Getting to the Core

Grade 8 Unit of Study

STUDENT RESOURCE

Roller Coaster Physics

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SAUSD Common Core Science 8 Unit – Roller Coaster Physics

Contents:
Big Idea – Energy plays an important role in manufacturing design.

Name ___________________________________

Quick Write and Round-Robin on Roller Coasters

Quick Write

Choose ONE of the following questions and write your answer using complete sentences in the box below:

1. Think of your favorite roller coaster or amusement park ride. Describe where it is, when you rode on it and why it is your favorite.
2. What is the scariest roller coaster you have ever heard of? Describe where it is and what makes it so terrifying.

Round-Robin

- Working in teams of four, take turns reading your quick write statements to the group.
- The person with the shortest first name (student A) goes first, then B, C and D.
- Everyone shares—even if a previous team member had the same response.
- Others may not interrupt or comment until everyone has shared their experience.

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Roller Coaster Physics

Day 1/Day 14 Extended Anticipatory Guide

Statement	Day 1		Day 14		Day 14 Evidence
	Agree	Disagree	Agree	Disagree	Evidence: Explain using your own words
1. At the bottom of a hill, a roller coaster has the greatest amount of potential energy.					
2. “One G” of force is equal to the amount of gravity acting on you right now.					
3. “Air time” on a roller coaster occurs when all of the forces are balanced.					
4. Engineers don’t revisit or change their design plans once they begin a project.					
5. Roller coasters work by converting potential energy into kinetic energy.					
6. Potential energy is the energy of motion.					
7. Roller coasters are the leading cause of brain hematomas.					
8. Inertia makes your body slam into the side of the car when a coaster turns sharply.					
9. When you travel in a loop you don’t fall out because of gravity.					
10. Acceleration does not occur during sharp turns.					

Name ___________________________

Roller Coaster History

1. Roller coasters have a long, fascinating history. The direct ancestors of roller coasters were monumental ice slides -- long, steep wooden slides covered in ice, some as high as 70 feet -- that were popular in Russia in the 16th and 17th centuries. Riders shot down the slope in sleds made out of wood or blocks of ice, crash-landing in a sand pile.

2. Coaster historians diverge on the exact evolution of these ice slides into actual rolling carts. The most widespread account is that a few entrepreneurial Frenchmen imported the ice slide idea to France. The warmer climate of France tended to melt the ice, so the French started building waxed slides instead, eventually adding wheels to the sleds.

3. In 1817, the Russes a Belleville (Russian Mountains of Belleville) became the first roller coaster where the train was attached to the track (in this case, the train axle fit into a carved groove). The French continued to expand on this idea, coming up with more complex track layouts, with multiple cars and all sorts of twists and turns.

4. The first American roller coaster was the Mauch Chunk Switchback Railway, built in the mountains of Pennsylvania in the mid-1800s. The track, originally built to send coal to a railway, was reconfigured as a "scenic tour." For one dollar, tourists got a leisurely ride up to the top of the mountain followed by a wild, bumpy ride back down.

5. Over the next 30 years, these scenic rides continued to thrive and were joined by wooden roller coasters similar to the ones we know today. These coasters were the main attraction at popular amusement parks throughout the United States, such as Kennywood Park in Pennsylvania and Coney Island in New York. By the 1920s, roller coasters were in full swing, with some 2,000 rides in operation around the country.

6. With the Great Depression and World War II, roller coaster production declined, but a second roller coaster boom in the 1970s and early 1980s revitalized the amusement park industry. This era introduced a slew of innovative tubular steel coasters. Some of the most popular ride variations -- such as the curving corkscrew track -- saw their heyday around this time.

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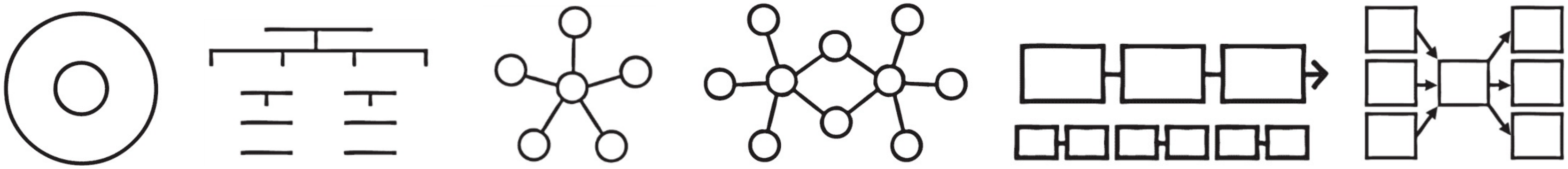
Thinking Map - The History of Roller Coasters

Step 1: After reading the article, “The History of Roller Coasters,” number the events that lead to the creation of a modern day roller coaster.

Step 2: Working with your team, create a Thinking Map that best organizes the events listed in the article.



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CONCLUSION: Compare all the coasters you have read about today. What do all the coasters have in common with respect to what makes them move?

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Name ___________________________________

Question Generator

Instructions: As a team generate as many <u>questions</u> as you can that relate to the following statement:

Roller Coasters work by converting Potential Energy into Kinetic Energy

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Energy Exploration

Materials:

- 3 foot section of foam tubing
- marble
- stopwatch
- meter stick

Guidelines:

1. The marble cannot leave the foam track in order for the trial to be recorded.
2. You must collect some type of quantitative data (numbers) for the trial to be recorded.
3. The foam track cannot be moved while the marble is moving.
4. You must release the marble only, not push it.

