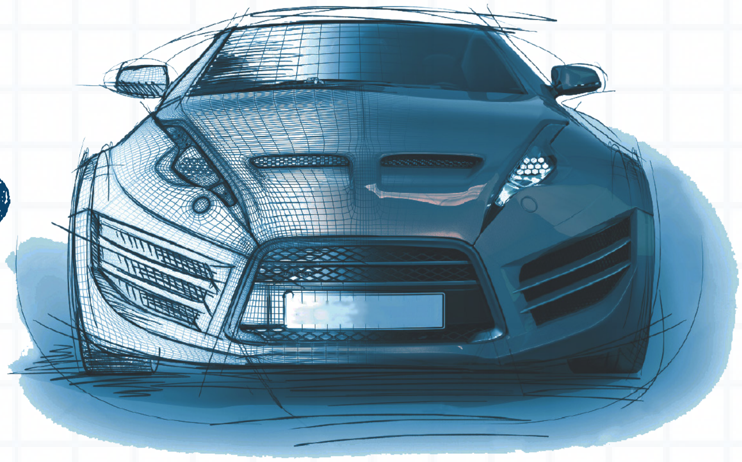
LeMAY
AMERICA'S CAR MUSEUM®

STYLISH SPEED
CURRICULUM GUIDE

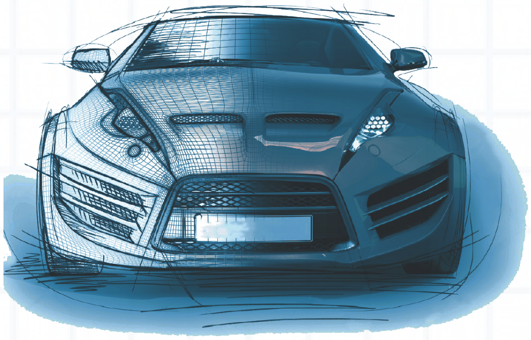


PROGRAM OVERVIEW:
Students will make connections between car design and speed. During a docent-led gallery tour, they will see how car shapes and colors have changed over time and learn how certain car designs reflect our society's history and culture. Students will also hypothesize about the relationship between car shape and aerodynamics. In an optional culminating activity, students will be able to design their own car to take home. Their challenge will be to utilize the design process to create a car that has good aerodynamics and/or appeals to a particular audience.

GUIDING QUESTIONS:
Why are car bodies designed in certain ways? What makes a car aerodynamic? How have car designs changed over time and how are they a reflection of the time period in which they were created?

PROGRAM KEY CONCEPTS:
- Use of shape and color for design purposes
- Chronological order
- Cause and effect
- Compare and contrast
- Center of gravity
- Drag and drifting
- Friction
- Aerodynamics
- Surface area and volume

HOW TO PREPARE FOR YOUR MUSEUM VISIT:
This curriculum guide includes background information, pre- and post-visit lesson plans, a glossary of terms, and additional resources to help enhance your museum experience. Each lesson corresponds to Essential Academic Learning Requirements (EALRs) and Common Core Standards (CCSS). Please modify these lessons as you see appropriate. Feel free to let us know if we can provide you with additional resources to better integrate your field trip into your classroom curriculum.



BACKGROUND INFORMATION

SIGNIFICANCE OF CAR DESIGN

As consumers contemplate their options when buying a car, often the style of the vehicle is just as important as the technology in swaying their decision. While engineers at automotive manufacturing companies consider how a vehicle will perform on the road, designers are tasked with making sure a car stands out from the competition when consumers are searching for a new vehicle. Designers consider things like "what makes a car **look** fast?" and "what design and safety features should be incorporated into the interior of the vehicle to make a family more comfortable?" Automotive designs are often chosen to appeal to specific audiences and cultures. For example, early vehicles, such as the "horseless carriages," were designed to look similar to modes of transportation that already existed. Studying the style and materials used in a car body can reveal much about the growth of science and technology, the desires and fears of everyday people, as well as, the impact of major events throughout history.

