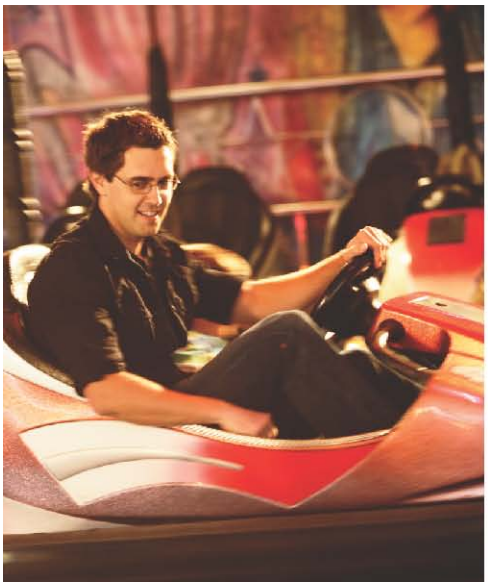


MIDDLE SCHOOL PHYSICS DAY

The Adventuredome™ THEME PARK CIRCUS CIRCUS LAS VEGAS

Table of Contents

INFORMATION

Teacher Suggestions

-Preview activities prior to field trip and instruct students which questions will NOT be able to be answered based on equipment availability, student ability, and curriculum previously taught.
-There are several pre-trip activities that will enhance the experience and help students complete the questions:
a. The Words of Physics pg. 4
b. Gut Feelings at the Park pg. 5
c. Formulas pg. 6
d. Fun Facts at the Park pg. 7
-Workbook should be printed and folded to create a booklet.
-Useful tools for students during the trip:
a. Calculator
b. Stopwatch
c. Accelerometer

Student Directions

-Complete the "Before Ride" questions while waiting in line.
-Record "Before Ride" heart rate into table on pg. 8.
-Read the "After Ride" questions BEFORE you get.
-After each ride record your "After Ride" heart rate into table on pg. 8.
Safety Notice
Students are not required to ride any ride that makes them uncomfortable. If you do not want to ride a particular ride, you may excuse yourself from that ride. Each student will be responsible for getting the missing data from other students. Please wait in the assigned area for the group to complete the ride.

Individual Ride Restrictions

Canyon Blaster - Must be 48" tall to ride. Canyon Cars - Must be 54" tall to be a driver, 42" tall to be a passenger. Fun House - Must be 48" tall to ride. Extreme Ride Theater - Must be 48" tall to ride. Sand Pirate - Must be 42" tall to ride. Sling Shot - Must be 48" tall to ride. No eating or drinking while on rides. You must keep your hands and arms in the ride at all times. You must remain seated at all times during the ride and hold on.

Posted Park Warnings

Pregnant women and individuals who have experienced the following medical conditions should not ride: Seizures, back injuries, neck injuries, arthritis, dizziness, motion sickness, claustrophobia, high blood pressure, heart condition, pace maker, stroke or other serious medical condition. Individuals are prohibited from riding if they are intoxicated or under the influence of drugs that impair their mental or physical abilities. Safety bars may cause injury to individuals who are large/tall. You assume risk of injury when you ride. Not responsible for lost or broken property.

NOTES

THE WORDS OF PHYSICS

Before the trip, fill in the correct term for each definition using the words provided below:

velocity	***period***	***friction***	***acceleration***	***force***
centripetal force	***momentum***	***speed***	***inertia***	***potential energy***
mass	***heart rate***	***gravity***	***g-force***	***kinetic energy***

1. _____- a change in speed and/or direction. The acceleration due to gravity is 9.8 meters/second^2.

2. _____- a push or pull that makes an object move in a curved path. Its direction is towards the center of the object's path.

3. _____- any sort of push or pull.

4. _____- a force from surrounding materials that pushes or pulls on objects when you try to move them. A force that opposes motion. Air resistance is one kind of friction.

5. _____- an attraction between two objects with mass.

6. _____- one g equals the gravitational pull at the surface of the earth. A force of 2 g's means a force acting on an object is equal to 2 times its weight.

7. _____- the number of times in a minute the human heart beats.

8. _____- the tendency of matter to remain at rest or move at a constant speed.

9. _____- the active energy of motion.

10. _____- the quantity of matter that a body contains. The more mass an object has, the harder it is to accelerate it.

11. _____- a kind of moving inertia that tends to keep moving objects going in the same direction. Momentum is the mass of a body multiplied by its velocity- $M=mv$.

12. _____- Motion that exactly repeats itself in regular time intervals.

13. _____- the amount of energy due to position. The higher an object is, the greater the gravitational potential energy it has relative to the surface.

14. _____- the distance an object travels in a given time- $S=d/t$.