Data Table

	Design 1	Design 2	Design 3	Design 4
Diagram				
Observations				

Conclusion:

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Kinetic and Potential Energy

Potential Energy

Potential energy is the same as stored energy. The "stored" energy is held within the gravitational field. When you lift a heavy object you exert energy that later will become kinetic energy when the object is dropped. A lift motor from a roller coaster exerts potential energy when lifting the train to the top of the hill. The higher the train is lifted by the motor the more potential energy is produced, thus forming a greater amount of kinetic energy when the train is dropped. At the top of the hill the train has a huge amount of potential energy, but it has very little kinetic energy.

Kinetic Energy

The word "kinetic" is derived from the Greek word meaning to move, and the word "energy" is the ability to move. Thus, "kinetic energy" is the energy of motion -- it's the ability to do work. The faster the body moves the more kinetic energy is produced. The greater the mass and speed of an object, the more kinetic energy there will be. As the train accelerates down the hill the potential energy is converted into kinetic energy. There is very little potential energy at the bottom of the hill, but there is a great amount of kinetic energy.

From: http://library.thinkquest.org/2745/data/ke.htm

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Name ___________________________________

Clarifying Bookmark 1: Talk About what you understand

What I can do	What I can say	What my partner can say
Think About Meaning	After rereading this part, I think it may mean... I'm not sure what this is about, but I think it means...	*I agree/disagree because...* *I think I can help, this part means...*
Get the Gist/Summarize	What I understand about this so far is… The main points of this section are... I can paraphrase this part in these words...	*I agree/disagree because...* *I agree disagree and I would like to add...* *I don't understand, can you explain more?*

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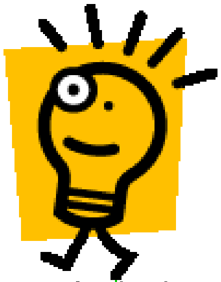

What Makes Roller Coasters So Thrilling?

In the box below, **brainstorm** as many thrilling components as you can think of.

Draw a picture or diagram that illustrates the most thrilling part of the ride.

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Name ___________________________________

BATMAN THE RIDE
Six Flags Magic Mountain

1. Prepare for the ride of your life...hang on tight, but most importantly keep your feet inside the car...but...what happened to the floor of the car? Batman The Ride takes the concept of a roller coaster to a new dimension. On Batman, your feet dangle free from the ski lift style trains that hang from the track overhead.

Batman The Ride – The Story

2. After entering through the Gotham City portal, visitors stroll through Bruce Wayne's beautifully landscaped Gotham City Park, complete with ornate sculptures and an ongoing concert of nature sounds symphony.

3. As unsuspecting guests venture further, the peacefulness of Gotham City Park is suddenly disturbed by unsettling noise in the streets, which are now ruled by Batman's arch-enemies. Guests will encounter a crashed police car, broken fire hydrant and other evidence of the growing chaos in the streets.

4. Once in the underground tunnels beneath Gotham City, guests will finally escape through the Batcave and be whisked away on Batman's newest crime-fighting device, Batman The Ride.

Batman The Ride

5. Suspended from the track, riders fly through the air, feet dangling free, experiencing sensations only felt on an inverted coaster.

6. After cresting the ten story lift hill, the ride begins with a 87-foot twisting dive into a seven story tall vertical loop, followed by a zero-G one-of-a-kind spin and a second 68-foot vertical loop.

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7. Riders then proceed at full throttle through several twisting turns, a few quick dips and two more corkscrew inversions sending your feet for the sky, before the brake run.

8. The sensation created by an inverted coaster is very different from that of traditional roller coasters. It is a sensation that every coaster fan must experience. Batman The Ride boasts a top speed of 50 mph that is consistently maintained throughout the ride while giving riders the force of up to 4 G's. The heart pounding centripetal force is felt as riders race around the turns and through the loops.

9. Batman The Ride was built and designed by premier coaster experts Bolliger and Mabillard and was the first inverted roller coaster in Southern California. Today Batman remains one of the most popular attractions at Six Flags Magic Mountain.

Adapted by SAUSD from:

http://www.ultimaterollercoaster.com/coasters/reviews/batman/

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GHOSTRIDER

Knott's Berry Farm

1. In 1998 Knott's Berry Farm in Buena Park California set out to build one of world's greatest thrill rides and the first major new attraction in nearly a decade. GhostRider would become one of the tallest, fastest and longest wooden roller coasters in the world.

GhostRider – The Ride Experience

2. Designed to fit into the rugged Western town, GhostRider was the first major attraction for the Ghost Town since the Timber Mountain Log Ride opened in 1969. This state-of-the-art wooden roller coaster instantly became the park's flagship attraction and one of the most visible, seen passing over Grand Avenue at the park entrance and from nearby Beach Boulevard.

3. Seated two to a row, 28-passengers depart the station dipping into a spiral turn before approaching the lift hill. While a nice start, it's just a quick teaser of what's to come.

4. While climbing the lift hill riders are treated to a beautiful Southern California view of Knott's and the nearby surroundings. Don't let the pleasant view fool you because the fun quickly begins at the lift's peak, when without warning, the lead car suddenly disappears over the edge. Falling down the 118 ft in the first drop at a 51-degree angle, to reach a top speed of 56 mph! If you're in the rear prepare for the first of what will be many doses of “airtime.”