SCIENTIFIC FACTORS: When comparing vehicles throughout history, one can see major changes in the overall shape of the car frame, as well as the quality of the materials used in construction. Cars from the 1890s-1920s were generally tall and boxy; several features were separate from the car body including the headlights, hubcaps, trunk, and bumper; and the grill was also quite large to allow for better cooling of the engine. All of these factors led to poor aerodynamics because they increased drag and reduced velocity. In addition, many early cars had a high center of gravity. While tall, thin wheels made it easier to drive through fields or avoid sinking completely in muddy, unpaved roads, they also made it easier to topple over if going fast around a curve. By the 1930s, new technology allowed cars to be built using uni-body construction and metal frames replaced wood frames. Rounded bodies came into style, hub-caps and headlights were connected to the main car body, windshields became curved, and the center of gravity was lowered, allowing wheels to become smaller and wider. Many of these changes provided less resistance for air particles moving around the vehicle and thus increased efficiency.

CULTURAL FACTORS: Historical events, gender stereotypes, and pop culture all influenced the way cars have been designed and advertised. At the beginning of the twentieth century, many people believed that women couldn't or shouldn't drive at all. The cars that were marketed to women, mainly electric cars, contrasted with louder, supposedly more "masculine" gasoline-powered cars. Safety and comfort features were also seen as more appealing to women than men. Car designers tried to appeal to this new market with more options for paint colors, interior features, and even matching accessories. As the Cold War heated up, new "masculine" features could be found on cars that resembled airplanes, guns, missiles, and bullets. Cars continue to be designed and marketed today to represent the desired image of the future car owner while simultaneously being impacted by political, environmental, and economic factors.

POSSIBLE CARS THAT WILL BE HIGHLIGHTED:

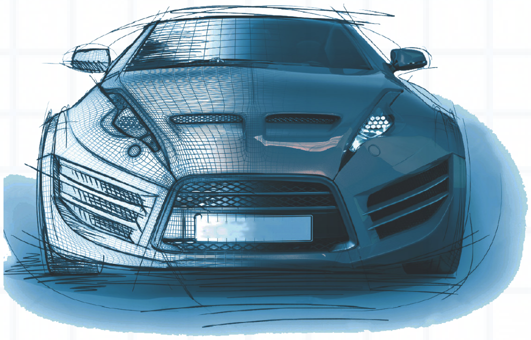
1937 Chrysler Airflow: This is considered the first streamlined car. It was a flop when it debuted in 1934 because it was considered "too modern." However, its innovative aerodynamics left a mark on every car since.

1951 Studebaker: The "bullet nose" on this car is a classic example of military-inspired design.

1959 Chrysler 300 E: The "fins" on this car make it look as though the car is mid-flight.

2012 No. 5 Farmers Insurance Chevrolet: Enumclaw native Kasey Kahne drives this type of car.

Images of these cars can be found near the end of this curriculum guide.



PRE-VISIT LESSON PLAN

DRAG AND DRIFTING

ACTIVITY:

1. Introduce the video as an episode of *The Science of Speed*, which was produced for the National Science Foundation. It explains how science principles are essential to the NASCAR experience. In this clip, race car teams modify their cars to minimize drag, but then it's up to the drivers to find "the drag" and to trust the drivers behind them to literally "bump" them into Victory Lane.
2. Display the video questions on the board and ask students to copy them down or make copies for each student. During the video, they are responsible for finding the answers (which are written in parenthesis on the teacher copy). You may want to stop the video frequently for students to write down answers or to review the concepts discussed.

ANSWER KEY

1. What is drag? (It is resistance to motion due to friction between air molecules and the car.)
2. Why are race cars made without side view mirrors? (It reduces drag.)
3. What effect does taping over grills have on the engine? (The engine heats up.)
4. What are the two longest tracks on the circuit? (Daytona and Talladega)
5. What is drafting? (Student answers may vary. Transcript from video: When two cars get close enough, air flows around them as if they were a single car. This decreases the total amount of drag on the two cars because one car is pushing the air molecules out of the way for both cars. The first car doesn't generate as much of a weight either because the second car is so close behind it. The end result is that the second car gets pulled along with the first car and they both go faster.)

