2011 Teacher Summit

Science & Engineering in the MOVIES

—WITH— STEVE WOLF

TEXAS A&M UNIVERSITY

NUCLEAR POWER INSTITUTE
nuclearpowerinstitute.org

Chevron

January 28, 2011
College Station, Texas
Hilton Hotel and Conference Center

Presented by
The College of Science and
The Dwight Look College of Engineering
at Texas A&M University

Teacher Summit 2011 Evaluation Form

We hope you enjoyed the summit and it provided you with valuable information. Please take a moment to tell us how we did and provide us with any suggestions for improving this event in the future.

Part I: Teacher Summit

1) Please rate the relevance of this year's ***Science & Engineering in the Movies*** summit for use in your classroom. (Please circle.)

   1 Poor 2 Fair 3 Good 4 Very Good 5 Excellent

   Comments _____

2) Please rate the overall demonstration by Steve Wolf of Stuntworks. (Please circle.)

   1 Poor 2 Fair 3 Good 4 Very Good 5 Excellent

   Comments _____

3) Please check all workshop demonstrations by Stuntworks that you found useful.

   Fire _____ Smoke _____ Pulleys_____ Snow_____

   Comments _____

4) Will you be able to use any of the summit material in your classroom or in out-of-classroom STEM related activities?

   Yes _____ No _____ Why not? _____

5) Did you find the session "How to Best Prepare High School Students for STEM Majors" useful?

   Yes_____ No_____ Comments_____

6) Did you find the Texas A&M student presentations useful?

   Yes_____ No_____ Comments_____

7) In which class or activity do you plan to use today's material? (Check all that apply.)

   a. Algebra I _____ Algebra II_____

   b. Geometry_____ Pre- Calculus_____ Calculus_____

   c. Physics Pre AP_____ Physics AP (non-calculus–based) _____ Physics AP (calculus-based) _____

   d. Chemistry Pre-AP_____ Chemistry AP_____

   e. Biology Pre AP_____ Biology AP_____ Anatomy_____

   f. Engineering _____ Environmental _____ IPC_____

   g. Other (please specify) _____

8) How did the Teacher Summit affect your impression of STEM majors at Texas A&M University? (Check one.)

Improved _____ Did not affect _____ Lowered _____

Please explain. _____

9) How did the Teacher Summit affect your impression of Texas A&M University? (Check one.)

Improved _____ Did not affect _____ Lowered _____

Please explain. _____

10) Will you recommend Texas A&M University to your students? (Circle one.)

Yes No Not sure

Why or why not? _____

Part II: Facilities/Registration

Please rank the facilities and registration below (1 being the lowest and 5 being the highest):

11) Ease of online registration process

1 2 3 4 5 Suggestions: _____

12) Quality of lodging, conference facility and food

1 2 3 4 5 Suggestions: _____

13) Usefulness of resource tables

1 2 3 4 5 Suggestions: _____

14) Value of door prizes

1 2 3 4 5 Suggestions: _____

Part III: Please tell us about yourself

15) Identify your expertise area. (Circle all that apply.)

a) Astronomy
b) Biology
c) Chemistry
d) Engineering
e) Math
f) Physics
g) Other _____
_____

16) Identify the grade levels you currently teach (Circle all that apply.)

a) 7th grade
b) 8th grade
c) 9th grade
d) 10th grade
e) 11 grade
f) 12th grade
g) Other _____

17) Identify the subject matters you currently teach. (Check all the apply.)

a. Algebra I _____ Algebra II_____

b. Geometry_____ Pre- Calculus_____ Calculus_____

c. Physics Pre AP_____ Physics AP (non-calculus–based) _____ Physics AP (calculus-based) _____

d. Chemistry Pre-AP_____ Chemistry AP_____

e. Biology Pre AP_____ Biology AP_____ Anatomy_____

f. Engineering_____ Environmental _____ IPC_____

g. Other (please specify) _____

18) What is the size of your student population at your school (all grades included)? _____

19) How did you receive your invitation? (Circle all that apply.)

a) Dwight Look College of Engineering
b) College of Science
c) Participated in the Research Experience for Teachers
d) Selected by principal or other school administrator
e) Other _____
_____

20) Suggestions for future speakers and topics.

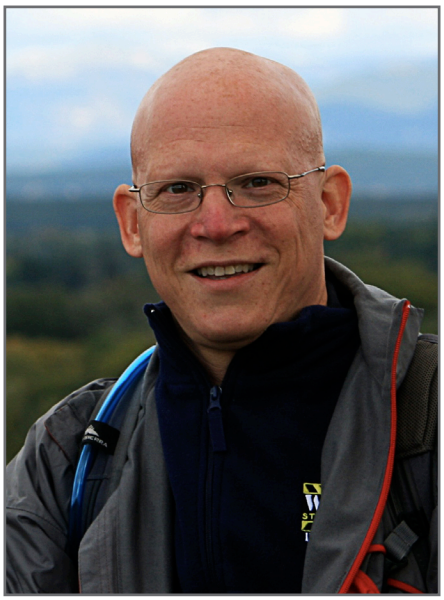
_____

_____

Thank you.

Teacher Summit 2011

FEATURED SPEAKER



Steve Wolf

Special Effects & Stunt Coordinator
Wolf StuntWorks

Steve Wolf is an experienced stunt and special effects coordinator who is passionate about how exciting science can be. When he heard that U.S. students were ranked among the lowest in developed nations for science knowledge, he decided that he could make a difference. By using the science that he encounters every day in his movie and television work, Steve was able to create a program that makes science exciting and fun for children. Steve also works with teachers to help them use some of the same approaches to teaching science in the movies.

TELEVISION AND MOVIE CREDITS INCLUDE

James Cameron's Expedition: Bismarck

Beyond the Prairie: The Story of Laura Ingalls Wilder

American Outlaws

Cast Away

A Time to Kill

The Jungle Book

The Firm

Whitney Houston: Live in Concert

Crocodile Dundee II

America's Most Wanted

Rescue 911

All My Children

Timothy P. Scott

Associate Dean for Undergraduate Programs
College of Science, Texas A&M University

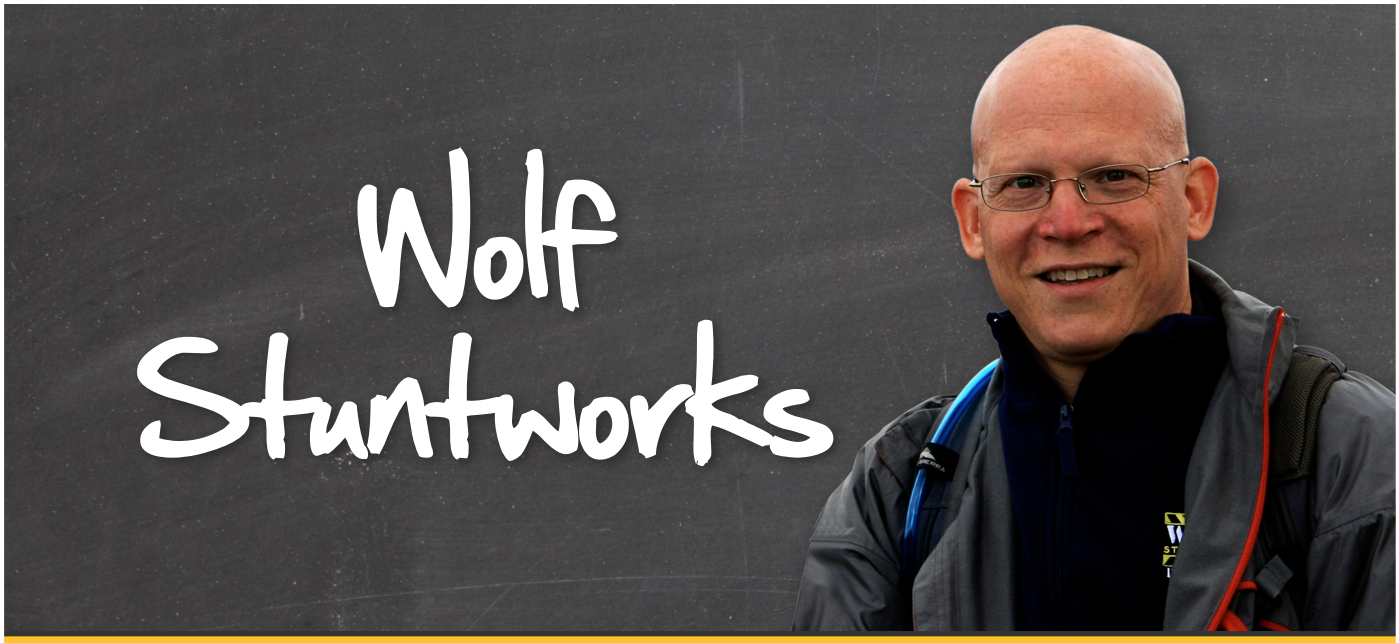
Dr. Timothy P. Scott is Associate Dean for Undergraduate Programs in the College of Science at Texas A&M University, where he also is an Associate Professor of Science Education Policy. In addition, he serves as Co-Director of the Center for Mathematics and Science Education at Texas A&M University. Dr. Scott's work focuses on national and state science standards and policy as it relates to teacher certification. He directs the University's aggieTEACH program, which was developed to address the shortage of teachers in the high need areas of mathematics and science. Dr. Scott also performs research on learning and teaching in science.

In addition to serving on various committees and overseeing the Governor's Science Initiative, Dr. Scott has also served the state by overseeing reviews of the biology and science textbooks adopted by the state. The projects Dr. Scott has acquired and collaborated on total more than $21 million.

Magdalini Z. Lagoudas

Program Director
Engineering Student Services and Academic Programs , Texas A&M University

Magda Lagoudas directs the Engineering Student Services and Academic Programs (ESSAP) Office in the Dwight Look College of Engineering at Texas A&M University. In this role, she manages all outreach, recruiting, retention, and enrichment programs for the college. She is responsible for the E12 recruitment program, which involves working closely with 12 high schools across Texas to increase the number of qualified students from ethnic minorities that enroll engineering at Texas A&M. She has developed a college-level multidisciplinary program for undergraduate engineering students that promotes involvement on team projects with industry support, and collaborates regularly with others on efforts that promote STEM awareness at high school and middle school levels. She was previously director of the Space Engineering Institute and associate director of the Spacecraft Technology Center at Texas A&M, and has been a lecturer in the Department of Engineering Technology and Industrial Distribution and the Department of Mechanical Engineering. Before coming to Texas A&M in 1992, she was a design engineer for Dynamic Systems Inc. in Poestenkill, N.Y., and a junior engineer in the Office of General Services for the State of New York in Albany. She earned a diploma from Aristotle University (Greece) and a master's degree from Lehigh University, both in mechanical engineering. She is a member of the American Society of Engineering Education and an advisor for the Society of Women in Engineering.



