine block complete with crankshaft, connecting rods, and pistons
- paper, pencil, ruler, and calculator to calculate engine displacement
- illustration of a Monster Truck engine [optional]
- precision measuring tools, such as telescoping gauge, outside micrometer, bore gauge [optional]

## Lesson Steps:

1. **As a class, explore why it is important to be able to figure out an engine's displacement.** Allow at least a few different students to speculate on why they think it is important. (Some students may already know the answers to the question.) After gathering a few responses, indicate if their answers are correct (or close to being correct). Clarify that knowing an engine's displacement is important because it is the foundation of an engine's power—i.e., it indicates what power an engine starts with. If more power is needed (as is the case with Monster Trucks, for example), then the engine will need to be modified in order to create more horsepower.
2. **Using their knowledge of the four-stroke engine, have students explain how they think that engine displacement is derived.** (If preferable, students could even write short paragraphs on the questions you pose in Step 1 and Step 2.)
3. **Provide students with the formula for calculating engine displacement:**

$$\text{Total displacement} = (\text{Bore}^2) \times (\text{stroke}) \times (0.7854) \times (\text{number of cylinders})$$

(Note that  $.7854 = \pi/4$ )

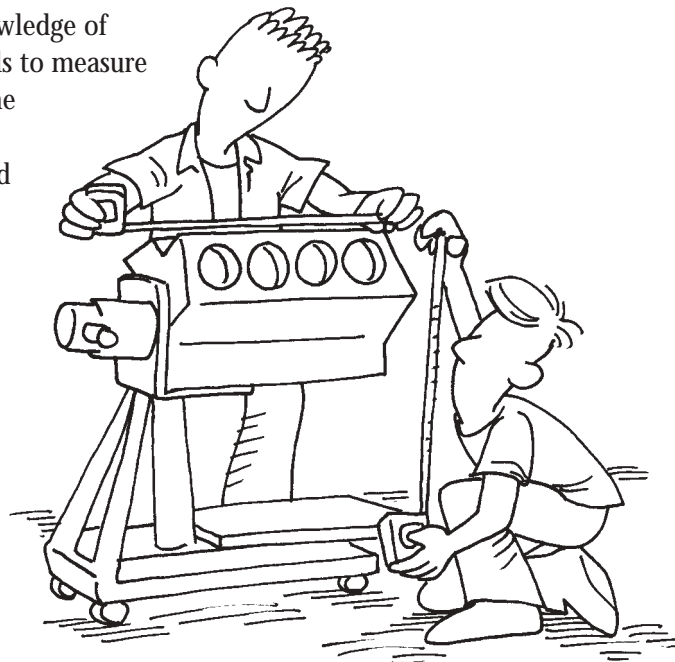
4. **You may want to give students some practice problems on paper before moving to the lab.** The problems can be configured in different ways so that different values are missing. For example, students can work backwards, knowing that an engine's total displacement is 350 cubic inches and that it has 8 cylinders, to determine the diameter of an individual cylinder. Additionally, you can challenge students with problems in which an engine is modified. For example, engines can be "bored out" by increasing each cylinder's diameter by .060 of an inch. Similarly, a problem can contain an increased or decreased engine stroke.

**Important Terms:** BDC, bore, displacement, horsepower, piston stroke, TDC

### Exhibit Link:

This lesson serves as a good pre-exhibit activity. The exhibit Shop area examines the modifications and specifications for Monster Truck engines. Students can apply the formula they learn to figure out the displacement of engines on display in the exhibit.

5. **Move to the classroom lab.** Depending on students' knowledge of measuring tools, use the ruler or precision measuring tools to measure an engine block. Using the ruler will give the students the concept of how engine displacement is derived, but it is important to point out that precision tools should be used in an actual precision measurement for displacement.
6. **Have students record their measurements and return to the classroom and calculate their findings.** Check for understanding and correctness. You may wish to provide the additional sample problems in class or as homework. (Answers: 1) 37.5, 3.638 2) 454 cubic inches, 7.4 liters 3) 4.49 or 4.5



#### Academic Extensions/Modifications:

- ☛ Using diagrams and/or actual measurements taken from the Monster Trucks exhibit, have your students compare the displacement measurements for engines in standard vehicles vs. Monster Trucks.
- ☛ This lesson can also serve as a way to teach students how to use precision measuring tools.
- ☛ If you have several engine blocks available, divide the class into groups and allow students to measure several different engines.
- ☛ Have students convert their cubic inch measurements to liters, and/or cubic centimeters.
- ☛ After learning that the same displacement formula applies to all engines, have students research ways in which people modify engines, e.g., adding horsepower, turbo chargers, etc. They can summarize their findings and report them back to the class.