OPTIONAL:

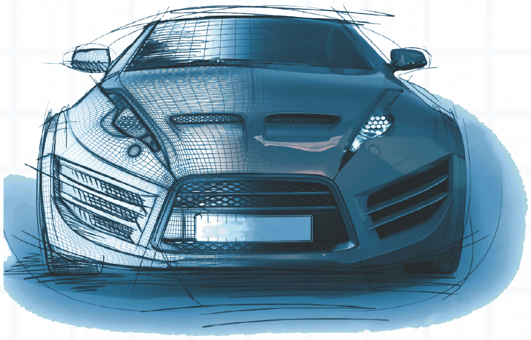
1. Allow students to test drag by placing their hand in front of a fan. Encourage them to notice the difference in pressure if their hand is parallel to the ground (less drag) or perpendicular to the ground (more drag).
2. Show the car images on an overhead projector or make copies for students. Discuss which aspects of each car will reduce or increase drag. Ask students to arrange selected images in order of least to most aerodynamic.

LEARNING OBJECTIVE:

In this lesson, students will watch a short video clip about drag and drafting on superspeedways. Following the video, they will review how shape affects aerodynamics.

MATERIALS:

- Computer and overhead projector
- Drag and Drifting Video: https://www.youtube.com/watch?v=70s1Zycr_x0
- White board and markers
- Pencil and paper
- Optional: Images of cars from LeMay - America's Car Museum
- Optional: Fan
- Optional: Copy of video questions (one per student)



POST-VISIT LESSON PLAN

MUSEUM REFLECTION

ACTIVITY:

Discuss the following questions or have students respond to them as writing prompts:

1. What was your favorite thing about your museum visit?
2. What was your least favorite thing about your museum visit?
3. Which car was your favorite and why?
4. What did you learn about car design from the museum visit?
5. How are cars designed to be aerodynamic?
6. How have car shapes, colors, and styles changed over time?
7. Give an example of a car that is designed to reflect the culture of its time period.

OPTIONAL ART EXTENSION ACTIVITIES

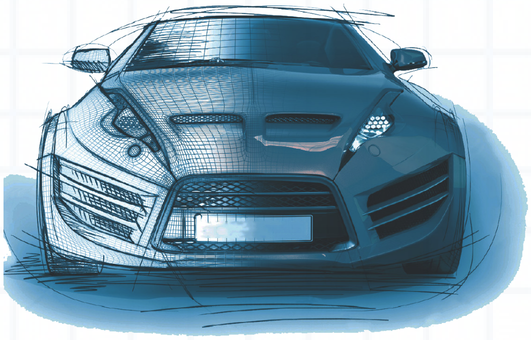
1. Illustrate a "car for the future" and describe the inspiration behind your design. Be specific about how it is an improvement over current vehicles.
2. Just like a real car designer, make a car model by molding clay/play dough over a block of wood. Use car drawing guides for assistance.

LEARNING OBJECTIVE:

In this lesson, students will reflect on what they learned during their Museum visit and review the key concepts from their guided tour.

MATERIALS:

- Lined paper
- Pencils
- White board and markers
- Optional: Wood blocks and modeling clay
- Optional: Drawing paper, pencils, and markers/colored pencils