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5. If you're into airtime then GhostRider is going to be your best friend. GhostRider sets a precedent for what airtime should be on a world-class wooden roller coaster...*EXTREME!*

6. Out of the second drop the lead car powers up a hill and dips into a 180-degree turn with a swooping dip at the edge of Beach Boulevard. The trains take the turn with relentless speed, the centripetal force delivers powerful lateral G forces of up to 3.14 G. Out of the turn, the train dives into the third drop, speeding back towards the station.

7. Slowing down high above the station, the trains make a 180-degree turn without banking on level track, producing an intense amount of lateral G force. But don't be fooled by the milder attitude...a surprise awaits, especially for those in the rear of the train.

8. As unexpected as it comes, the train passes through the block break to suddenly fall with force down a steep drop into the middle of the wooden structure. Those in the rear cars will surprisingly be ejected from their seats with force for some standing airtime from the negative G force.

9. The second half of GhostRider takes on a different feel as it winds its way through the immense wooden structure. Screams can be heard from within as the train flies over Grand Avenue to enter the lower level of the second 180-degree turn at the Beach Boulevard end.

10. Headed back towards the station, the train screams up and over a bunny hill crossing Grand Avenue again with a pop of floating air. Entering the finale the intensity does not let up. The train flies into a helix with a speed of 56 miles per hour. Your body is immediately taken over by lateral G forces that are so intense that even the strongest of souls must beg for forgiveness.

11. With speed to spare, the train rounds the final corner to meet the final break run which quickly slows the mining cars to a stop. The initial reaction...words cannot describe it. Quite simply said, GhostRider's one incredible ride!

Adapted by SAUSD from:
http://www.ultimaterollercoaster.com/coasters/reviews/ghostrider/

Name ___________________________________

PHANTOM'S REVENGE
Kennywood

1. Thrill seekers beware... a Phantom seeking revenge is lurking at Kennywood Park. Will the Phantom get his revenge?

2. Kennywood is a traditional amusement park with a rich history dating back more than a hundred years. Walking through the Pittsburgh, Pennsylvania park is like taking a step back in time. Many of the park's primary attractions date back to the early 1900's and deliver thrills typical of the era.

3. This reinvented roller coaster is nothing typical of a ride you'd find in a traditional amusement park. Instead, it's a ride of gargantuan size, bird's flight airtime and stealth like speed.

4. The first part of the Phantom's Revenge rises up out of the station sixteen stories. The original steel track bends to the right as it forms the first drop that then leads to the first hill. Once you crest the first hill, the anticipation is over as the train begins the impressive and equally famous 228-foot drop. Heading downward your heart starts racing as the train accelerates to 82 mph before diving under the wooden structure for the Thunderbolt roller coaster. With a high-speed turn to the left, the centripetal force creates powerful positive-Gs as you turn high above the ground.

5. Traveling back towards the impressive drop on a curvy descent out of the previous turn, the track travels again under the historic Thunderbolt roller coaster passing this time through a tunnel. Beware of a head chopper or two that might scare even the most seasoned rider. Flying out of the tunnel, the track turns

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to the right, where roller coaster fans get a glimpse of the numerous, “air time” producing bunny hills ahead.

6. Two small bunny hops near the Phantom's station and the track dives into an exciting double down, reminiscent of a ride on a bucking bronco. The ejector air caused by the negative G-forces will just about satisfy anyone who craves an adrenaline rush.

7. But beware of the Phantom, for he hasn't finished his revenge and has saved one more hidden surprise. Turning to the right the Phantom's hidden element sends you flying out of your seat as the Phantom pummels you with a double up just before the brake run.

8. The Phantom's trains hit the brake run with impressive force and speed. If there's one criticism about this near perfect ride, it's that it is too short. Only 1 minute and 57 seconds. Why end the party by burning the speed with brakes when another thousand feet of track could've done the same? Of course, you can have too much of a good thing and with the desire for more, you'll just have to hop back in line for a second ride.

9. The final verdict is the new Phantom is a flat out winner, and it's the kind of revenge we love.

Adapted by SAUSD from:
http://www.ultimaterollercoaster.com/coasters/reviews/phantoms-revenge

Name ___________________________________

X2: Six Flags Magic Mountain

1. It's been dubbed the "most anticipated new ride of the decade" and the world's first "4 D Coaster", but until now no one knew for sure. Now the question is did X2 live up to all the hype?

2. X2 is far different compared to the traditional roller coaster. For the first time ever riders are seated in prototype vehicles that spin independently 360-degrees forwards and backwards on a separate axis. The added spinning effect creates an unprecedented and never before "don't know what to expect next" sensation.

3. The quest for amusement parks to build something bigger and better has been at its height in the past several years. But building restrictions are preventing many parks from going taller and faster, so the industry is looking to the designers to come up with new ideas. X2 is exactly that, a new idea that really pushes the roller coaster to a new level.

4. So would X2 live up to the expectations of being the first 4th Dimension Coaster?

5. The first thing riders will notice about X2 are the monster-sized trains inside the station. The 20-foot wide, 70-foot long wing shaped vehicle seats 28 passengers, two abreast in fourteen individual cars, seven positioned on each side of the train.

6. The state-of-the art restraint system adjusts to each rider's size and safely secures the individual for the duration of the ride.