#### Potential Discussion Questions:

1. Why are different units of measurement, for example, standard and metric, used?
2. How do the displacement values of engines in Monster Trucks compare with those of standard vehicles?
3. How are the engines of Monster Trucks modified?

#### Additional Problems

1. A 4.90 liter V8 Cadillac has a 300 cubic inch engine displacement. What is the displacement of one cylinder? If the bore = 3.623 inches, what is the value of the stroke?
2. A standard 3 1/4 ton GM truck has 8 cylinders. If the cylinders measure 4.25 inches in diameter, and the stroke value is 4 inches. What is the total engine displacement? What is the displacement in liters?
3. Blue Thunder has a 8 cylinders, a 4.25 inch stroke and a displacement of 540.47 cubic inches. What is the bore value?

# SAFETY IS OUR GOAL

## Objectives:

Students will brainstorm safety precautions they feel are necessary when working in an auto shop. After reviewing the rules, students will conduct a mock safety inspection of their shop.

## Curriculum Connection

Automotive safety is embedded in all NATEF tasks and is a required unit that all automotive students must complete in order to be qualified to perform in an automotive lab. Being able to work around an automobile and in an automotive shop safely is one of the most important goals of any automotive student. Some prior knowledge of automotive safety is helpful for this lesson but not required.

## Class Time:

60 minutes

## Materials Needed:

- ☞ General Safety Rules Checklist Starter
- ☞ automotive lab bugged with minor safety problems for students to find during inspection

## Lesson Steps:

*Note:* Prior to beginning this exercise, bug your automotive lab with some minor safety violations. Some violations should be more subtle than others.

1. **Begin by asking students to brainstorm what they think are good safety rules to use in an automotive shop.** List their responses on the board or overhead. Students should provide reasons why the safety rules they list are important.
2. **Distribute the General Safety Rules Checklist Starter to students and identify how many rules they named are on the list.** Make sure that students realize that the checklist is only a partial list of safety rules. Add more rules to the list based on their brainstorm.
3. **Allow students to ask questions about the rules that are listed, making certain that they clearly understand them.** As part of the discussion, ask students if they think that the safety rules apply in auto shops of all kinds. Further, ask them if they think certain shops—e.g., Monster Truck shops, NASCAR shops—likely have additional safety rules that are unique.
4. **Divide students into groups. Instruct students to use their checklists to conduct an inspection of the automotive lab for any safety issues and to make note of what they find.**
5. **Have students return to classroom to share their findings and explain what is needed to correct the problems found.**

**Important Terms:** eye wash station, fire extinguishers, jack stands, Material Safety Data Sheets (MSDS)

## Exhibit Link:

This activity serves as an excellent pre-exhibit lesson. The Monster Truck Safety Lab includes the USHRA safety guidelines, and danger and hazard warnings are posted in the lab. As they view the Monster Truck exhibit, students could note any familiar safety equipment they see being used around the exhibit to protect viewers, and also note any specialty safety equipment or special rules they see specific to the Trucks Shop.

### Academic Extensions/Modifications:

- ☛ Divide students into two groups: one group is assigned to go to the lab and create some minor safety problems, and the other group is charged with finding the safety violations. Challenge the group that initiates the problems to create violations that they think the other group will overlook.
- ☛ Have students create a drawing of a specialty automotive lab—e.g., Monster Truck or NASCAR lab—including the safety equipment they think is needed.
- ☛ If time permits, review specific MSDS you have on hand.

### Potential Discussion Questions:

1. What are some important safety concerns in the automotive lab? What are some of the negative consequences that could result from not having rules in place?
2. What should you do when you find a safety violation in a lab?
3. Why do you think that so many safety rules and concerns are shared in many different kinds of labs?



# General Safety Rules Checklist Starter

Use this checklist to inspect your automotive lab. Be sure to also note any violations you identify which are not included in this list.