Teacher Summit 2011

WOLF
STUNTWORKS

The Secret Science Behind

Movie Stunts & Special Effects

STEVE WOLF

Teacher Workbook

Table of Contents

Student Worksheets

To the Teacher

This workbook will help you guide your students as they read "The Secret Science Behind Movie Stunts and Special Effects" textbook. In some cases, the information is presented in a different manner to help you prepare for class discussions. The worksheets can help you reinforce the students' understanding of key ideas and concepts.

This book and workbook will help you spark a curiosity in students that you can use to direct them to further learning.

States of Matter and Plasma (pages 18 to 22)

VOCABULARY

SOLID

Solid is a state of matter in which a substance has a definite shape and volume. The molecules in a solid are closely packed together and do not move about.

LIQUID

Liquid is a state of matter that has no definite shape but with a definite volume. The molecules are close together but may slide past each other.

GAS

Gas is a state of matter that has no definite shape or volume. The molecules are spread apart and distributed uniformly. Gases have lower density than solids or liquids.

PLASMA

Plasma is a state of matter where the molecules exist as highly charged ions with most or all of their detached electrons distributed uniformly. Plasma is produced by heating a gas until the atoms lose all their electrons.

BACKGROUND

Solids and liquids are called condensed states of matter because the particles are close together and have a constant volume.

The particles in a solid vibrate, but because they are tightly packed together, they are held rigidly in place. The particles in a solid are usually part of a regular pattern. Solids have a definite shape that does not easily change.

The particles in a liquid are not held in a regular pattern. As a result, the particles move about by sliding past each other. Liquids take the shape of the container in which they are held.

The particles of a gas have a much higher energy than particles of a solid or liquid, and move about at high speeds. Because of this, they can expand or contract to fill any closed container.

Liquids and gases are both fluids because they the ability to flow. It is this property that allows fluids to take the shape of their container. One difference between liquids and gases is that liquids have a fixed volume and gases can change their volume based on their container.

Plasmas can carry electrical currents and be controlled by magnetic and electric fields. Common plasmas can be found in fluorescent and neon lights.

Changes in States of Matter (page 24)

VOCABULARY

MELTING

Melting is the change in state from a solid to a liquid

SUBLIMATION

Sublimation is the change of state from a solid to a gas

FREEZING or SOLIDIFICATION

Freezing or solidification is the change of state from liquid to solid.
Water freezes at 0°C (32°F).

BOILING or VAPORIZATION

Boiling or vaporization is the change of state from a liquid to a gas.
Water boils at 100°C (212°F).

EVAPORATION

Evaporation is the change of state from a liquid to a gas that takes place slowly at room temperature.

CONDENSATION

Condensation is the change of state from a gas to liquid.

BACKGROUND

Special effects smoke is made with a fog machine. A fog machine works by heating up a combination of water and "fog juice" to produce a smoke-like vapor that is about the same density as air. This allows it to float and look like smoke.

"Fog juice" is usually a mixture of water and a fogging agent that may be glycerin-based, glycol-based, or mineral oil-based. A small pump in the fog machine squirts the fog juice into the heat exchanger, transforming it into a vapor.

Dry ice, frozen carbon dioxide, can also be used to make smoke. When dry ice is added to water it produces a thick fog which is heavier than air and sinks to the floor. The fog produced is water vapor, which disperses into the air.

Dry ice should never be handled with bare hands or allowed to touch skin because it can freeze skin on contact. Dry ice also produces carbon dioxide, so it should only be used in a well-ventilated area.

Fire and Chemical Reactions (pages 26 to 29)

VOCABULARY

CHEMICAL REACTION

A chemical reaction is a process where the atoms of two or more compounds are rearranged to produce one or more different compounds.

REACTANT

A reactant is a starting substance in a chemical reaction.

PRODUCT

A product is a substance that forms during a chemical reaction.

EXOTHERMIC REACTION

An exothermic reaction releases heat to the environment.

ENDOTHERMIC REACTION

An endothermic reaction absorbs heat from the environment.

BACKGROUND

Chemical reactions cause a chemical change to take place. This chemical change rearranges the atoms of the reactants to produce entirely new products. We cannot see the atoms being rearranged, but there are clues that a chemical change occurred. These clues include foaming or fizzing (producing a gas), making a sound, releasing or absorbing heat, creating light, or producing an odor. Because chemical changes are the result of rearranging atoms, they cannot be reversed through physical means alone. Great amounts of energy are often required to get obtain the original reactants from the product.

A chemical reaction is usually written down in the form of an equation. The general form for a chemical reaction is:

$$\text{reactant(s)} + \text{reactant(s)} \longrightarrow \text{product(s)}$$

A chemical reaction requires energy to rearrange the atoms of the reactants. One way to think of a chemical reaction is in terms of breaking and forming bonds. Energy is required to break the bonds of the elements and is released when new bonds are formed.

If a chemical reaction produces more energy from forming bonds than it used to break bonds, energy is released. This type of reaction is called an exothermic reaction. The energy is often released as heat. Fuel combustion is an example of an exothermic reaction.

If a chemical reaction requires more energy to break bonds than is released by forming bonds, the reaction is called an endothermic reaction. This type of reaction absorbs heat and usually feels cold to the touch. Photosynthesis is an example of an endothermic reaction. For photosynthesis to occur, solar energy is required to convert water and carbon dioxide into glucose.

Fluids (pages 32 to 39)

VOCABULARY

FLUID

A fluid is any substance whose molecules move past one another and takes the shape of its container. Liquids and gases are fluids.

VALVE

A valve is a mechanical device used to control the flow of fluids.

BACKGROUND

Fluids can be poured and take the shape of their containers. Water is a common example of a fluid. You can pour water from one container into another and the water always takes the shape of the container.

Gases expand to fill their container. Like liquids, this means that gases take the shape of their containers. If a gas is lighter than air, it will quickly disperse from an open container. Helium is a common gas that is lighter than air. If you fill a balloon with helium, it will float upward in air. Other gases are heavier than air. Carbon dioxide is a common gas that is heavier than air. If you have an open container with carbon dioxide in it, you can pour it out just like you would a liquid.

To demonstrate how some heavier gases can be poured, take a large jar or beaker and add some baking soda and vinegar to it. This causes a chemical reaction that creates carbon dioxide. The carbon dioxide is heavier than air and forces the air out of the container. Light a candle and carefully pour the gas out of the jar, high over the flame. The carbon dioxide will snuff out the candle flame.

Combining Systems/Carbon and Hydrocarbons (pages 41 to 49)

VOCABULARY

LIMITING REAGENT

The limiting reagent, also called the limiting reactant, is the reactant that is completely used up in a chemical reaction. The limiting reactant determines the amount of product produced in a chemical reaction.

CARBON

Carbon is an element with a molecular weight of 14. All life contains carbon.

HYDROCARBON

Hydrocarbon is a fuel which contains both carbon and hydrogen.

BACKGROUND

In any chemical reaction, mass is conserved. Whic means, even though a chemical reaction is producing a product or products, the mass of all the atoms in the products is exactly the same as the mass of all the reactants. If one of the reactants is completely used up, it is considered the limiting reagent. The excess reactant or reactants remain unchanged so their mass is not part of the chemical reaction.

The limiting reagent is the reactant that determines exactly how much of the products will be produced. By controlling the amount of one of the reactants, the amount of products is easily controlled.

Combustion reactions take place when some type of fuel reacts with oxygen. The engine of a car runs because of a combustion reaction between gasoline and oxygen in the engine. If you have a gas stove, the flame produced is also a combustion reaction. Combustion reactions produce carbon dioxide and water.

In this chapter of the book, the combustion reaction between propane and oxygen is used to create fire for special effects. The chemical equation for the complete reaction involving propane is:

$$C_3H_8 + O_2 \longrightarrow CO_2 + H_2O + \text{heat}$$

Sufficient quantities of propane and oxygen are present so the fire burns with a blue color and no smoke. When smoke is needed to make the fire look more like a burning house, the oxygen is kept as a limiting reagent to prevent the reaction from going to completion. In addition to carbon dioxide and water, the incomplete reaction also produces carbon.

The carbon that is produced makes the thick, black smoke that the special effects require.

Hemoglobin (pages 50 to 51)

VOCABULARY

HEMOGLOBIN

Hemoglobin is a protein in red blood cells that carries oxygen.

CARBON MONOXIDE

Carbon monoxide is a colorless, odorless, tasteless gas that is toxic. It is formed during incomplete combustion reactions.

CARBON DIOXIDE

Carbon dioxide is a colorless, odorless gas which is formed during combustion reactions.

BACKGROUND

Animals need the oxygen in air to break down food molecules into energy. Hemoglobin is the protein in the red blood cells of animals that picks up oxygen from the lungs and distributes it to cells all over the body. These cells use the oxygen in a combustion reaction with glucose to get energy. The reactants from this process are carbon dioxide and water. Carbon dioxide is carried back to the lungs where it is released out of the body.

When hydrocarbons are burned in a combustion reaction with oxygen as the limiting reagent, carbon monoxide may be produced. Some carbon monoxide is produced by car engines and gas-fired heaters.

Carbon monoxide attaches to hemoglobin 40 times more readily than oxygen. If it is present in the air, the hemoglobin will distribute cabon monoxide to the cells in the body instead of oxygen. The cells won't work properly until the carbon monoxide is eliminated from the air being breathed and an adequate supply of oxygen is provided.

Carbon monoxide is called the Silent Killer because it is colorless, odorless, and tasteless. The symptoms of carbon monoxide are similar to the flu and include headaches, nausea, and fatigue. Prolonged exposure to carbon monoxide can lead to brain damage, heart damage and death. It is important to use products that produce carbon monoxide in properly ventilated areas and install carbon monoxide detectors.

Gravity/Compressing Gases (pages 52 to 54)

VOCABULARY

FREE FALL

Free fall is defined as any object falling solely under the influence of gravity.

BACKGROUND

All objects in free fall are subject to the force of gravity and accelerate at a rate of 9.8 m/s^2 here on Earth. If you drop a feather and a bowling ball in a vacuum, both would fall at exactly the same rate and land at the same time. If you tried this in air, the bowling ball falls faster and lands first because a second force, air resistance, significantly slows down the feather.

This table shows the speed of a free falling object in a vacuum. As you can see, the speed increases at a constant rate.

Time (s)	Velocity (m/s)	Velocity (mph)
0	0	0
1	9.8	21.9
2	19.6	43.8
3	29.4	65.8
4	39.2	87.7
5	49.0	109.6

This information is very important for performing falls. When an object is in free fall, it gains not only speed but energy. Breaking a stunt person's fall must be done in such a way that the energy is transferred away from the person in a controlled manner. In other words, you want to slow them down over time, not splatter them all at once.

Using an air bag breaks a stunt person's fall. An air bag is like a large pillow filled with gas—air. Energy from the free falling stunt person is transferred to the air bag by quickly compressing the gas inside, safely stopping the stunt person.