7. Leaving the station facing backwards, the train rounds a turn and begins its ascent up 190 feet, before reaching the crest of the lift hill. Traveling backwards riders get an impressive, sweeping view of Six Flags Magic Mountain, and are not afforded the comfort of seeing what's to come.

8. Before plunging off the near vertical first drop, the seats you're strapped in suddenly flip forward placing the rider in a position few will be comfortable with. Chills run up your spine, as you realize there is nothing between you and the ground below, as you hang in the restraint disoriented by this sudden surprise. Try not to loose focus now, as the train is about to fall off a steel cliff and drop like a brick.

9. The first drop is insane, descending 215 feet at a near vertical 88.5-degree angle, to reach a blazing speed of 76 mph. But get this, just as you reach full velocity, your seat completes that forward flip that you began 200 feet above all while you experience a G-force of up to 4.0.

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10. Before you've got any clue about what just happened you're back in the upright position, soaring into the first, massive 185-foot Raven Turn. Fly birdie... FLY as the train gains altitude and soars through the turn placing the riders into a flying position. Look down from eighteen stories, spread those arms out and fly... uh, maybe you should scream... SCREAM!

11. Descending out of the Raven Turn the seats rotate backwards as they descend into a valley in the track, but don't relax as the next surprise awaits. As the train rockets into a bunny hop, the seats do a complete zero-G back flip that is filled with beautiful airtime. This makes for a weightless flip that is a perfect floater, graceful and smooth.

12. So now you realize this ride is filled with surprises... and you'd better believe it. The intensity never lets off as the train rounds a sweeping turn high above the station and dives into one of the best elements of the entire ride.

13. Try combining a half-twist, with a forward flip, while traveling at a furious pace and you get one radical maneuver. And as unbelievable as it seems X2 pulls off this feisty element in style, leaving you so disoriented that you literally cannot comprehend the centripetal force that hurls you into the second Raven Turn.

14. And guess what? The ride is not over! With speed to burn, the train soars through the another Raven Turn, this time on the outside of the track and ascends into the final maneuver, a back flip that concludes by sliding into the brake run.

Adapted by SAUSD from:
http://www.ultimaterollercoaster.com/coasters/reviews/x2/

Name ___________________________________

Jigsaw Matrix – Roller Coaster Thrills

	Batman	Ghost Rider	Phantom	X2
Where is the roller coaster found?				
Describe the type of roller coaster.				
What is the maximum speed of the roller coaster?				
Describe the thrilling components of the ride.				
What forces are found in a roller coaster?				

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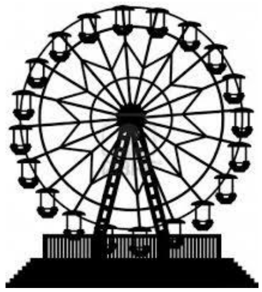
Quick Write



roller coaster

Think of a time you have gone to an amusement park or a fair….

What do <u>workers</u> do to keep you safe on a ride? List as many things as you can think of below:	What does <u>the park</u> do to keep you safe on a ride? List as many things as you can think of below:

Working with your partner, determine which of you has the longest hair.

The partner with the longest hair will read their listed ideas out loud.

The partner with the shortest hair will add any ideas they did not already have listed.

Reverse roles.

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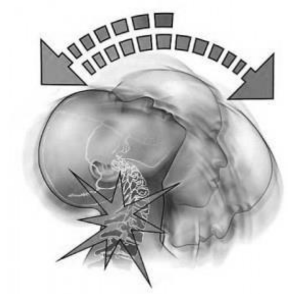
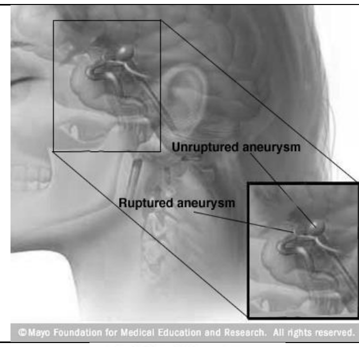
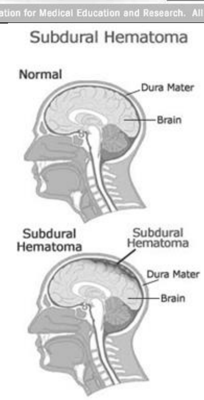
Common Injuries Related to Roller Coaster Riding Matrix

Type of Injury	Location	Diagram	Description of Injury
Whiplash	Neck – soft tissue	 http://drmartinschmaltz.com/whiplash-injuries/	• Injury to soft tissue in neck • Caused by sudden forward and/or backward motion of head • Headache, neck/shoulder pain, dizziness – symptoms may be delayed • Treatment with heat, ice, gentle exercise
Brain Aneurysm	Brain		• A weak area in wall of blood vessel that bulges like a balloon • Can burst - sudden severe headache, vomiting, • Requires immediate surgery • Not caused by roller coaster riding, but if present, can burst during ride
Traumatic Brain Injury – subdural hematoma	Brain	 http://www.health-pictures.com/conditions5/subdural-hematoma.htm#axzz2by3STD2g	• Caused by blow to head • Blood vessels break and blood collects between the skull and the brain itself • Headaches, dizziness, confusion • Can be repaired by surgery
Bone Fractures	Bones		• Caused by physical force exerted on bone that is stronger than the bone itself (falls, twists, etc) • Swelling, pain, deformity, loss of use • Treatment – set bone; severe breaks may require surgery • Skull fractures require immediate medical care

Medical information from webmd.com

Seek medical help for any suspected injury – information above is a summary list, not detailed

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Name ___________________________________

Prediction Matrix

My Article ____

My Predictions and Questions	My Group's Predictions and Questions
After Reading – Summarize the overall message of your article	
As you share – What did you learn from your partners?	