EXTENSION ACTIVITY

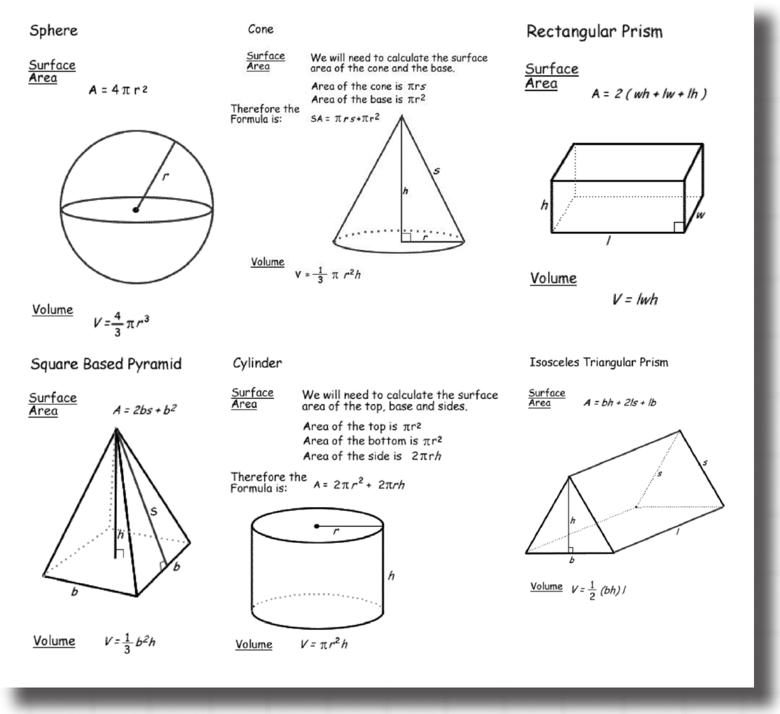
SURFACE AREA AND VOLUME

ACTIVITY:

1. Using recycled materials, allow students to create a custom-designed toy car.

2. Using the "Guide to Surface Area and Volume," students will determine the total surface area and volume of their car. Begin by measuring and computing the surface area of each shape used on the car. Then, add the surface area of each shape used to determine the total surface area. Repeat to determine the total volume. Allow students to compare and contrast their cars.

GUIDE TO SURFACE AREA AND VOLUME

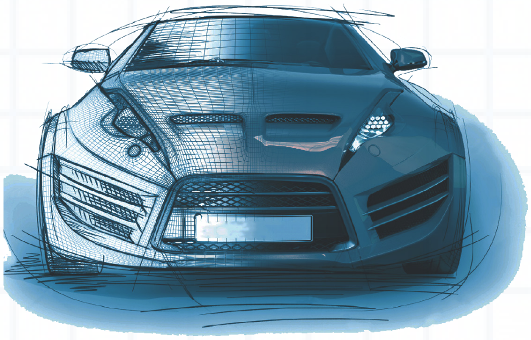


LEARNING OBJECTIVE:

In this lesson, students will determine the surface area and volume of a custom designed toy car.

MATERIALS:

- Recycled materials to make custom-designed toy car
- Ruler/measuring tape
- Paper
- Pencil
- Copies of "Guide to Surface Area and Volume" (one per student)
- Optional: Calculators



GLOSSARY

The following terminology is addressed throughout the museum tour and the pre- and post-visit lesson plans.

2-D or two-dimensional: an object that is flat—having height and width.

3-D or three-dimensional: an object that has height, width, and depth and can be viewed from multiple points of view. For example: cone, sphere, hemisphere, cube, cylinder, rectangular prism, square pyramid, hexagonal prism, and triangular prism.

Acceleration: the measure of how much the velocity of an object changes over a period of time.

Aerodynamic: shaped so that air flows smoothly over and around an object; cars are often designed with rounded edges to reduce wind drag and increase fuel efficiency.

Airflow: the pattern of air movement around a moving vehicle. Airflow is invisible, unless studied under special conditions in a wind tunnel.

Area: measurement of surface.

Automobile: a passenger vehicle designed for use on ordinary roads and typically having four wheels and a gasoline or diesel internal-combustion engine. “Auto” means “self”, “mobile” means “moving.”

Axle: the pin, bar, shaft, or the like, on which or by means of which a wheel or pair of wheels rotates.

Battery: supplies the initial electrical power that starts the engine. It is made up of two lead plates plus a mixture of acid and water. This combination creates electricity that triggers the starter motor.

Biofuel: a type of fuel, made without petroleum (such as sugar cane and vegetable oil), that can be used in an ordinary internal combustion engine.

Car: a motor vehicle with four wheels; usually propelled by an internal combustion engine.

Centripetal Force: bends motion around into a curve.

Center of Gravity: the point where the weight of an object appears to be concentrated, usually near its middle. Cars with a high center of gravity are more likely to topple over when they go around corners.