Components of Air (page 55)

VOCABULARY

None

BACKGROUND

Air is a mixture of gases made up mostly of nitrogen and oxygen. Nitrogen makes up about 78% and oxygen almost 21% of all the gases in the atmosphere. This table shows the composition of gases in air.

Gas	Percentage in Atmosphere
Nitrogen (N_2)	78.09%
Oxygen (O_2)	20.95%
Argon (Ar)	0.93%
Carbon dioxide (CO_2)	0.038%
Neon (Ne), Helium (He), Krypton (Kr), Hydrogen (H_2), Xenon (Xe)	Less than 0.002% each

Air may also contain up to 4% water vapor. This amount varies widely and changes the composition accordingly. The amount of water vapor depends on many factors but one of the most important is temperature. Warm air can hold more water vapor than cold air.

Simples Machines/Examples of Simple Machines (pages 58 to 61)

VOCABULARY

SIMPLE MACHINE

A simple machine is a tool with few or no moving parts used to make work easier. There are six basic types of simple machines that can be used in combination to make compound machines.

FORCE

A force is an action exerted on a body that changes the body's motion or state of rest.

LOAD

A load is any weight or mass.

BACKGROUND

A simple machine makes doing work easier by redirecting or multiplying a force. Tools such as hammers, axes, and wheelbarrows are all simple machines. Simple machines may be combined together to make more complex machines.

There are six types of simple machines—levers, inclined planes, screws, wedges, wheels and axles, and pulleys. Each of these types belongs to one of two families—the lever family and the inclined plane family.

All levers have some type of rigid arm that turns on a point called a fulcrum. Different types of levers are identified by the location of the input force, the output force, and the fulcrum. A pulley is a modified lever. Pulleys are used to lift loads. A single pulley does not multiply the force but rather changes the direction of the force. When two or more pulleys are used together, they act as a force multiplier. A wheel and axle is another type of lever. A wheel and axle is made up of a pulley (the wheel) connected to a shaft (the axle). As the axle is turned, the force is multiplied on the wheel. A small input force becomes a large output force.

An inclined plane spreads the force required to move a load over a distance. For example, it takes the same amount of force to lift a box up onto a loading dock as it does to push the box up a ramp onto the loading dock. If the load is small, lifting the box is easy. If the load is large, spreading the work over a long distance is easier. A longer ramp spreads the force over a greater distance than a shorter, steeper ramp.

A wedge is actually two inclined planes put together. A wedge used to split wood works by adding a force to each side of the wedge until the log splits. A screw is simply an inclined plane wrapped around a cylinder. Just like pushing a load up a ramp, tightening a screw spreads the force over a distance.

Pulleys (pages 62 to 67)

VOCABULARY

MECHANICAL ADVANTAGE

Mechanical advantage is a number that tells how many times a machine multiplies the input force.

BACKGROUND

Simple machines can be rated by assigning a value called the mechanical advantage. The mechanical advantage tells how many times the input force is multiplied compared to the output force. For example, if a simple machine has a mechanical advantage of two, it means that the output force is doubled compared to the input force. If a simple machine has a mechanical advantage of four, it means that the output force is four times the input force.

Pulleys are one of the simple machines that can provide a high mechanical advantage. A single, fixed pulley has a mechanical advantage of one. This means that the input force is the same as the output force. This does not seem like much of an advantage until you realize that a single fixed pulley changes the direction of the force. Think of using a single pulley mounted on the ceiling and using it to lift a load. The load can be lifted over your head and much higher than simply lifting the load with your hands.

If you change the setup and attach the rope to the ceiling and the pulley to the load, you make a moveable pulley. This set up increases the mechanical advantage to two. This means that you are able to lift the load with half the effort. If you use a fixed pulley on the ceiling and a moveable pulley on the load, you increase the mechanical advantage to three. As you continue adding pulleys to the system, you continue to increase the mechanical advantage. The general rule for estimating the mechanical advantage of a system of pulleys is to count the number of supporting ropes. Each supporting rope increases the mechanical advantage of the system by one.

The mechanical advantage of a pulley system does have a cost. The increased mechanical advantage requires a greater length of rope to be pulled through the pulley system. This is a small price to pay for the great lifting capacity of pulley systems.

Tensile Strength and Tension (pages 68 to 73)

VOCABULARY

TENSILE STRENGTH

Tensile strength is the resistance of a material to a force that is trying to tear it apart.

TENSION

Tension is the force related to pulling an object.

BACKGROUND

A stunt person may use ropes, webbing, cable or chains to support an object or themselves. These materials are said to be under tension when they are supporting a load. Tensile strength describes how much load these materials can support without breaking.

Different supporting materials have different tensile strengths. The tensile strength for a given material may vary depending on the temperature, humidity, and whether the supporting material is wet or dry.

Depending on how the load is distributed in a suspended system, it may exert more or less tension than its weight on the supporting materials. It is very important for stunt people to understand the physics of determining the tension in a suspended system. As long as the tensile strength exceeds the tension, the set will not break. In fact, just to be safe, stunt people often make sure that the tensile strength is many times greater than the tension involved.

Blowing Things Up/Air Cannons/Work, Time, Distance, and Energy (pages 75 to 81)

VOCABULARY

PRESSURE

Pressure is the amount of force exerted per unit area of a surface.

BACKGROUND

The particles of a gas are in constant motion. They bump into each other and their container. If you fill a balloon with air, the air pushes against the inner surface of the balloon. If you push on the surface of the balloon with your finger, the force you feel pushing back is pressure.

Pressure is dependent on the number of particles pushing on the container and the amount of energy with which they collide. If the particles have a lot of energy, they move quickly and hit the container with more force. The more particles in the container, the more they collide. Both the increase in energy and the number of particles result in higher pressure.

If you take the balloon and poke it with a needle, the balloon pops. This happens because the air, under pressure, escaped very quickly. A gas under pressure can exert a great amount of force. Special effects engineers can use air to simulate explosions without using dangerous explosives. One way to do this is with an air cannon.

An air cannon is a tube connected to a container of pressurized gas by a valve. A projectile is loaded into the cannon tube. When the valve is opened, gas rushes out of the container through the tube, forcing the projectile out at a high rate of speed, and sending it flying through the air.

Because the pressure, distance, time, and force of an air cannon can be measured and calculated, special effects engineers can tell the camera people exactly where and when a projectile will be in a particular spot.

Fires Stunts/Insulation (pages 82 to 87)

VOCABULARY

None

BACKGROUND

Fire is dangerous. Remind students that they should never attempt any fire stunts. Stunt people and special effects engineers have special training that helps keep themselves and others safe. Remember, it's not just the heat you have to worry about, but also the smoke and other gases a fire can prouce.

Insulation is used to keep hot things hot and cold things cold. The insulation in your house keeps heat from moving into or out of the house depending on the season. Stunt people use insulation in much the same way.

Stunt people wear special clothes that don't melt or burn to protect them from fire. These clothes provide insulation between the fire and the stunt person.

A chemist and special effects engineer named Gary Zeller developed Zel Jel. It is a water-based gel used by stunt people to prevent burns for up to three minutes. This gives the camera people time to make the shot and for the fire to be put out.

Zel Jel was first used in 1975 and quickly caught on in the special effects world. In 1989, Gary Zeller won an Academy Award for Scientific Achievement. Zel Jel is not only used for special effects; firefighters use Zel Jel to prevent burns while battling fires.

Explosions: More Ways to Blow Things Up (pages 88 to 92)

VOCABULARY

EXPLOSION

An explosion is a sudden chemical reaction that releases great amounts of energy.

BACKGROUND

An explosion is caused by a chemical reaction that happens quickly. A chemical reaction that causes an explosion is usually a decomposition or combination reaction that forms gases as products and generates lots of heat. If the reaction occurs quickly enough, the rapidly expanding gas can provide a lot of force.

The air cannon that was discussed previously used compressed gas from a cylinder to create a force to drive a projectile. A chemical explosion uses a similar principle. The difference is that in a chemical explosion, a chemical reaction creates the rapidly expanding gas. The faster the chemical reaction takes place, the more force the explosion creates.

Explosions create a shock wave from the rapidly expanding gases. The shock wave moves faster than the speed of sound so it is felt before the explosion is heard. The shock wave in a large explosion can do damage over a large area and can even break windows miles away.

When special effects engineers use explosives, they make sure that everyone is a safe distance from the explosion to make sure no one is hurt. But they also make sure that the shock wave from the explosion will not affect anything nearby.

Speical effects engineers who work with explosives need to understand the chemistry behind these fast chemical reactions. Not only are explosions dangerous, they sometimes involve chemicals that are hazardous. Knowledge of chemistry lets the special effects engineers know the properties of these chemicals and minimize the risks.

If a special effects enginner has adequate training and follows the right safety procedures, handling explosives is safe. People without specific training should never handle explosives.

Chemical Reactions (pages 94 to 103)

VOCABULARY

ELECTRIC CIRCUIT

An electric circuit consists of connected electrical components that provide a path for an electric charge to flow.

RESISTANCE

Resistance is the internal friction caused by the movement of an electric charge through a conducting material.

ENERGY OF ACTIVATION

The energy of activation is the amount of energy necessary to activate a chemical reaction.

BACKGROUND

Most chemical reactions, including those that result in explosions, don't occur spontaneously. They must have energy added to them to "kick off" the reaction. This added energy is called the energy of activation.

Electric circuits are any set of electrical components that complete a pathway for a charge to move. When the pathway is completed, electricity may be converted into heat, sound, light, motion, or noise, following the first law of thermodynamics. According to this law, the net change in energy equals the energy converted to sound, light, motion, noise, and heat.

Electric energy is converted to heat when electricity is passed through a thin wire. If you have ever looked at a hair dryer or electric heater while it is running, you probably saw glowing wire coils. These glowing wire coils are where electricity is being converted into heat. The reason the wires are glowing is because of friction. The amount of friction in the wire is called resistance. If electricity is sent through a thick wire, the resistance can be minimal. With a thinner wire, the resistance is increased and the wire becomes red hot from the friction.

Special effects engineers use this same principle when setting off explosions. Electricity moving through a thin wire can generate enough heat to be the energy of activation for a chemical reaction, resulting in an explosion.

Electric Circuits/Series and Parallel Circuits/Firing Box (pages 105 to 111)

VOCABULARY

SERIES CIRCUIT

A series circuit is one in which the parts are joined one after another so that the current in each part is the same.

PARALLEL CIRCUIT

A parallel circuit is one in which the parts are joined into branches so that the potential difference across each part is the same.

BACKGROUND

A series circuit provides a single path for electricity to flow through the circuit. A very simple series circuit is a light bulb hooked up to a battery using 2 wires. One wire connects the positive terminal of the battery to one of the electrical contacts of the light bulb, the second wire connects the light bulb's other electrical contact to the negative terminal of the battery. This makes a complete circuit and the bulb lights up. Electricity flows from the battery to the light bulb, through it and then back to the battery.