- Skim your article and make predictions/questions about what you think the topic of your article is
- Share your predictions/questions with your group
- Silently reread your article with a pencil, underlining or circling the most important information
- Write a sentence that summarizes the overall message in your article
- Share out with your group – D first, then C, B, and A
- Write down what your partners shared

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Amusement Ride Safety Tips
International Association of Amusement Parks and Attractions (IAAPA)

Safety is the Amusement Park Industry's Number 1 Priority

Safety is a partnership between an amusement park and its patrons. Unfortunately, a majority of the injuries occur because the guest didn't follow posted ride safety guidelines or rode with a pre-existing medical condition.

IAAPA created a list of amusement ride safety tips for guest use.

- Obey listed age, height, weight, and health restrictions.
- Observe all posted ride safety rules.
- Keep hands, arms, legs and feet inside the ride at all times.
- Remain seated in the ride until it comes to a complete stop and you are instructed to exit.
- Follow all verbal instructions given by ride operators or provided by recorded announcements.
- Always use safety equipment provided and never attempt to wriggle free of or loosen restraints or other safety devices.
- Parents with young children should make sure that their children can understand safe and appropriate ride behavior.
- Never force anyone, especially children, to ride attractions they don't want to ride.
- If you see any unsafe behavior or condition on a ride, report it to a supervisor or manager immediately.

http://www.iaapa.org/safety-and-advocacy/safety/amusement-ride-safety/amusement-ride-safety-tips#sthash.qn8iVCvc.dpuf

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Ride Safety in the United States

International Association of Amusement Parks and Attractions (IAAPA)

Safety is the Amusement Park Industry's Number 1 Priority

- Nearly 300 million people visit the approximately 400 amusement parks in the United States annually and take nearly 2 billion safe rides.
- 61 of the 1,415 ride-related injuries reported in 2011, or less than 5 percent of all ride injuries, were considered serious, meaning they required some form of overnight treatment at a hospital.
- The likelihood of being injured seriously enough to require overnight hospitalization for treatment is 1 in 24 million. The chance of being fatally injured is 1 in 750 million. (Based on an average of five rides per guest.)

One of the Safest Forms of Recreation in the United States

Activity: Number of serious injuries per million participant days (based on estimates from the National Sporting Goods Association)

- Roller skating: 912
- Basketball: 799
- Football: 704
- Soccer: 405
- Fishing: 85
- Golf: 53
- Exercising with equipment: Nine
- Playing billiards: Eight
- Camping: Five

Comparatively, data from the National Highway Traffic Safety Administration shows that the number of deaths on America's roadways in 2011 was 32,367.

The National Weather Service estimates the chance of being struck by lightning in the U.S. is 1 in 775,000.

http://www.iaapa.org/safety-and-advocacy/safety/amusement-ride-safety/safety-in-us#sthash.OXdWK94U.dpuf

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Design and Technology

International Association of Amusement Parks and Attractions (IAAPA)

Technological Advancements Result in Safer Experiences

- The design and development of amusement rides requires a mastery of physics, engineering, and mathematics.
- As technology has improved to include computers, advanced materials, and certain design innovations, the result has been an increasingly rigorous, complex, and precise creative process.
- This process has contributed to an extraordinary safety record proving amusement rides are one of the safest forms of recreation available to the public.
- The amusement park industry's tradition of continual improvement greatly enhances ride safety. For example, the introduction of force reactive supports, headrests, comfort padding, seat dividers, ratcheted restraints, computer controls, and magnetic braking systems.
- Modern-day ride designers employ a steady stream of advances to create new, unique, and safe amusement rides and attractions.

Amusement ride manufacturers applied the industry's biodynamic knowledge as it relates to G-forces to the design and construction of rides to ensure a safe experience.

While technological gains have led to the development of bigger and faster rides, overall G-force levels have generally remained the same because riders' tolerance levels have not changed.

http://www.iaapa.org/safety-and-advocacy/safety/amusement-ride-safety/design-techology#sthash.AZKqvBgD.dpuf

Name ___________________________________

G-Forces

International Association of Amusement Parks and Attractions (IAAPA)

- Equal the force of gravity
- One G is equal to the normal pull of earth's gravity on the body.
- Modern-day ride designers employ a steady stream of advances to create new, unique, and safe amusement rides and attractions.
- Amusement ride manufacturers applied the industry's biodynamic knowledge (collected over years) as it relates to g-forces to the design and construction of rides to ensure a safe experience.
- While technological gains have led to the development of bigger and faster rides, overall g-force levels have generally remained the same because riders' tolerance levels have not changed.

When discussing the effects of g-forces on a person who is on a ride, the duration of the g-force and a multitude of other variables must be considered. When it comes to the higher–g sections of amusement rides, exposure often lasts fractions of a second. Therefore, the rider does not experience any adverse effects. Blackouts and other health issues associated with Gs require exposure to g-forces which are either greater in magnitude or of much longer duration than those achieved by today's amusement rides.