Characteristics: a feature that helps to identify or describe an object.

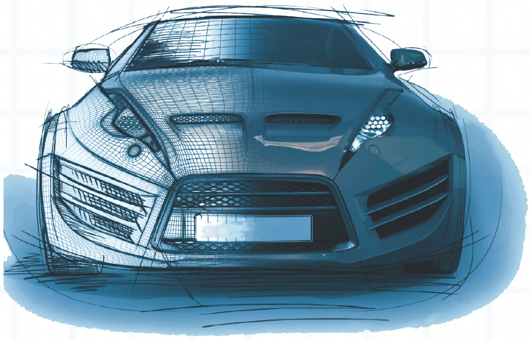
Chronological: in order of time or occurrence.

Classify: to organize objects based on similar or differing characteristics.

Color: what the eye sees when a wavelength of light is reflected from a surface.

Distance: the amount of space between two points.

Design: a plan for an object or work of art.



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Down Force: air pushing down on an object as it moves forward; opposite of lift.

Drafting: a method of passing in which one car follows another closely; because the leading car blocks the wind, the car behind it can get up enough speed to pass.

Drag: is resistance to motion due to friction between air molecules and the car.

Efficiency: the fraction of the energy that a machine uses effectively compared with how much is put in. A typical gasoline engine is 30% efficient, so it uses 30% of the energy in the gasoline to move the car forward and wastes the other 70%, mostly as heat.

Electric Motor: a machine that uses electricity and magnetism to power an axle.

Emphasis: use of contrasts (color, size, shapes) to place greater attention on specific parts of artwork.

Energy: a source of usable power, such as petroleum or coal; usable heat or power; the capacity of a physical system to do work. Living systems (plants and animals) also need energy to function; ability of a system to do work.

Engine: a machine that turns energy into mechanical force or motion.

Force: push or pull that gives energy to an object, causing it to start moving, stop moving, or change its motion; a force is that can cause an object with mass to accelerate.

Form: a three-dimensional object that has height, width and depth.

Fraction: a part of a whole.

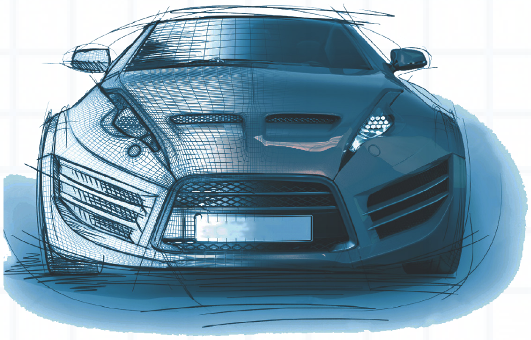
Friction: a force that is trying to stop the motion of an object; the resistance encountered when one body is moved in contact with another; surface resistance to relative motion; observed when an object sliding or rolling.

Fuel: something consumed to produce energy. For example, a material such as wood, coal, gas, or oil burned to produce heat or power. Animals use food as fuel. Plants use energy from the sun to complete their energy process.

Fuel Cell: an electrical device powered by fuel from a tank that makes energy through a chemical reaction (similar to large battery).

Gasoline: a volatile (evaporates easily) mixture of flammable liquid hydrocarbons that mostly comes from crude petroleum and used as a fuel for internal-combustion engines.

Gravity: the force of attraction between all masses in the universe; especially the attraction of the Earth's mass for bodies near its surface; the natural force of attraction exerted by a celestial body, such as Earth, upon objects at or near its surface, tending to draw them toward the center of the body.



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Heat: a form of energy released by atoms and molecules moving around randomly.

Horsepower: a measurement of the amount of power a car engine can produce. In metric units, 1 horsepower = 746 watts- roughly the power produced by twelve 60-watt light bulbs.

Hybrid car: cars with two sources of energy: an ordinary gasoline engine, powered by a fuel tank, and an electric motor, powered by batteries.

Inclined Plane: slanted surface used to raise an object.

Inertia: tendency of objects to remain in motion or stay at rest unless acted upon by an unbalanced force.

Integer: a number expressible in the form of a or –a for some whole number a.