A flashlight has a circuit set up just like this except a switch is added. A switch acts to either open or close the circuit. When the switch is open, electricity cannot flow so the light bulb does not light up. When the switch is closed, the circuit is complete, electricity flows, and the light bulb lights up.

A series circuit can have more components added to it, but the electricity must have a single path to follow. If one of the components is removed from the circuit, the circuit is broken and electricity can not flow.

A parallel circuit has two or more paths for electricity to follow. When the electrons leave the power source, they may flow through any of the routes in the circuit. If one of the components of the circuit is removed, that path in the circuit is broken. Because the circuit has two or more pathways, the remaining components in the circuit still have power flowing to them.

Most devices, such as the firing box used by special effects engineers, are made up of a combination of series and parallel circuits. A firing box controls the different circuits with a selector switch. The part of the circuit energized is determined by the position of the selector switch. Safety switches are also included in the circuit in series to prevent an accidental activation or firing.

Atmospherics (pages 112 to 125)

VOCABULARY

The vocabulary for this section is found in the student worksheet that supports the reading selection.

BACKGROUND

Atmospherics includes rain, snow, sleet, and hail. In some movie scenes, atmospherics are important to the plot or the setting. It is not practical for a film crew to wait for the right rainstorm or snowstorm when filming a movie. To make sure the atmospherics are available, special effects engineers have to make them happen on cue.

Making rain is simple. Water sprayed through a variety of different sprinkler or showers-type heads looks like rain.

Making snow is a bit more difficult. Snow is made up of ice crystals. If the weather conditions are just right, all that is needed to make snow is spraying a fine mist of water. The water will freeze in the air and make snow. Unfortunately, the right conditions are seldom there when snow is needed on the set.

Special effects engineers have several ways to make snow. One way is to use snow syrup to make foam that looks like snow. Special effects engineers mix a specific chemical solution of snow syrup and water. The ratio of water and snow syrup has to be just right for the solution to work. In this solution, water is called the solvent and snow syrup is called the solute.

On page 117, the book is describing a volume percent solution—a solution that is determined by the volume in milliliters of solute per 100 milliliters of solution (milliliters solute + milliliters solvent).

Volume percent (v/v) = (volume of solute in mL/100 mL of solution) × 100

Example: 10 mL of methyl alcohol in 90 mL of water is a 10% by volume solution

Smoke, Haze, and Mist (pages 126 to 141)

VOCABULARY

HAZE

Haze is any atmospheric moisture, dust, or smoke that causes reduced visibility and light scattering.

MIST

Mist is a suspension of fine droplets of water in air.

SMOKE

Smoke is fine particles of liquids and solids of organic origin suspended in air.

BACKGROUND

Fog machines are the primary way special effects engineers create haze, mist, and smoke effects. They use different chemicals to create the different effects. Sometimes they need smoke that rises so they use one type of chemical. For other scenes, they need a mist that stays at ground level. Special effects engineers have a variety of different chemicals that they can choose to make the specific effect that they need for the scene.

Safety is always an important consideration when chemicals are used on a movie set, especially when used in the air people breath. Special effects engineers find out important safety, handling, and exposure guidelines of different chemicals by reading the Material Safety Data Sheet (MSDS) provided with the chemical.

Name _____ Date _____

States of Matter and Plasma

While You Read

Reading Strategy: Compare and Contrast

As you read pages 18 to 22, complete the Compare and Contrast chart below. You can use your science textbook to help you fill in the blanks.

	Solid	Liquid	Gas	Plasma
Shape				
Volume				
Closeness of the particle				
Movement of the particles				
Example				

A gas and plasma share many of the same characteristics. What are two ways in which a gas and a plasma differ? _____

_____

_____

Lights, Camera, Action!

Steve is helping some students understand the different states of matter. He asks them to group two or more states of matter into a larger group. Looking at the chart above, help Steve group two or more states of matter. Why did you group the states together?

_____

_____

Name _____ Date _____

Changes in States of Matter

While You Read

Reading Strategy: Sequencing Events

As you read page 24, think about the steps needed to make theatrical smoke and the order in which those steps occur. Place the steps to make theatrical smoke in order. Write "1" in the blank next to the step that comes first, a "2" in the blank next to the step that comes next, and so on.

____ Turn on the smoke machine to add heat to the liquid.

____ Determine the type of liquid needed to make the smoky effect you want.

____ Open the end of the machine to release the smoke. The room fills with theatrical smoke.

____ Place the liquid into the smoke machine.

____ Liquid changes to a gas allowing the particles to expand making smoke.

Lights, Camera, Action!

To make theatrical smoke, Steve needs to know the properties of the liquid (known as fog juice) used in the smoke machine. By knowing the properties, Steve can choose the right fog juice for the job. Use the chart below to answer the following questions.

Property	Fog Juice 1	Fog Juice 2	For Juice 3
Boiling Point	212°C	244°C	102°C
Flash Point	None	None	78°C
Vapor Pressure	0.25 mmHg	19 mmHg	2.67 mmHg
Vapor Density	3.9	Less than 1	3.7
Solubility in Water	Yes	Yes	No

6. Steve wants to choose the fog juice with the lowest boiling point. Which should he choose? _____

7. Steve wants to choose a fog juice that is water soluble. Which juice should he choose? _____

8. **Vapor density** tells Steve whether the resulting smoke will hang in the air or roll along the ground. A vapor density greater than 1 means that the resulting smoke will be close to the ground. Which fog juice will make smoke that will hang in the air?

_____

Name _____ Date _____

Fire and Chemical Reactions

While You Read

Reading Strategy: Finding the Main Ideas

As you read pages 26 to 29, think about chemical reactions, what is needed to make one happen, and what the results, or products, are. Read pages 26 to 29; as you read answer the following questions.

1. What are the three things you need to make fire?

   a. _____

   b. _____

   c. _____

2. Without _____ (a gas in the air) a fire would not burn.

3. In a chemical reaction that produces fire, the part of the reaction that burns is called the _____.

4. Something that will not easily burn is said to be _____.

5. A fuel that is often used in movies is _____.

Lights, Camera, Action!

To create fire on a movie set, Steve uses propane and oxygen. For the crew on the set, he writes the following chemical equation (a chemical equation uses symbols or words to describe a chemical reaction). Use the equation to answer the following questions.

$$\underset{\text{Propane}}{C_3H_8} + \underset{\text{Oxygen}}{5O_2} \xrightarrow{\text{Heat}} \underset{\text{Carbon Dioxide}}{3CO_2} + \underset{\text{Water}}{4H_2O} + \text{Fire}$$

6. The **reactants** in this reaction are _____ and _____.

7. The **products** of the reaction are _____ and _____.

8. In the reaction, fire is a _____.

9. What is the purpose of the heat in this reaction? _____

   _____

Name _____ Date _____

Fluids

While You Read

Reading Strategy: Creating a Word Map

As you read pages 32 to 39, think about fluids. Use the information to complete the following word map.

Definition:

Examples of fluids

_____

_____

Fluids

Examples of valves

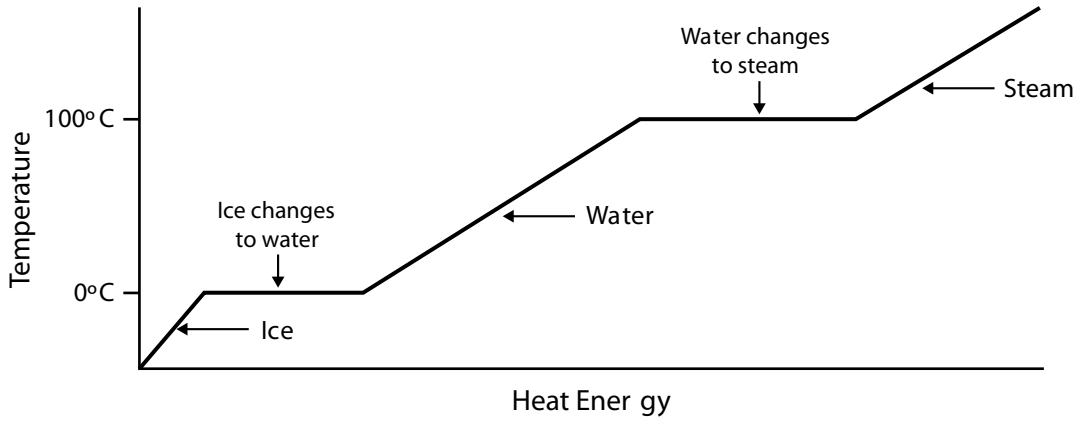
_____

_____

States of matter that are fluids

Lights, Camera, Action!

To make smoke, Steve needs to know how to change a liquid, such as water, into a gas. To do so, he can study a diagram, like the one below, called a heating curve.



1. Label the graph to show the temperature range where **condensation** and **evaporation** take place.

2. Make an observation about the relationship between heat and different states of matter.

_____

Name _____ Date _____

Combining Systems/Carbon and Hydrocarbons

While You Read

Reading Strategy: Cause and Effect

As you read pages 41 to 49, think about the substances and circumstances surrounding burning (combustion). For each "cause" describe the corresponding "effect."

Cause	Effect
1. Combine fuel, oxygen, and heat . . .	
2. Apply fire (heat) from a chemical reaction to a liquid . . .	
3. Chemically combine carbon atoms and hydrogen atoms . . .	
4. Chemically combine propane with plenty of oxygen . . .	
5. Chemically combine propane with a limited amount of oxygen . . .	

Lights, Camera, Action!

Steve is exploring how much heat energy is produced when different fuels are burned. The table shows how much heat (measured in megajoules) is produced per kilogram of fuel. Use the table to answer the following questions.