A study by Murray Allen, MD, Ian Weir-Jones, P. Eng, Ph.D., and several other doctors and engineers was published in the November 1994 edition of Spine. The study "found that in one event of daily activity, the vector acceleration of 10.4 g was experienced uneventfully." Our bodies are exposed to greater gravitational pull during our everyday lives than that of an amusement park ride.

Examples of everyday gravitational forces:

- Sneeze 2.9
- Cough 3.5
- Crowd jostle 3.6
- Slap on back 4.1
- Hop off step 8.1
- Plop down in chair 10.1

At least five independent scientific reviews have analyzed the issue of amusement ride g-forces, and all five have concluded: The rotational accelerations experienced by the head during rides pose no risk of brain injury to the general populace.

http://www.iaapa.org/safety-and-advocacy/safety/amusement-ride-safety/g-forces#sthash.Y29qWhNZ.dpuf

Name ___________________________________

Vocabulary Review Jigsaw Worksheet

- Work with your partners to complete the Vocabulary Review Jigsaw.
- Your goal is to correctly identify as many of the 12 vocabulary words as possible.
- Your group will receive points for each correct vocabulary word.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

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Name ___________________________________

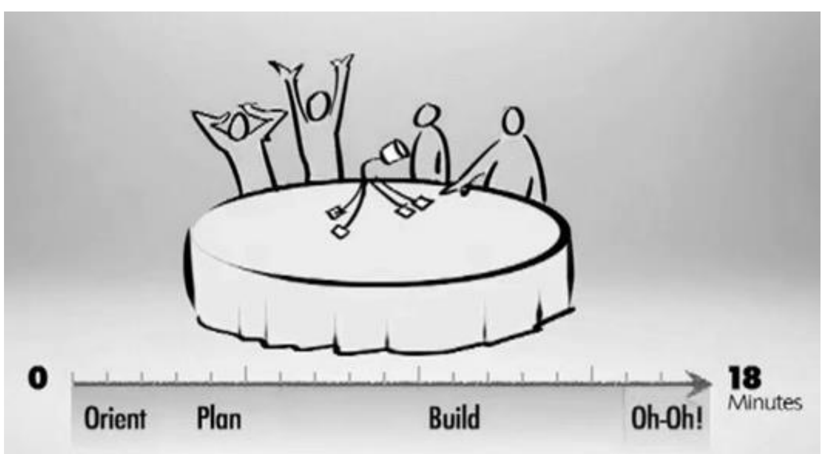
Marshmallow Challenge Reflection

1. Did your team successfully complete the challenge?

2. Why or why not?

3. How did your team work together today?

4. What could you personally do to better support your team?



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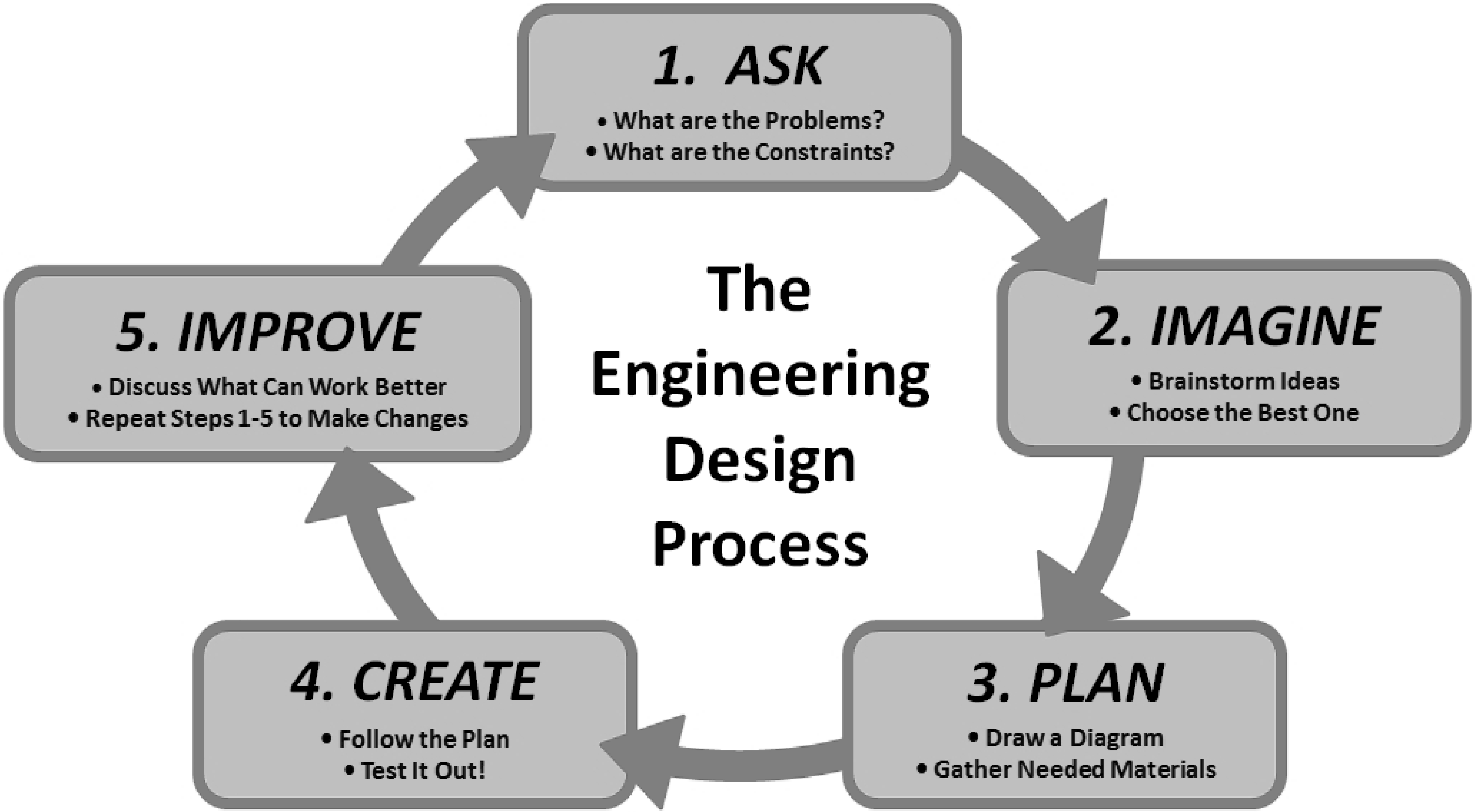