P=pass

F= fail

Violations

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- \_\_\_ 1. Always wear safety glasses when working in an automotive shop.
- \_\_\_ 2. Never play around or “horseplay” in an automotive shop. It is extremely dangerous and could hurt or kill someone.
- \_\_\_ 3. Use tools only for what they were designed for; always clean and store them properly.
- \_\_\_ 4. Notify the instructor when a tool is broken or does not seem to operate properly.
- \_\_\_ 5. Notify the instructor immediately if an accident occurs.
- \_\_\_ 6. Obtain your instructor’s permission before using any power tool or lifting device.
- \_\_\_ 7. Keep safety guards on all power tools. Do not remove them for any reason.
- \_\_\_ 8. Maintain electrical cords on power equipment; never use cut or frayed insulation or exposed wires.
- \_\_\_ 9. Place jack stands under a vehicle any time it is jacked up, even if only for a few minutes.
- \_\_\_ 10. Clean up spills immediately and dispose of all waste fluids in a proper container.
- \_\_\_ 11. Ensure that fire extinguishers are always easily accessible and in working condition.
- \_\_\_ 12. Always wear protective clothing and gear to prevent damage to your face, hands, ears, body, and feet.

# A SAFE RIDE ANYWHERE

## Objectives:

Students will identify and understand the active and passive restraint systems on a vehicle. Students will also examine the unibody construction of a car and its built-in safety features.

## Curriculum Connection:

As a supplement to a unit focusing on automotive safety, this lesson examines the standard safety equipment and features provided on a vehicle to protect the driver and passengers in the event of an accident.

## Class Time:

45-60 minutes

## Materials Needed:

- ☞ demonstration vehicle and lift to show unibody construction and to demonstrate safety equipment
- ☞ demonstration items such as a seat belt including shoulder harness, and a deployed air bag

## Lesson Steps:

1. **Begin by showing students the seat belt and air bag that you have acquired.** Ask them for input on how they work. Allow time for discussion. If students share any incorrect information, give other students the opportunity to correct the wrong information. When necessary, reinforce the correct use of the seat belt in order for the air bag to provide protection in the event of an accident.
2. **Follow up the discussion of seat belts and air bags—two of the more obvious safety features—with other safety features on various vehicles.** These may include anything from anti-lock brakes to active head restraints. (Hopefully in the discussion, students mention the body of the vehicle, which you will explore more deeply in the next step.)
3. **Ask students to define “unibody construction” and explain why this type of construction is safer than earlier types of construction.** Guide the discussion so that students understand how unibody construction is relatively lightweight and has built in “crush zones” to help absorb impact in the event of an accident.
4. **Move to the automotive lab and have a demonstration vehicle on a lift so that students may examine how the unibody construction is designed.** Show them the various parts that by design will absorb impact and make the vehicle safer.
5. **After seeing how vehicle manufacturers have built in measures to improve safety, lower the vehicle to reinforce some of the behaviors that individuals can take to maximize their own safety.** Ask for volunteers to get in the vehicle and demonstrate the correct use of seat belts. Students can be in the driver and passenger positions. Have remaining students examine and evaluate whether they are buckled in properly.
6. **Locate where the air bags are in the demonstration vehicle and demonstrate with a student the proper positions for the driver, steering wheel, and passenger to maximize the effect of an air bag should it deploy.** It is also important to review safety precautions to take if work is being done on the vehicle to avoid accidentally deploying the system.
7. **For closure, have students relate the safety features of standard vehicles with those of Monster Trucks.** Ask what special features a Monster Truck must have and what unique dangers Monster Truck drivers face.

**Important Terms:** active restraint, passive restraint, Supplemental Restraint System (SRS), unibody design

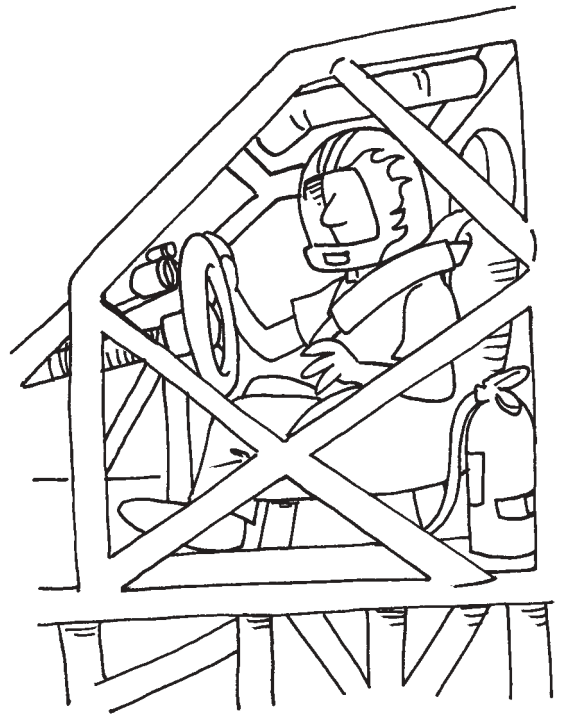
### Exhibit Link:

This lesson is best utilized as a pre-exhibit activity. After examining the safety features of a normal car, students can visit the Safety Lab in the exhibit in order to compare the safety features of a Monster Truck to those of a car.

Though the safety features of Monster Trucks may require some speculation on the part of students, they will still need to show their understanding of the safety of standard vehicles; thus providing you with an engaging way to assess their understanding.

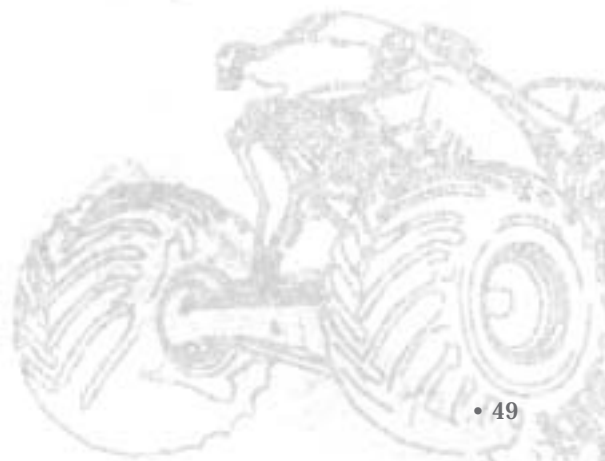
#### Academic Extensions/Modifications:

- ☛ As mentioned in **Step 7**, comparing safety features of Monster Trucks with standard vehicles often results in a deeper understanding of the safety features of a standard vehicle. Have students research the safety components of a Monster Truck and provide a detailed comparison of safety features on standard vehicles and Monster Trucks. Make sure that they also explain the reasons for the specialty safety features on Monster Trucks.
- ☛ This lesson is an excellent opportunity for students to do some statistical research on how safety has improved since the implementation of safety requirements in the production of the automobile. Some available resources could be local law enforcement records, Insurance Audit Information sites, etc. Extending the lesson in this way could also involve skills that the students have learned in mathematics/statistics classes.
- ☛ If possible, you can deploy a driver's air bag to give students an example of what one looks and feels like. Explain the detonating device and show how the air bag deflates after it has been inflated. [There are vent holes placed strategically in the air bag to allow the vapors to escape.]



#### Potential Discussion Questions:

1. What are some ways that the driver is protected in the event of an accident?
2. What are some safety devices on the automobile that you think you would also find in some form on a Monster Truck?
3. What safety equipment do you think the Monster Truck has that an automobile does not have?



# Glossary

**acceleration:** a change in the direction or magnitude (speed) of an object.

**average acceleration:** can be computed with this equation:  $a = (v_f - v_i)/t$ , where “a” is the acceleration, “ $v_i$ ” is the initial speed, “ $v_f$ ” is the final speed, and “t” is the time it takes to change speed.

**active restraint:** a type of safety equipment activated by the vehicle passenger, designed to restrict the movement of drivers and/or passengers. (ex. seat belt, child safety seat restraints)

**adiabatic process:** a thermodynamic process in which no heat is lost or gained. The power stroke in an engine occurs so rapidly that little heat is lost; therefore, the power stroke is considered an adiabatic process.

**angular acceleration:** the change in angular velocity divided by time.

**angular momentum:** the product of the moment of inertia and its angular velocity.

**angular velocity:** for rotating objects, the amount of rotation expressed in radians/time.

**BDC:** the measurement of a piston at the bottom of its travel in the cylinder.

**bore:** the diameter of a cylinder in an engine.

**camshaft:** the component that controls the opening and closing of valves in an engine.

**capacity:** the amount a container or object can hold or contain; e.g., the amount of fuel a Monster Truck’s fuel tank can hold.

**Carnot engine:** an ideal engine in which each process is reversible.

**circumference:** the distance around a circle.

**coefficient of friction:** the ratio of the force of friction to the normal force when one surface is sliding (or attempting to slide) over another surface.