1. Which fuel produces the most heat per kilogram of fuel? _____
2. Steve plans to burn 2 kg of methane; how much heat will he produce? _____

Heat of Combustion	
Fuel	megajoules/kg
Hydrogen	141.9
Ethanol	29.8
Propane	49.9
Butane	49.2
Methane	54.0

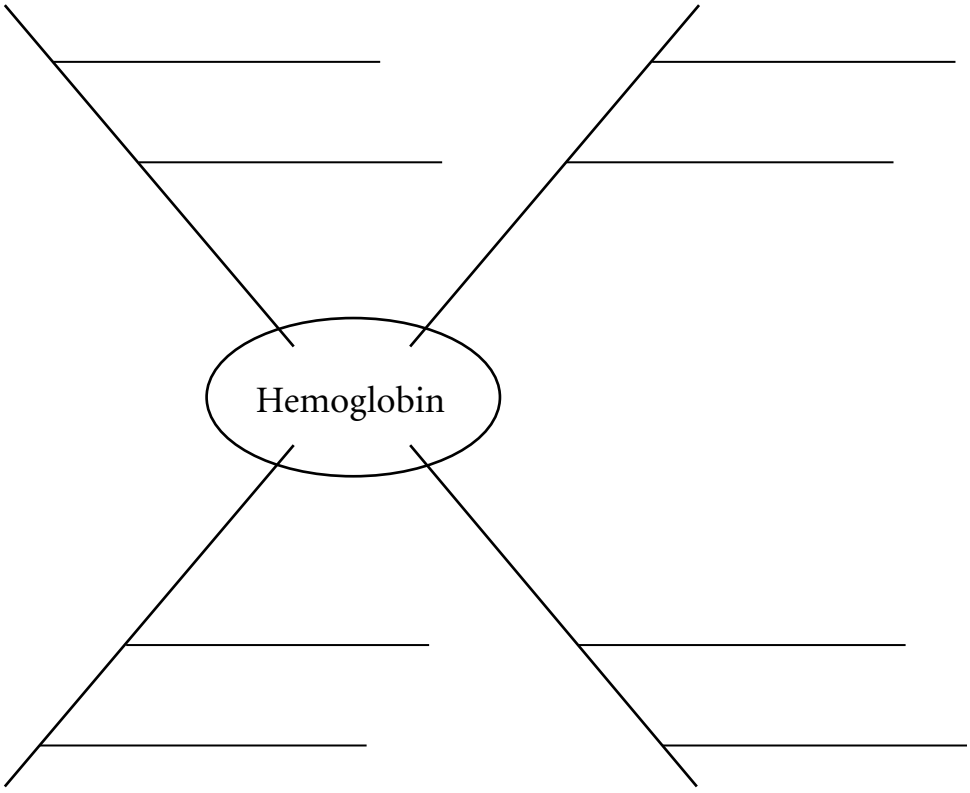
Name _____ Date _____

Hemoglobin

While You Read

Reading Strategy: Using a Graphic Organizer (Spider Map)

As you read pages 50 and 51, think about the effect carbon monoxide has on the body and how to avoid carbon monoxide poisoning.



Lights, Camera, Action!

Steve is learning more about hemoglobin. In his research he discovers that the basic formula for hemoglobin was established in 1885. He found that the chemical formula for hemoglobin is $C_{2952}H_{4664}N_{812}O_{832}S_8Fe_4$. Learn more about the composition of hemoglobin by completing the chart.

Symbol	Element's Name	Number of Atoms
C		
H		
N		
O		
S		
Fe		

Name _____ Date _____

Gravity/Compressing Gases

While You Read

Reading Strategy: Finding the Main Ideas

As you read pages 52 to 54, think about the role gravity and gases play in the creation of a movie stunt.

1. What is the definition of gravity? _____

   _____

2. When preparing a stunt in which a stunt person falls from a height, care must be taken to ensure that the _____ is safe.

3. To ensure a stunt in which the stunt person is falling is successful, the stunt coordinator will use a(n) _____.

4. An airbag works by _____ _____ the fall of the stunt person.

5. When the particles of a gas are forced closer together, the gas is said to be _____.

Lights, Camera, Action!

Steve is planning a stunt in which a stunt person will jump from the top of a building. Use the Fall Table on page 183 to help Steve gather the data he needs to plan the stunt.

6. A 150 pound stunt person is going to fall 70 feet.

   a. The number of seconds the fall will take: _____

   b. The impact speed at the end of the fall: _____

   c. The impact force at the end of the fall: _____

7. A 200 pound stunt person is going to fall 150 feet.

   a. The number of seconds the fall will take: _____

   b. The impact speed at the end of the fall: _____

   c. The impact force at the end of the fall: _____

Name _____ Date _____

Components of Air

While You Read

Reading Strategy: Using a Graphic Organizer (Chart)

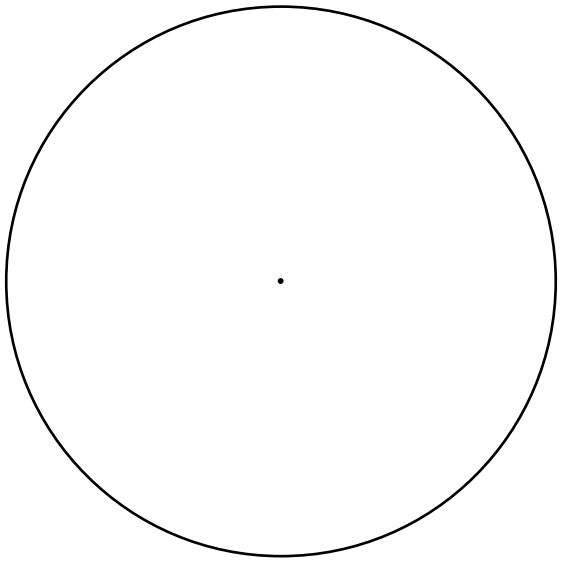
As you read page 55, think about the gases that make up Earth's atmosphere. Complete the chart below. Use the data to answer the questions that follow.

Gas Name	Chemical Formula	Percent Volume
Nitrogen	N_2	
Oxygen	O_2	
Water Vapor	H_2O	0 to 4%
Argon	Ar	0.93%
Carbon Dioxide	CO_2	0.0360%
Neon	Ne	0.0018%
Helium	He	0.0005%
Hydrogen	H_2	0.00005%

1. The most common gas in the atmosphere is _____.
2. Nitrogen and oxygen together make up _____ percent of Earth's atmosphere.
3. The other gases make up _____ percent of Earth's atmosphere.

Lights, Camera, Action!

Use the data in the chart above to make a circle graph showing the gases that make up Earth's atmosphere. Because the amount of water vapor in the air can vary, do not include water vapor in your circle graph.



Name _____ Date _____

Simples Machines/Examples of Simple Machines

While You Read

Reading Strategy: Compare and Contrast

As you read pages 58 to 61, think about the different kinds of simple machines. Complete the chart below comparing the different kinds of simple machines.

Simple Machine	Description	Example
Lever		
Inclined Plane		
Wedge		
Screw		
Wheel and Axle		
Pulley		

Lights, Camera, Action!

In his workshop, Steve has lots of tools and equipment. For each tool in Steve's workshop, tell which type of simple machine it is.

1. drill _____
2. pencil sharpener _____
3. crowbar _____
4. ax _____
5. doorknob _____
6. shovel _____

Name _____ Date _____

Pulleys

While You Read

Reading Strategy: Creating a Word Map

As you read pages 62 to 67, think about how a pulley is used to multiply effort and move an object. Use the information to complete the following word map.

Definition of a pulley:

Definition of mechanical advantage

_____

_____

Pulleys

Relationship between the number of ropes in a system and its mechanical advantage.

_____

_____

Drawing of a pulley

Lights, Camera, Action!

Steve needs to make two pulley systems. One pulley system needs to have a mechanical advantage of 5 and one needs to have a mechanical advantage of 8. In the space below draw each pulley system.

Pulley system – mechanical advantage 5

Pulley system – mechanical advantage 8

Name _____ Date _____

Tensile Strength and Tension

While You Read

Reading Strategy: Using a Graphic Organizer (Network Tree)

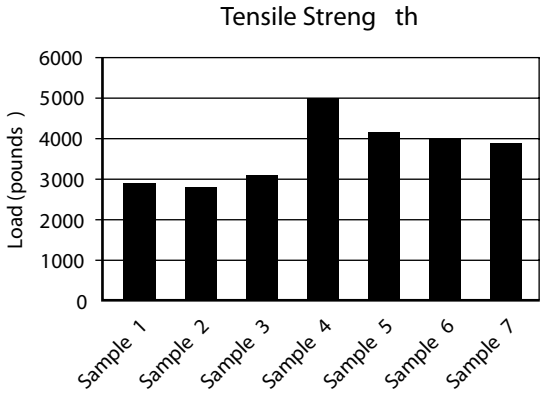
As you read pages 68 to 73, think about the properties of the materials used in rigs and harnesses. Complete the network tree below.

Harnesses and Rigs

- Can resist breaking during a stunt because of a property called _____.
  - Harnesses are typically made of a strong material called _____.
    - This material is strong because of strong _____ _____.
- Two types:
  - a.
  - b.
  - The tension in a _____ rig is equal to the weight of the load.
  - The tension in a _____ rig can be as much as 10 times the weight of the load.

Lights, Camera, Action!

For his latest stunt, Steve is investigating the tensile strength of different samples of nylon webbing. The graph to the right shows the tensile strength of the samples. Use the graph to answer the following.



1. The sample with the greatest tensile strength is Sample _____. It has a tensile strength of _____ pounds.
2. The sample with the lowest tensile strength is Sample _____. It has a tensile strength of _____ pounds.

Name _____ Date _____

Blowing Things Up/Air Cannons/Pressure & Force, Work, Time, Distance, and Energy

While You Read

Reading Strategy: Finding the Main Idea

As you read pages 75 to 81, think about what is needed to move an object, such as a couch. As you read, answer the following questions.

1. When you blow something up, a force is pushing _____ an object, pushing the object _____ from you.
2. In an air cannon, a _____ forces a gas into a tank with a valve; when the valve is opened the gas rushes into a _____ that contains the item, resulting in the item being _____.
3. Pressure is _____

   _____
4. A task requiring a great deal of _____ can be carried out over _____ and distance so that the task is never very difficult at any one time, and the work is spread out.

Lights, Camera, Action!

For today's stunt, Steve will send a 90 kg couch shooting across a room with an acceleration of 5 m/s^2. Help Steve determine the Force, Work, and Power produced by the air cannon to perform the stunt.

1. Calculate the **Force** needed to shoot the couch across the room. Use the formula $F = ma$ (F = force, m = mass of the couch, a = acceleration of the couch). Force is measured in newtons (N).
2. How much **Work** is done in moving the couch 100 m? Use the formula $W = Fd$ (W = work, F = force calculated in Item 1, d = distance traveled). Work is measured in joules (J).
3. If the couch travels the 100 m in 3 seconds, how much **Power** is needed? Use the formula $P = W/t$ (P = power, W = work from Item 2, t = time). Power is measured in watts (W).

Name _____ Date _____

Fires Stunts/Insulation

While You Read

Reading Strategy: Using a Graphic Organizer (Vocabulary Map)

As you read pages 82 to 87, think about fire and insulators and insulation. As you read, complete the vocabulary map below.

Definition:

Antonym(s):

Insulator

Sentence: _____

_____

Examples:

Lights, Camera, Action!

Steve is comparing different types of insulators. He checks the change in temperature of 100 mL of water using different materials to insulate the glass holding the water. Use the data in the chart to answer the following questions.