http://www.engr.ncsu.edu/theengineeringplace/educators/k8plans.php

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Name ___________________________________

Roller Coaster Challenge Letter

Six Flags

Dear Engineering Design Teams,

The owners of Six Flags Magic Mountain are seeking proposals for a new roller coaster ride. This coaster must thrill riders young and old with unique design features that incorporate the best in safety and engineering while providing an unforgettable experience.

It's no secret that Six Flags Magic Mountain is in desperate need of a new high-interest ride. Since the accident, attendance has dropped dramatically. Our goal is to attract roller coaster fans from near and far and restore their faith in our rides. The future of our local theme park rides on your ingenuity.

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Name ___________________________________

Roller Coaster Build Daily Journal

Complete an entry for each day your team worked on building your roller coaster.

What did your group get done today? Date: ____________ Are you happy with this progress? What is something new that you tried? Did it work like you expected? What did you do to resolve it? How did your team work together today? What can you personally do to have your team work together better tomorrow?
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Name ___________________________________

Roller Coaster Project

Model Guidelines

INTRODUCTION AND OBJECTIVES

Six Flags has issued a challenge to roller coaster designers to determine who should build their next roller coaster. You'll need to prove that you can make a model of an exciting roller coaster that meets their requirements, using as little money as possible.

EQUIPMENT NEEDED

- Paper Roller Coasters instruction manual
- Paper Roller Coaster pieces on card stock
- scissors
- tape
- cardboard base
- marble
- ruler

OBJECTIVE

The amusement park wants your roller coaster to have the following requirements:

1. Total track length must be 150 cm or longer
2. At least one loop
3. At least 6 turns
4. Safety – your marble must travel down the roller coaster smoothly without flying off the track

The following elements will help your chances of having your roller coaster chosen:

1. Uphill portions
2. Longer ride time

PROCEDURE

While trying to spend as little "money" as possible, build a Paper Roller Coaster using the supplies that your teacher provides. The roller coaster should be exciting, reliable, safe, and take a long time for the marble to travel from the start to the finish. You may want to look at the rubric and budget analysis forms before you begin. Good luck!

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Name ___________________________________

Roller Coaster Project

Proposal Guidelines

Step 1: Create a title page that will include:

- The name of your coaster
- A visual representation of your theme (This may include pictures, specialized font, colors that represent your coaster)
- Your design team name
- The names of each of your team members

Step 2: Blueprint/Pictures

- Include at least 2 blueprint drawings or color photographs that clearly illustrate your roller coaster's components
- You must include the following labels on your blueprint or photos
    - Greatest Potential Energy
    - Greatest Kinetic Energy
    - A place where G Force is greater than 1
    - A place where G Force is less than 1
    - A place where acceleration is occurring
    - A place where deceleration is occurring

Step 3: Budget Analysis

- Complete the budget analysis sheet

Step 4: Design and Performance Score

- Complete all of the calculations on the data sheet

Step 5: Written Proposal Questions

- Complete the written questions. Be sure to answer in complete sentences and paragraphs.

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Name ___________________________________

Roller Coaster Project

Budget Analysis

Type of Piece	Cost per Piece	Number of Pieces	Total Cost
Column	$ .50	x	
Straight track	$1.00	x	
Beam	$ .50	x	
Diagonal support	$1.00	x	
Sharp turn	$1.25	x	
Wide turn	$1.25	x	
Shelf	$ .05	x	
Funnel	$2.50	x	
Loop	$1.50	x	
Total Price:			

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Name ___________________________________

Roller Coaster Project

Design and Performance Data and Score Sheet

Height of Coaster

____

Total Track Distance

____

Design Cost

____

Time Trials

(if the marble falls off the track or stops, record that trial as a zero)

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

Total Time: ________

Average Speed

Take the distance of the track and divide it by the fastest time (smallest number).

Show your work!