**Combined Gas Law:** expression relating pressure, volume, and temperature before and after an event when the moles of gas remain constant:  $P_1V_1/T_1 = P_2V_2/T_2$ .

**consume:** to take in or use up; burn, as an automobile engine burns fuel to move a vehicle.

**crankshaft:** device that changes the reciprocating motion of the pistons to rotating motion; contains the area where the connecting rods are fastened and also the area where the flywheel and engine drive pulley are connected.

**customary system of measurement:** a measurement system used in the United States, which includes basic units such as feet and gallons.

**dashboard:** the panel under a vehicle’s front windshield, on which an automobile’s fuel gauge and other control instruments display.

**diameter:** a line segment that passes through a circle’s center to connect two points on the circle.

**displacement:** the distance between two points. In auto technology, the volume that a piston displaces in a cylinder as it moves from TDC to BDC.

**distance:** the straight-line measurement between two points.

**engine block:** the metal foundation containing the parts of an internal-combustion engine; includes cylinders, coolant passages, oil passages, etc.

**exhaust valve:** the valve that opens to allow all the vapors inside the cylinder to be removed from the engine on the exhaust stroke.

**eye wash station:** the area in a lab specifically designed for washing any foreign matter from the eyes; a station can be plumbed into the water system or may use separate bottles of saline solution.

**fire extinguisher:** hand-held fire fighting equipment designed with specific chemicals to put out small fires.

**First Law of Thermodynamics:** the change in the internal energy of a system equals the difference between the heat added to the system and work done by the system.

**four-stroke engine:** an internal-combustion engine developed by Nikolaus Otto in 1867. A four-stroke engine works as follows: as a piston moves down, the intake valve(s) opens, allowing a mixture of fuel and air to flow into the cylinder (intake stroke). After the intake valve(s) closes, the piston moves upwards, compressing the mixture and increasing its temperature (compression stroke). If this mixture is ignited, the piston is driven downwards, making the drive shaft rotate (power stroke). Lastly, the piston moves upwards while the exhaust valve(s) opens, allowing exhaust gasses to be pushed out of the cylinder.

**gauge:** a measuring device.

**horsepower:** the measurement of the engine’s ability to perform work.

**intake valve:** valve that opens to allow fuel and air to be drawn into the combustion chamber.

**jack stands:** safety devices designed to be placed under a vehicle that has been jacked up to prevent the vehicle from falling while work is being performed.

**kinematics:** the description of motion in terms of distance, speed, velocity, and acceleration.

**kinetic energy:** the energy an object has due to its motion.

**Law of Conservation of Energy:** states that the total energy in a system both before and after a process is constant.

**Law of Conservation of Momentum:** In an isolated system, if the momenta of two objects are measured before and after colliding, the total momenta will be the same.

**Material Safety Data Sheets (MSDS):** information provided by chemical manufacturers that have instructions on how to protect users and the environment in case of a spill; also contains instructions on how to clean up and dispose of material that has been spilled.

**metric:** the decimal-based measurement system used most often in the United States during scientific pursuits; basic units include meters and liters.

**moment of inertia:** the product of the mass of a rotating object and its radius squared. The exact equation depends on the shape of the object, but for drive shafts or tires, it is given by this equation:  $MR^2/2$  where M is the mass of the rotating object and R is its radius. The moment depends on the mass of the rotating object and on how far from the axis of rotation the mass is. If the mass is close to the axis of rotation, the moment is small. If the mass is far from the axis of rotation, the moment is large.

**momentum:** the product of an object's speed and its mass;  $p = mv$ . (plural: **momenta**)

**net force:** the sum of all the forces acting on an object.

**passive restraint:** a type of safety equipment designed to restrict the movement of drivers and/or passengers; activates automatically to protect the occupant of a vehicle. (ex. air bags, automatic shoulder harness)

**pi:** a ratio of a circle's circumference to its diameter, equal to about 3.14 (or 3).

**piston stroke:** the movement of the piston from the bottom of its travel to the top of its travel.

**piston:** the component in an engine that is driven up and down in the cylinder and is connected to the crankshaft by the connecting rod.

**potential energy:** the energy an object has due to its position.

**projectile motion:** the motion of an object in a gravitational field.

**radius:** a line segment that connects a circle's center to any point on the circle; it is half the size of the diameter.