Kinetic Energy: the energy that a moving object has due to its motion; energy of motion.

Kinetic Friction: friction that resists motion of an object that's already in motion.

Load: something taken up and carried.

Machine: any device that transmits or modifies power, forces, or motion to do work.

Mass: the amount of something there is (amount of matter in an object).

Momentum: tendency of a moving object to keep moving; mass times its velocity.

Motion: change in the relative position of the parts of anything; action of a machine with respect to the relative movement of its parts; the act or process of moving from one place to another.

Oil: refined or crude petroleum; motor oil is used to lubricate an internal combustion engine.

Overtaking: passing.

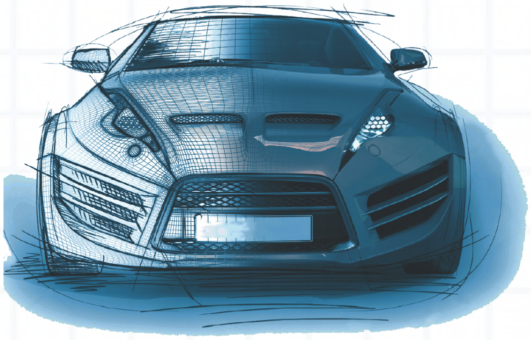
Pattern: repeating sequence of lines, shapes, or colors.

Petroleum: a thick, flammable, yellow-to-black mixture of gaseous, liquid, and solid hydrocarbons that occurs naturally beneath the Earth's surface.

Pi ("π"): mathematical constant that is the ratio of a circle's circumference to its diameter; is approximately equal to 3.14159.

Potential Energy: energy stored in an object due to its position.

Power: the energy or motive force by which a physical system or machine is operated.



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Probability: a number between 0 and 1 used to quantify likelihood for processes that have uncertain outcomes.

Pythagorean Theorem: in any right-angled triangle, the area of the square whose side is the hypotenuse (the side opposite the right angle) is equal to the sum of the areas of the squares whose sides are the two legs (the two sides that meet at a right angle). $\mathbf{a^2 + b^2 = c^2}$

Rational Number: a number expressible in the form a/b or –a/b for some fraction a/b. The rational numbers include the integers.

Shape: a 2-dimensional, enclosed space.

Speed: the rate or a measure of the rate of motion; distance traveled divided by the time of travel; how fast an object moves.

Static Friction: friction on an object that resists making it move.

Streamlined: having a contour designed to offer the least possible resistance to a current of air, water, etc.; optimally shaped for motion or conductivity.

Surface Area: sum of all the areas of all the shapes that cover the surface of the object.

Tire: a ring or band of rubber placed over the rim of a wheel to provide traction and resistance to wear.

Torque: A measurement of force.

Transportation: the act of moving something from one location to another; an object that moves something from one place to another.

Vehicle: something that transports people or objects from one place to another.

Velocity: the speed of the object moving in a specific direction.

Volume: quantity of three-dimensional space enclosed by some closed boundary.

Weight: response of mass to the pull of gravity.

Wheel: a simple machine consisting of a circular frame with spokes (or a solid disc) that can rotate on a shaft or axle (as in vehicles or other machines).

Wheel and Axle: a simple machine consisting of a grooved wheel turned by a cord or chain with a firmly attached axle (as for winding up a weight) together with supports.

Whole Number: the numbers 0, 1, 2, 3...

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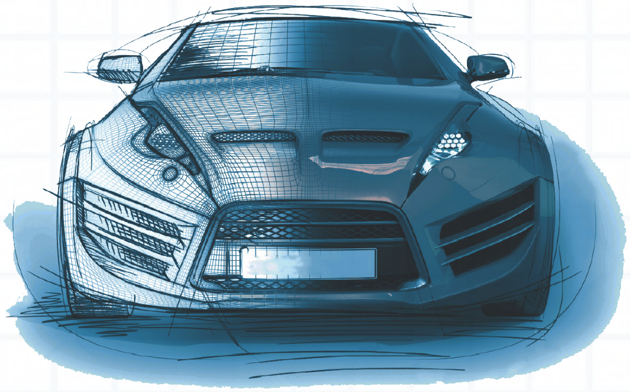

Drag and Drifting Video Questions:

1. What is drag?
2. Why are race cars made without side view mirrors?
3. What effect does taping over grills have on the engine?
4. What are the two longest tracks on the circuit?
5. What is drafting?