$s = d \div t$

Category	Points
Total time (5 trials) each second = 1 point	
Track length > 150 cm? (10 points)	
At least 1 loop? (10 points)	
At least 6 turns? (10 points)	
Uphill sections (5 points for each section of track where the marble goes uphill)	
Total Construction Score	
Cost of Materials ($1 = 1 point) (Subtract from Construction Score)	-
Final score (Total Construction Score – Cost of Materials)	

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Name ___________________________________

Roller Coaster Project

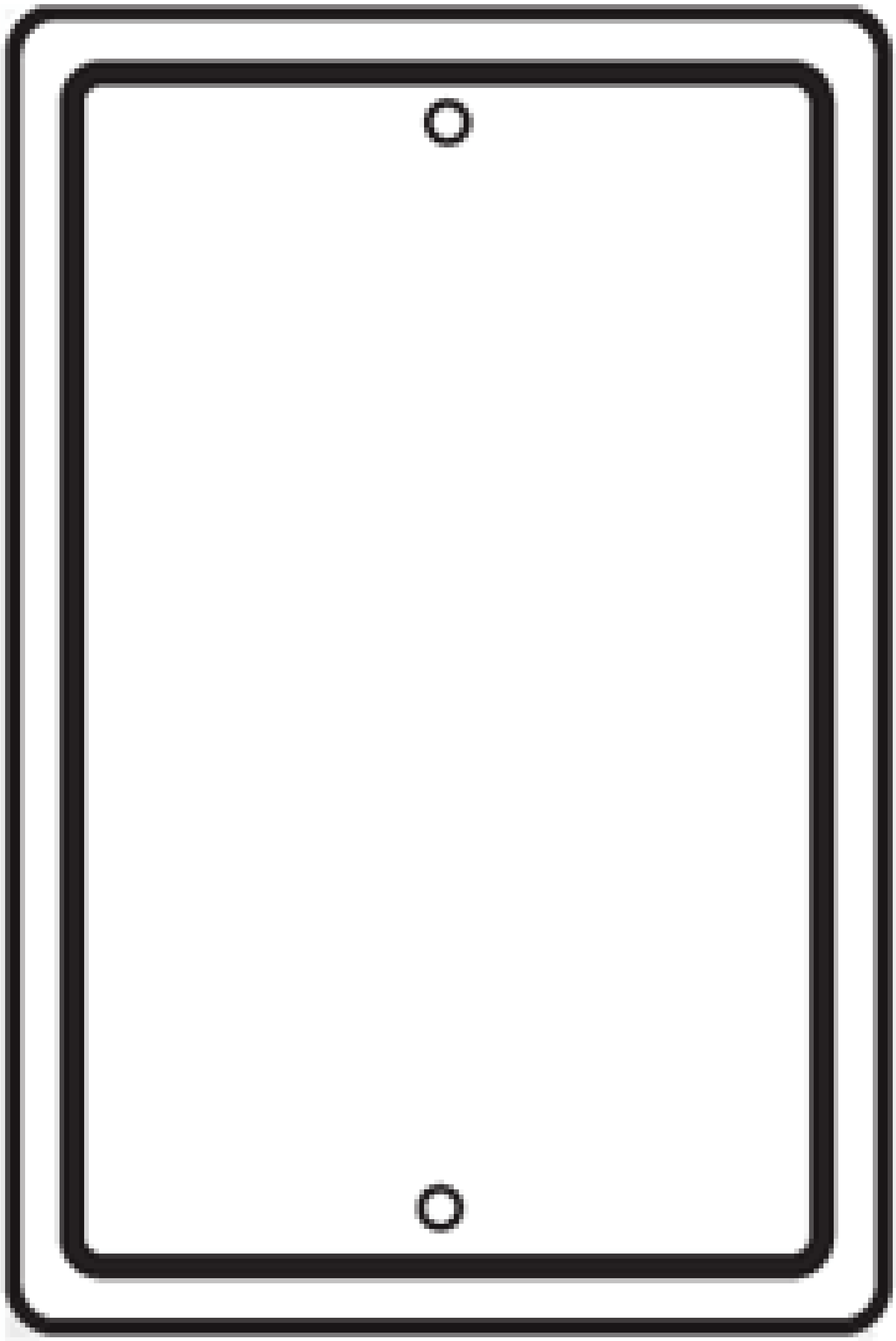
Proposal Questions

1. What makes your ride special? Walk us through the components of your coaster that create the most thrilling ride.

2. Why should Six Flags accept your proposal? (Consider the entire package, theme, thrill level, safety, consideration of the scientific forces, length of ride, speed, etc…)

Name ___________________________________

3. Create a warning sign that states all of the safety concerns that someone will need to consider before riding your ride.



Name ___________________________________

Roller Coaster Project

Proposal Rubric

Component	Point Value	Your Points
Title Page	5	
Blue Prints/Pictures	15	
Design and Performance Score	50	
Budget Analysis	15	
Written Proposal	15	
Total Project Score:	***100***	

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Name ___________________________________

Roller Coaster Project

Peer Review

Instructions: Rate the other coasters on a scale of 1-5, where a 5 is the best score possible. When scoring construction quality, consider the precision of the folds, and the difficulty of the design elements. When scoring excitement value, consider the loops, turns, speed, length of ride and other components that make a ride exciting.

Name of Coaster: Construction Value _____ Excitement Value _____	Name of Coaster: Construction Value _____ Excitement Value _____	Name of Coaster: Construction Value _____ Excitement Value _____
Name of Coaster: Construction Value _____ Excitement Value _____	Name of Coaster: Construction Value _____ Excitement Value _____	Name of Coaster: Construction Value _____ Excitement Value _____
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Name of Coaster: Construction Value _____ Excitement Value _____	Name of Coaster: Construction Value _____ Excitement Value _____	Name of Coaster: Construction Value _____ Excitement Value _____
Favorite Roller Coaster (Other than your own!)		

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