Time (min)	Temperature of water in a container insulated with:		
	Insulator 1	Insulator 2	Insulator 3
0	20°C	20°C	20°C
15	13.3°C	17.2°C	18.9°C
30	6.7°C	14.4°C	17.8°C
45	0.0°C	11.7°C	16.7°C
60	– 6.8°C	8.9°C	15.6°C

1. Which sample is the best insulator? Insulator _____

   How do you know? _____

   _____

2. Which sample is the poorest insulator? Insulator _____

   How do you know? _____

   _____

Name _____ Date _____

Explosions: More Ways to Blow Things Up

While You Read

Reading Strategy: Cause and Effect

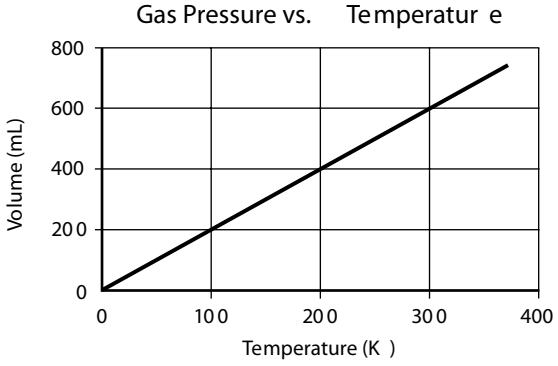
As you read pages 88 to 92, think about how Steve uses his knowledge of chemistry to create "explosive" effects. For each "cause" describe the corresponding "effect."

Cause	Effect
1. A rapid chemical reaction occurs making a tremendous amount of gas . . .	
2. Building gas pressure is released in one direction . . .	
3. A fuel reacts with oxygen, burning at a speed of 1,100 feet per second . . .	
4. Energy, usually heat energy, is added to fuel and oxygen . . .	

Lights, Camera, Action!

When planning a stunt using an explosion, Steve needs to know how the gas produced by the reaction will behave. As part of his schooling Steve learned about gas behavior—he would have studied graphs like the one below. Use the graph to answer the following questions about gas behavior.

1. When the temperature of the gas increases, the volume _____.
2. When the temperature of the gas is 100K, the volume of the gas is _____ mL.
3. When the gas has a volume of 600 mL, the temperature of the gas is _____ K.



Name _____ Date _____

Chemical Reactions

While You Read

Reading Strategy: Finding the Main Idea

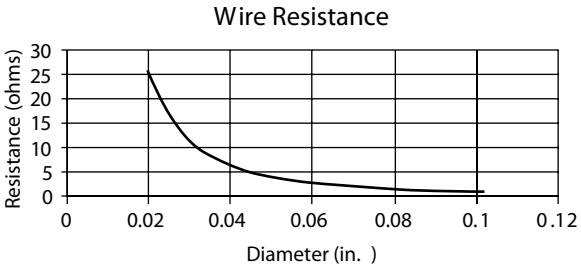
As you read pages 94 to 103, think about making and completing an electric circuit. Complete the statements below.

1. The circle that electricity travels is known as a(n) _____ _____.
2. In an electric circuit the flow of current starts at the _____ terminal of the battery.
3. The particles creating an electric current are known as _____.
4. When a switch is _____ the electric circuit is complete and electric current will flow.
5. To convert electric current to heat the resistance in the wire needs to _____.
6. For safety reasons a firing box has two switches. There is one switch attached to the trip wire. There is a second switch that the operator uses called the _____ switch. Only when both are ON will the explosion occur.

Lights, Camera, Action!

Steve needs to decide on the wire to use for a fire stunt. Part of the process of selecting the right wire is choosing one with a desired resistance. Steve consults a graph like the one below. Use the graph to answer the following questions.

7. In general, as the diameter of a wire decreases (the wire gets thinner) the resistance _____.
8. In looking at the graph, will the resistance in a wire ever be zero? _____
9. Steve needs a wire in which the resistance is less than 6 ohms. What should be the thickness of the wire? _____



Name _____ Date _____

Electric Circuits/Series and Parallel Circuits/Firing Box

While You Read

Reading Strategy: Compare and Contrast

As you read pages 105 to 111, think about series and parallel circuits. Complete the compare and contrast chart below.

Series		Parallel
	How are they alike?	
	How are they different?	

Lights, Camera, Action!

Steve needs to create a parallel circuit. The circuit has a battery, wires, a switch, and three light bulbs connected in parallel. Draw a circuit diagram of Steve's circuit.

Name _____ Date _____

Atmospherics

While You Read

Reading Strategy: Understanding Vocabulary

As you read pages 112 to 125, look for the states of matter and when matter changes from one state to another. As you read, complete the following chart. You might need to use your textbook or dictionary for some terms.

Start from:	Change to:	Name
solid	liquid	
	solid	freezing
liquid		boiling
gas		condensation
solid	gas (skipping liquid phase)	
gas	solid (skipping liquid phase)	

Define each of the following terms.

1. Solute _____
2. Solution _____
3. Solvent _____

Lights, Camera, Action!

Steve is making a solution of SnowSyrup. He dissolves 3 gallons of syrup in water and makes 150 gallons of the solution. What is the percent solution of this mixture. Use the formula:

$$\text{concentration} = (\text{quantity of solute} \div \text{quantity of solution}) \times 100$$

Name _____ Date _____

Smoke, Haze, and Mist

While You Read

Reading Strategy: Compare and Contrast

As you read pages 126 to 141, think about the properties of smoke, haze, and mist. Compare the properties of each by completing the following chart.

	Smoke	Haze	Mist
Type of particles suspended in the air			
Can particles be water droplets?			
Low to the ground?			
Spread out evenly?			
Color from a distance.			

Lights, Camera, Action!

On pages 128 and 129, you read about Material Safety Data Sheets. You also saw part of a label for muriatic acid. Look up the Material Safety Data Sheet for muriatic acid and find the following information.

Chemical Name:

Boiling Point:

Solubility in Water:

Appearance and Odor:

Inhalation:

Skin Contact:

Answer Key

1. States of Matter and Plasma

While You Read

	Solid	Liquid	Gas	Plasma
Shape	definite	varies	varies	varies
Volume	definite	definite	varies	varies
Closeness of the particle	very close	close	far apart	far apart
Movement of the particles	slight	slip and slide past each other	stay far apart	stay far apart
Example	ice or any solid	water or any liquid	steam/water vapor or any gas	plasma TV or neon lights

Gases are made of atoms with their electrons. Gases are common on Earth.

Lights, Camera, Action!

students can group liquids and gases together as well as plasma

2. Changes in States of Matter

While You Read

1. 3
2. 1
3. 5
4. 2
5. 4

Lights, Camera, Action!

6. Juice 3
7. Juice 1 or 2
8. Juice 2

3. Fire and Chemical Reactions

While You Read

1.
a. fuel
b. oxygen
c. heat

2. oxygen
3. fuel
4. nonflammable
5. propane

Lights, Camera, Action!

6. propane/oxygen
7. CO_2/H_2O/fire
8. product

4. Fluids

While You Read

Definition: material that takes the shape of the container in which it is placed

Examples of fluids

water

oxygen

Fluids

Examples of valves

see page 33

States of matter that are fluids

liquids and gasses

Lights, Camera, Action!

1. Evaporation and condensation are changes in the state of matter that happen between 0 and 100 degrees C for water.

2. As the temperature increase, the atoms have more energy.

5. Combining Systems/Carbon and Hydrocarbons

While You Read

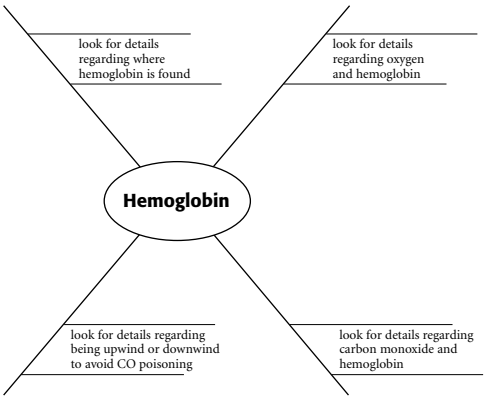
Cause	Effect
1. Combine fuel, oxygen, and heat . . .	a chemical reaction (burning) occurs
2. Apply fire (heat) from a chemical reaction to a liquid . . .	the liquid will change to a gas
3. Chemically combine carbon atoms and hydrogen atoms . . .	a hydrocarbon will form
4. Chemically combine propane with plenty of oxygen . . .	complete combustion of propane producing CO_2 and H_2O
5. Chemically combine propane with a limited amount of oxygen . . .	incomplete combustion, producing carbon (C) or carbon monoxide (CO)

Lights, Camera, Action!

1. hydrogen
2. 108MJ

6. Hemoglobin

While You Read



Lights, Camera, Action!

Symbol	Element's Name	Number of Atoms
C	carbon	2,952
H	hydrogen	4,664
N	nitrogen	812
O	oxygen	832
S	sulfur	8
Fe	iron	4

7. Gravity/Compressing Gases

While You Read

1. Gravity is the natural force of attraction created by a celestial body such as Earth.
2. landing
3. airbag
4. slowing down
5. compressed

Lights, Camera, Action!

6.
   a. 2.09 seconds
   b. 45.76 mph
   c. 10,500 ft-lb
7.
   a. 3.05 seconds
   b. 66.99 mph
   c. 30,000 ft-lb

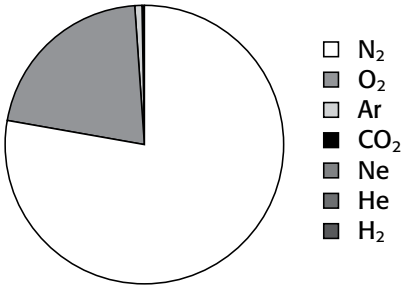
8. Components of Air

While You Read

Gas Name	Chemical Formula	Percent Volume
Nitrogen	N_2	78%
Oxygen	O_2	21%
Water Vapor	H_2O	0 to 4%
Argon	Ar	0.93%
Carbon Dioxide	CO_2	0.0360%
Neon	Ne	0.0018%
Helium	He	0.0005%
Hydrogen	H_2	0.00005%

1. nitrogen
2. 99
3. about 1

Lights, Camera, Action!



9. Simples Machines/Examples of Simple Machines

While You Read

Simple Machine	Description	Example
Lever	A stiff bar that rests on a support called a fulcrum.	
Inclined Plane	A slanting surface connecting a lower level to a higher level	
Wedge	An object with at least one slanting side ending in a sharp edge	
Screw	An inclined plane wrapped around a pole	
Wheel and Axle	A wheel with a rod, called an axel, through its center: both parts move together	
Pulley	A grooved wheel with a rope or cable around it.	

Lights, Camera, Action!

1. screw
2. wheel and axle
3. lever
4. wedge
5. wheel and axle
6. lever

10. Pulleys

While You Read

Pulleys

Definition of a pulley:
a simple machine that is made up of a grooved wheel that is used to change the direction of force

Definition of mechanical advantage
the ratio between output force and input force

Relationship between the number of ropes in a system and its mechanical advantage.
the mechanical advantage of a pulley system is the same as the number of ropes in the system

Drawing of a pulley
see http://en.wikipedia.org/wiki/Image:Polea-simple-fija.jpg

Lights, Camera, Action!