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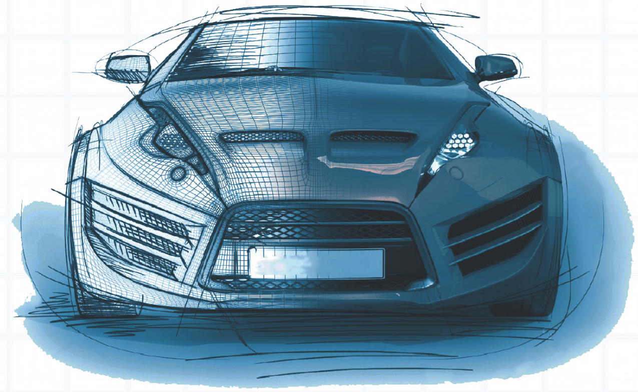

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1937 CHRYSLER AIRFLOW

1951 STUDEBAKER

1959 CHRYSLER 300 E

2012 NO. 5 FARMERS INSURANCE CHEVROLET

1954 PONTIAC CHIEFTAN DELUXE EIGHT

1921 FORD MODEL T

2005 MOMENTUM

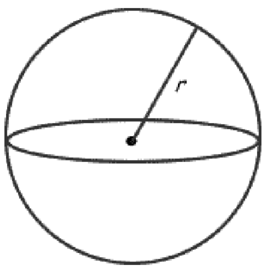
1930 DUESENBERG MODEL J

GUIDE TO SURFACE AREA AND VOLUME

Sphere

Surface Area

$A = 4\pi r^2$



Volume $V = \frac{4}{3}\pi r^3$

Cone

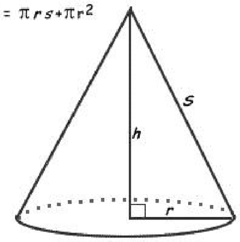
Surface Area

We will need to calculate the surface area of the cone and the base.

Area of the cone is $\pi r s$

Area of the base is πr^2

Therefore the Formula is: $SA = \pi r s + \pi r^2$

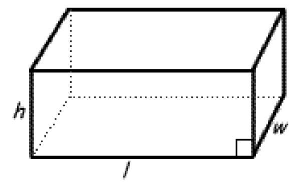


Volume $V = \frac{1}{3}\pi r^2 h$

Rectangular Prism

Surface Area

$A = 2(wh + lw + lh)$

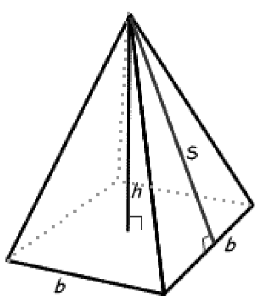


Volume

$V = lwh$

Square Based Pyramid

Surface Area $A = 2bs + b^2$



Volume $V = \frac{1}{3}b^2 h$

Cylinder

Surface Area

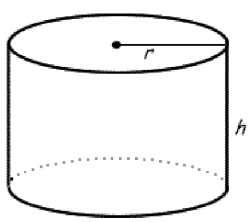
We will need to calculate the surface area of the top, base and sides.

Area of the top is πr^2

Area of the bottom is πr^2

Area of the side is $2\pi r h$

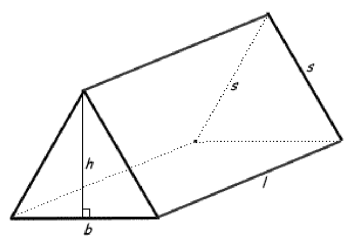
Therefore the Formula is: $A = 2\pi r^2 + 2\pi r h$



Volume $V = \pi r^2 h$

Isosceles Triangular Prism

Surface Area $A = bh + 2ls + lb$



Volume $V = \frac{1}{2}(bh)l$