**rate:** the measure of how fast something is changing; when the distance an object moves is divided by the time it takes to travel that distance, the quotient equals the object's average rate of speed, e.g. feet per second.

**spark plugs:** devices that, upon receiving power, ignite the fuel/air in the combustion chamber causing the piston to move down in the cylinder, and thus causing the crankshaft to turn.

**speed:** the rate of change in an object's position over time (speed = distance/time).

**Supplemental Restraint System (SRS):** restraints designed to help keep drivers and passengers in their respective seats in the event of an accident. (ex. air bags)

**TDC:** the measurement of the piston at the top of its travel in the cylinder.

**timing chain or belt:** a device that coordinates the movement of the crankshaft with the camshaft to ensure that pistons and valves are working together.

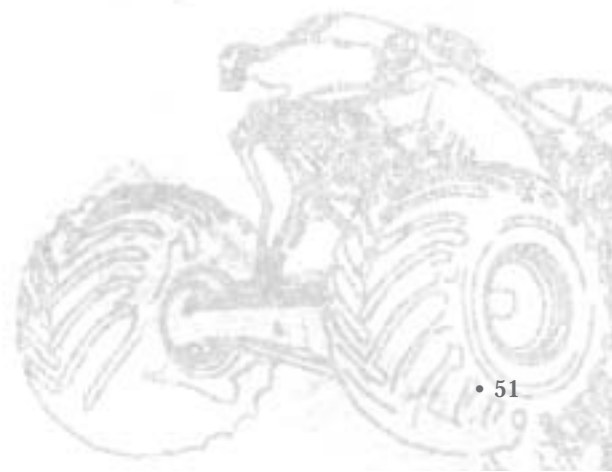
**torque:** a force applied to some point other than the center of an object's mass, causing movement or rotation.

**unibody design:** a chassis design that includes a floor pan and a small sub frame section in the front and rear.

**variable:** a quantity that may have more than one value.

**velocity:** speed in a particular direction. (e.g., 50 mph due north) If an object does not change its direction of motion, then its speed is the same as its velocity.

**work:** the transfer of energy to a body by the application of a force that moves the body in the direction of the force ( $W = Fd$ ).



# Additional Resources and Web Sites

## Teacher References

Giancoli, Douglas. *Physics: Principles with Applications*. 2nd Edition. © 2000-2001 by Prentice Hall Inc.

Halliday, D., Resnick, R., & Walker. *Fundamentals of Physics*. 5<sup>th</sup> Edition. © 1997 by John Wiley & Sons, Inc.

Hewitt, P. *Conceptual Physics*. 8<sup>th</sup> Edition. © 1998 by Benjamin Cummings.

Zitzewitz, P. *Glencoe Physics: Principles and Problems*. © 2002 by Glencoe/McGraw Hill.

Monster Truck Racing by Scott D. Johnston (Capstone Press, 1994)

This book is a clear, concise, and colorful introduction to Monster Truck racing for grades 4-6 students. The author describes the history, science, economics, and sport of Monster Truck racing. The book includes many photographs, a glossary, and a list of additional resources.

## Web Sites

<http://www.getbehindthewheel.com/index.htm>

This web site includes links to the web sites of automotive corporations, whose sites include detailed information about dozens of automobiles, including photographs you might wish to show students when discussing vehicles' relative fuel capacities.

<http://www.its-about-time.com>

Visit this site to learn more about the popular textbook line Active Physics and other supplemental kits available to teach math and science concepts to grades 6-12.

<http://www.monstermania.com>

Find information about upcoming events, Monster Mania news, and links to Monster Truck Home pages here.

<http://monstertruckracing.com>.

Access high-quality photographs of all your favorite trucks, plus read Truck facts and stats.

<http://www.physicsclassroom.com/>

A good resource for learning basic physics concepts and reviewing them in a Physics Tutorial. Also includes practice problems and a multimedia section where students can view physics in action.

<http://www.sciencejoywagon.com/physicszone/>

The Physics Zone presents introductory level, algebra-based physics concepts in a multimedia format that is engaging as well as informative.

<http://www.truckworld.com/index.html>

Read monthly articles written by experts and view the Show and Events section for all the latest results.

<http://ushra.com/#>

Official site of the USHRA, this resource provides current Monster Truck results, a photo gallery, official news and headlines, driver bios and more. A true Monster Truck fan must-see!