Pulley system – mechanical advantage 5
system should have 5 pulleys and 5 ropes

Pulley system – mechanical advantage 8
system should have 8 pulleys and 8 ropes

11. Tensile Strength and Tension

While You Read

Harnesses and Rigs

Can resist breaking during a stunt because of a property called ___tension___.

Two types:
a. vertical rig
b. zipline

Harnesses are typically made of a strong material called ___nylon webbing___.

This material is strong because of strong ___tensile___ ___strength___.

The tension in a ___vertical___ rig is equal to the weight of the load.

The tension in a ___zipline___ rig can be as much as 10 times the weight of the load.

Lights, Camera, Action!

1. 5,000
2. about 2,800

12. Blowing Things Up/Air Cannons/ Pressure & Force, Work, Time, Distance, and Energy

While You Read

1. against/away
2. compressor/barrel/pushed away
3. Pressure is the amount of force exerted per unit area of a surface.
4. work/time

Lights, Camera, Action!

1. 450 N
2. 45,000 J
3. 15,000 W

13. Fires Stunts/Insulation

While You Read

Insulator

Definition:
something that blocks the flow of energy, heat, or electricity

Antonym(s):
conductor

Sentence:
The ice did not melt because the foam was an insulator.

Examples:
rubber, glass, and foam

Lights, Camera, Action!

1. 3; Number 3 is the best insulator because the least amount of heat was lost.
2. 1; Number 1 was the worst insulator because the most heat was lost.

14. Explosions: More Ways to Blow Things Up

While You Read

Cause	Effect
1. A rapid chemical reaction occurs making a tremendous amount of gas . . .	the gas expands quickly producing tremendous pressure.
2. Building gas pressure is released in one direction . . .	the released pressure can move an object.
3. A fuel reacts with oxygen, burning at a speed of 1,100 feet per second . . .	an explosive reaction occurs.
4. Energy, usually heat energy, is added to fuel and oxygen . . .	a chemical reaction will occur.

Lights, Camera, Action!

1. increases
2. 200
3. 300

15. Chemical Reactions

While You Read

1. electric circuit
2. negative
3. electrons
4. closed
5. increase
6. arming

Lights, Camera, Action!

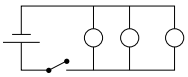
7. increases
8. No
9. 0.4 in. or greater

16. Electric Circuits/Series and Parallel Circuits/Firing Box

While You Read

Series		Parallel
	How are they alike?	
	they have a battery they have wires current flows from negative to positive terminal they have two or more resistors	
	How are they different?	
all parts are connect in one big circle current travels in one path an opening in the circuit deactivates the entire circuit		resistors are on different wires current travels along several paths an opening in the circuit deactivates just that one path

Lights, Camera, Action!



17. Atmospherics

While You Read

Start from:	Change to:	Name
solid	liquid	melting
liquid	solid	freezing
liquid	gas	boiling
gas	liquid	condensation
solid	gas (skipping liquid phase)	sublimation
gas	solid (skipping liquid phase)	deposition

1. is the substance that dissolves in a solvent.
2. is a homogenous mixture thoughout which two or more subanctances are uniformly dispersed.
3. is the substance that a solute dissolves in.

Lights, Camera, Action!

2% solution

18. Smoke, Haze, and Mist

While You Read

	Smoke	Haze	Mist
Type of particles suspended in the air	solid or liquid	solid or liquid	liquid
Can particles be water droplets?	no	yes	yes
Low to the ground?	yes and no	no	yes
Spread out evenly?	yes and no	yes	no
Color from a distance.	varies - usually black	brownish	bluish

Lights, Camera, Action!

Chemical Name: Hydrochloric Acid

Boiling Point: 127° F

Solubility in Water: Complete

Appearance and Odor: Clear Colorless to Yellowish Fuming Liquid, Pungent and Irritating

Inhalation: Inhalation causes severe irritation of upper respiratory tract. Remove person to fresh air. If not breathing, give artificial respiration. Call physician.

Skin Contact: CORROSIVE ! Can cause redness, pain and skin burns. Can cause some tissue destruction. Immediately flush with water.

TEXAS A&M Student Presentations

Teacher Summit 2011

TEXAS A&M STUDENT PRESENTATIONS

Student Presentations

From the Colleges of

Engineering & Science

At

Texas A&M University

TEXAS A&M COLLEGE OF SCIENCE

TEXAS A&M ENGINEERING

TEXAS A&M ENGINEERING

Albert L. Soto

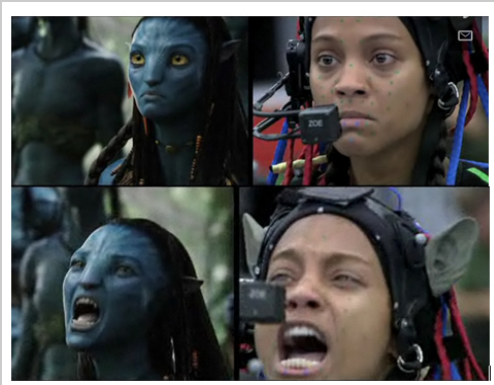
Senior Mechanical Engineering Student

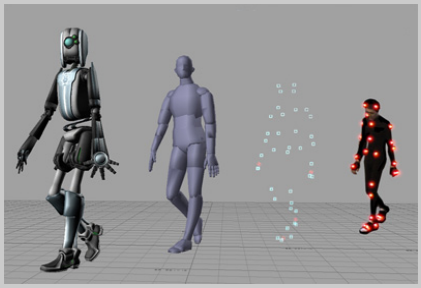
BOEING

LASR
Land Air and Space Robotics

PhaseSpace MoCap Camera System

Motion Capture Camera used for Animating Human Motion

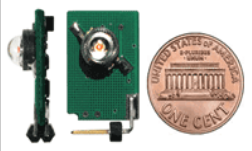




Motion Sensing

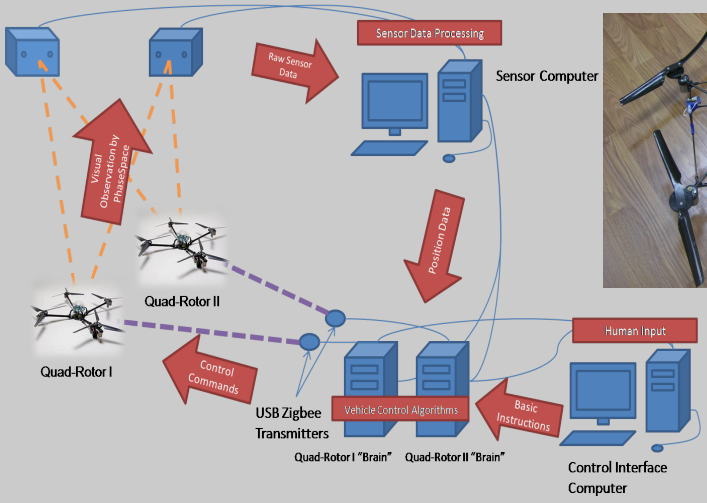
- Uses active, uniquely identifiable beacons
  - Track specific points
- 8 x 12-megapixel equivalent cameras @ 480 Hz
  - Real-time tracking
- Accuracy on the order of 1 cm
  - Detect relatively small motions
- Visible red or Infrared
  - Operates in typical room light

PhaseSpace camera



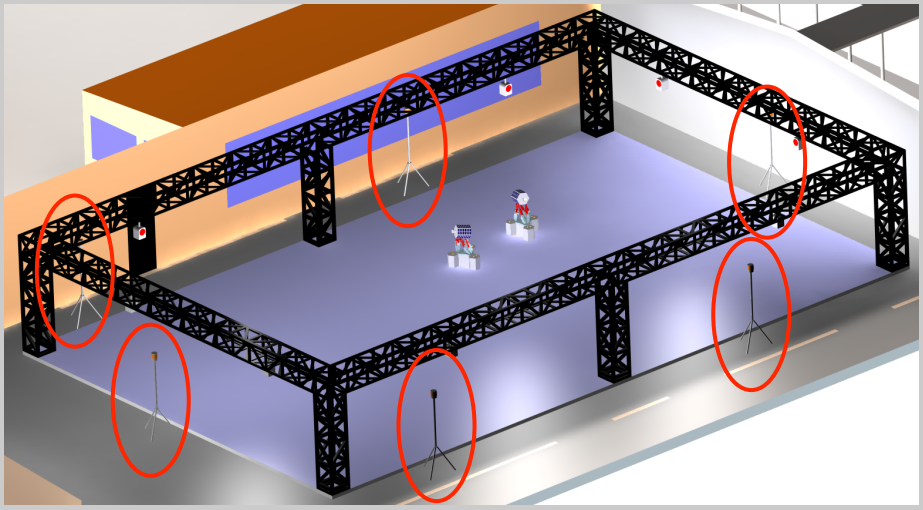
PhaseSpace beacon

UAV Tracking for Coordination



MoCap for Robotics

MoCap Tracking



MoCap Tracking

Given: Two 2D cameras and one marker = 3D position

Problem 1: Minimum number of cameras to determine a rigid body state in 3D space?

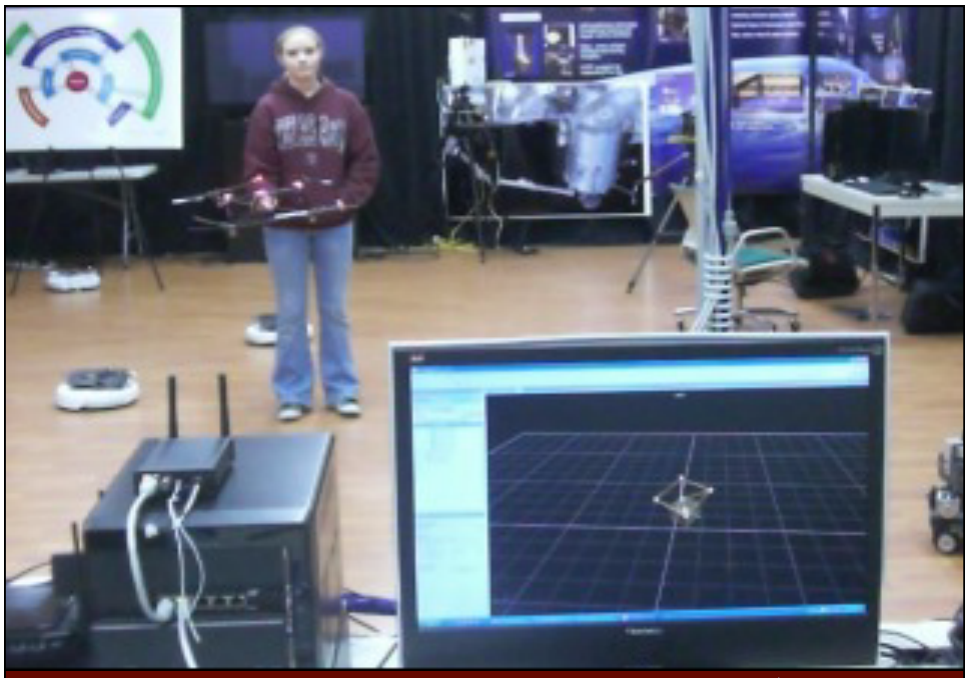
Solution: Fewest points to form a 6 DOF body (Degrees of Freedom) is three points (triangle)

3D space = 6 DOF

(3 markers) x (2 cameras per marker) = 6 cameras

Problem 2: Why is the "Given" statement true?

Hint: Computer graphics (vectors & reference frames)



High School Profile

Pflugerville HS
Pflugerville, Texas

Took: (2007)

- Mathematics: Algebra, Geometry, PreCal, and Calculus BC
- Science: Physics, Chemistry, Biology, and Physics A & C
- Electronics and Welding

Did not take:

- Statistics, Engineering "Fundamentals", Computer Programming, Computer-Aid-Design or Graphics
- Robotics or Scientific extracurricular activities

Did not follow "Distinguished" degree plan

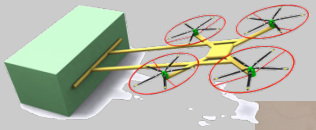
Not in top 10%

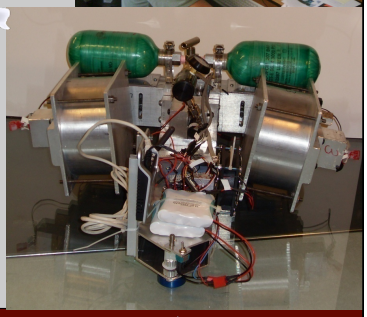
Interests: Taking things apart, Building things, Figuring out how things work

College Career

- 4 years of Undergraduate Engineering Research
  - Boeing Research Scholarship
- Internships:
  - Cornell (2008)
  - TAMU (2009)
  - MIT (2010-2011)
- 3 Research Publications
- Soto Technologies International

$$\xi = \delta + f\tan\left[\tan^{-1}\left(\frac{b_x\cos\alpha + b_y\sin\alpha}{b_z}\right) - \beta\right] + 1800,$$





Why Be an Engineer At Texas A&M?

Opportunity & Professional Skills

Course + Undergraduate Research + Capstone Classes

- Frequent Feedback with Engineering Professionals
- Training with Industry Standard Engineering Tools
- Leading-Edge Projects – Challenging and Interesting
- Introduce to Industry Methods
- Ability to Breaking Down Difficult Problems and Analyze

To Learn, to Communicate, and Time Management

TEXAS A&M ENGINEERING

Christie Tipton

Senior in Biomedical Engineering

The Girl Behind the Calculator

3rd Generation Aggie

Headed to Graduate School

PURDUE UNIVERSITY

Almost Done!

Love to Run

Navigating High School

- AP Classes
  - Science – Pre-AP physics, AP Physics (Not Calculus-based), AP Biology
  - Math – Pre-Calculus , AP Calculus AB
  - English – AP Composition and Rhetoric

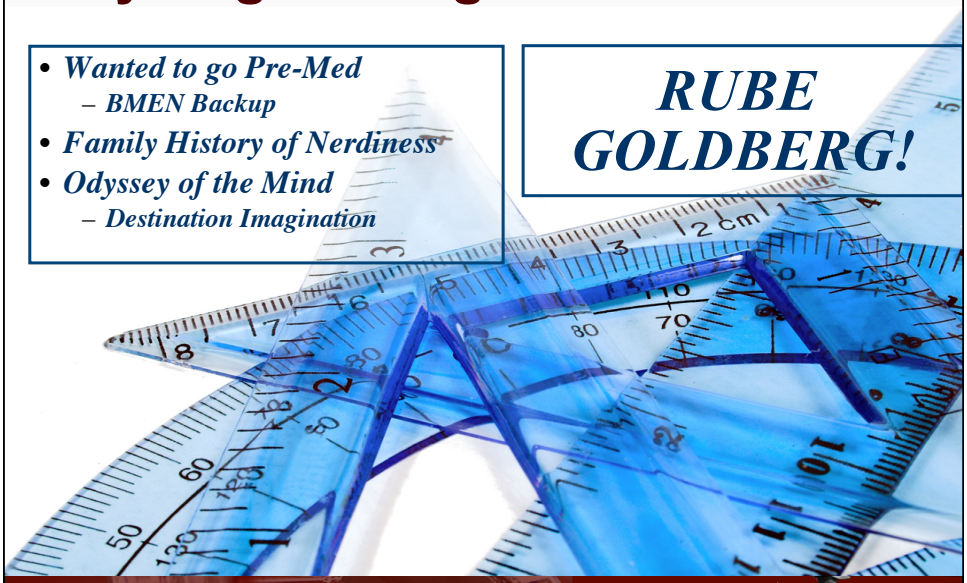
- Focus on Class Rank!

- Team-Oriented Activities*
  - Drill Team
  - Choir

Why Engineering?

- *Wanted to go Pre-Med*
  - *BMEN Backup*
- *Family History of Nerdiness*
- *Odyssey of the Mind*
  - *Destination Imagination*

RUBE GOLDBERG!



College Experiences

SEI

- Hands-Free Maintenance System
- Analyte Detection Via Protein Nanopore
  - Vomit Comet!
- PEM Fuel Cell Efficiency
- Two Phase Universal Heat Bus

Shadowing

- General Surgeon at St. David's Austin

NanoMedical Systems/ Continuum Biomechanics Lab

- Try it, you'll like it!

Goals

1. *Bachelors in Biomedical Engineering*
2. *Direct PhD in Cardiovascular Biomechanics*
3. *Take an inside look at Academia*
   - *Teaching Assistant / Research Assistant / Fellowships*
4. *Decide between Academia or Industry*

TEXAS A&M COLLEGE OF SCIENCE

Nicole Reusser

Senior in Department of Chemistry

High School Career

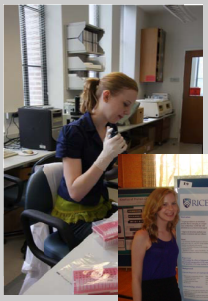
Bellaire High School
Houston, TX

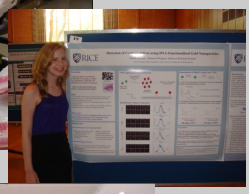
- AP classes:
  - Biology II, Chemistry II, Calculus BC, English Language, English Literature, French Language, French Literature, World History, US History, Political Science, Economics
- Awarded 62 transfer credit hours
- Extracurricular activities: Volunteer at Houston Zoo, French Symposium, Mock Trial Club, Piano
- Top 10%: chose TAMU based on interaction with faculty, research opportunities, and "feel" for the campus

Undergraduate Career

Texas A&M University
College Station, TX

- 3 years of study, average 14 hrs/sem
- Summer Internships:
  - Rice University, Houston TX
    - HHMI intern in Bionanotechnology under Dr. Rebecca Richards-Kortum
    - Oligonucleotide-Gold Nanoparticle Networks for Detection of *Cryptosporidum parvum* Heat Shock Protein 70 mRNA
  - Air Liquid, Paris France
    - IIP intern in Photovoltaics at Claude-Delorme Research Center
    - Transparent Conductive Oxides for use in Solar Cells





Undergraduate Career

Texas A&M University
College Station, TX

- Employers:
  - Texas Ear, Nose & Throat Consultants, Houston TX
    - Floor Specialist
  - Texas A&M University, College Station TX
    - Student Lab Tech in Psychology Department under Dr. Mary Meagher
  - Touch of Class, Houston TX
    - Rehabilitation Assistant
- Extracurricular Activities:
  - Volunteer at St. Joseph's Hospital, Volunteer for Project Sunshine, Academic Chair for the Student Affiliate Chapter of the American Chemical Society

Future Career

- Goal: Career in Medicine with an emphasis on medical and clinical research
- Texas A&M has given me:
  - Mentors to guide me in career choice
  - Opportunities to gain experience in different fields
  - Knowledge to prepare, expand and apply myself
  - Excellence, Integrity and Confidence
- Applied and received offers for Medical School

College Preparation Session

Teacher Summit 2011

COLLEGE PREPARATION

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Thursday, January 27, 2011 | College Station Hilton Hotel and Conference Center

5:30–7:30 p.m.	**Registration**
6–8 p.m.	**Welcome Reception — Oakwood Ballroom** *Hors d'oeuvres and refreshments*

Friday, January 28, 2011 | College Station Hilton Hotel and Conference Center

7:30–9 a.m.	**Registration**
7:45–8:15 a.m.	**Hot Breakfast Buffet**
8:15–8:45 a.m.	**Welcome — Ballroom 3**
8:45–9:45 a.m.	**Wolf Stunt Works Presentation — Ballroom 3**
9:45–10:15 a.m.	**Resource Tables and Break — Ballrooms 4–7**
10:15–10:45 a.m.	**Session 1 Workshops:** Team Howdy — Ballroom 1 Team Gig'em — Ballroom 2 Team Reveille — Mockingbird Room C Team 12th Man — Mockingbird Room D
10:45–10:50 a.m.	**Rotate**
10:50–11:20 a.m.	**Session 2 Workshops:** Team Howdy — Ballroom 2 Team Gig'em — Ballroom 1 Team Reveille — Mockingbird Room D Team 12th Man — Mockingbird Room C
11:20–11:25 a.m.	**Rotate**
11:25–11:55 a.m.	**Session 3 Workshops:** Team Howdy — Mockingbird Room C Team Gig'em — Mockingbird Room D Team Reveille — Ballroom 1 Team 12th Man — Ballroom 2
11:55 a.m.–12 p.m.	**Rotate**
12–12:30 p.m.	**Session 4 Workshops:** Team Howdy — Mockingbird Room D Team Gig'em — Mockingbird Room C Team Reveille — Ballroom 2 Team 12th Man — Ballroom 1
12:30–1:45 p.m.	**Lunch, Vendor Door Prize Drawings and Resource Tables — Ballrooms 4–7**
1:45–2 p.m.	**Diamond Sponsor Remarks: Chevron and NPI Presentations — Ballroom 3**
2–3:15 p.m.	**Presentation — Ballroom 3** ***How to use what you learned today in the classroom by Steve Wolf***
3:15–3:45 p.m.	**Presentation — Ballroom 3** ***How to Best Prepare High School Students for Success in a STEM Major by Dwight Look College of Engineering and College of Science***
3:45–4 p.m.	**Break**
4–4:30 p.m.	**Texas A&M Student Presentations — Ballroom 3**
4:30–4:45 p.m.	**Closing — Ballroom 3**
4:45–5 p.m.	**Door Prize Drawings — Ballroom 3**
5 p.m.	**Adjourn**

TEXAS A&M ENGINEERING

TEXAS A&M COLLEGE OF SCIENCE