15. _____- The speed of an object in a particular direction- $V=d/t$ *with direction noted.*

GUT FEELINGS AT THE PARK

Use the best measuring device of all, your body. Your body is equipped with highly sensitive measuring devices used to measure acceleration. You are a "natural accelerometer". Below is a data table the help you read your "natural accelerometer". *Fill in the table as your teacher reviews.*

Direction of Unbalanced Force Acting on You	**Gut Feeling**
Vertical or _____	• Feel pressed to the seat; the greater the acceleration the more "squished" you feel.
_____ or downward	• Feel like you are rising out of your seat. • Stomach feels like it is in your throat. • May feel queasy.
_____ or forward	• Feel pushed back in your seat. • Head and shoulders may swing backwards.
Horizontal or _____	• Feel pushed forward against safety harness. • Head and shoulders may lurch forward.
_____ or left/right	• Slide sideways across the seat. • Shoulder may be pressed against the side wall or your ride partner.

FORMULAS

Distance, Speed, Velocity, and Acceleration

	Formulas
Speed = distance ÷ time	$S = d \div t$
Velocity = Distance ÷ time in a given direction	$v = d \div t$ + direction
Acceleration = final velocity-beginning velocity ÷ final time-beginning time	$a = (v_f - v_i) \div (t_f - t_i)$

**All distances are measured in meters.

Potential and Kinetic Energy

Potential Energy = mass x gravity constant x height (above the Earth)	$P.E._g = m \times g \times h$
Kinetic Energy = (mass x velocity squared) ÷ by 2	$K.E. = m \times v^2$

Force, Momentum, Weight, and Gravity

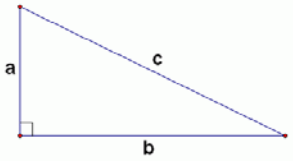
Force = mass x acceleration	$F = m \times a$
Gravity constant = 9.8 meters/seconds^2	$g = 9.8\ m/s^2$
Weight = mass x gravity	$W = m \times g$
Momentum = mass x velocity	$M = m \times v$

Metric Conversions

1000 mm = 100 cm = 10 dcm
1 m = .1 dkm = .01 hm = .001 km

Pythagorean Theorem

In a right triangle the sum of the squares of the sides is equal to the square of the hypotenuse.



$a^2 + b^2 = c^2$

Newton's Laws of Motion

1st Law of Motion-

_____

2nd Law of Motion-

_____

3rd Law of Motion-

_____

FUN FACTS

Try to find the answers for the following questions at http://www.adventuredome.com/.
You will need to convert all answers to metric units. Using an online conversion website is helpful.

1. How much area does Adventuredome cover? _____ km^2

2. How many square meters of pink glass were used? _____ m^2

3. How tall is the tallest mountain peak? _____ m

4. How tall is the central dome? _____ m

5. What is the diameter of the central dome? _____ m

6. How long is the large walking circle "loop" around the park? _____ m

7. How long is the small "loop" around the park? _____ m

8. How long is the track on the Canyon Blaster rollercoaster? _____ m

9. How long is the track on the El Loco rollercoaster? _____ m

10. How high is the largest drop on the El Loco rollercoaster? _____ m

HEART RATE REACTIONS

Heart Rate must be taken as soon as possible after getting off the ride or completing the activity. Taken by counting the number of beats for 15 seconds then multiplying by 4 determines the number of beats per minute. *Show your calculations (ex. 25 beats x 4 = 100 bpm) in the table below.*

Activity	***Before Ride*** **Heart Rate** (beats per min)	***Immediately After Ride*** **Heart Rate** (beats per min)
Sling Shot		
Canyon Blaster		
Inverter		
Chaos		
Extreme Ride Theatre		
Sand Pirates		
Canyon Cars		
El Loco		

INVERTER

Before Ride

1. At what point on the *Inverter* is the greatest amount of potential energy achieved?

2. How long does it take for the *Inverter* to make one complete rotation at top speed? *Record in seconds (s) using stopwatch.*

3. What is the maximum number of people who can ride at one time?

4. Calculate the mass of a full load of people on the ride assuming the average mass of a human is 65 kg. *Show your work.*

5. Sketch the *Inverter* at rest in box and label all pivot points on the ride with asterisks (*).

After Ride

6. The *Inverter* forces you into a circular motion. This is an example of which force? *Explain your answer.*

CANYON BLASTER

Before Ride

1. The *Canyon Blaster* drops a distance of 27 meters on the first drop.

   a. How long does it take for the riders to reach the bottom of the first hill?
   Record in seconds (s) using stopwatch.

   t = _____ *seconds*

   a. If s = d ÷ t, what is the max speed of the train?
   Calculate the speed assuming a distance of 27 m.
   Show your work.

   s = _____ *meters per second (m/s)*

2. How is the train pulled up to the top of the 1st hill and which mechanism is used?

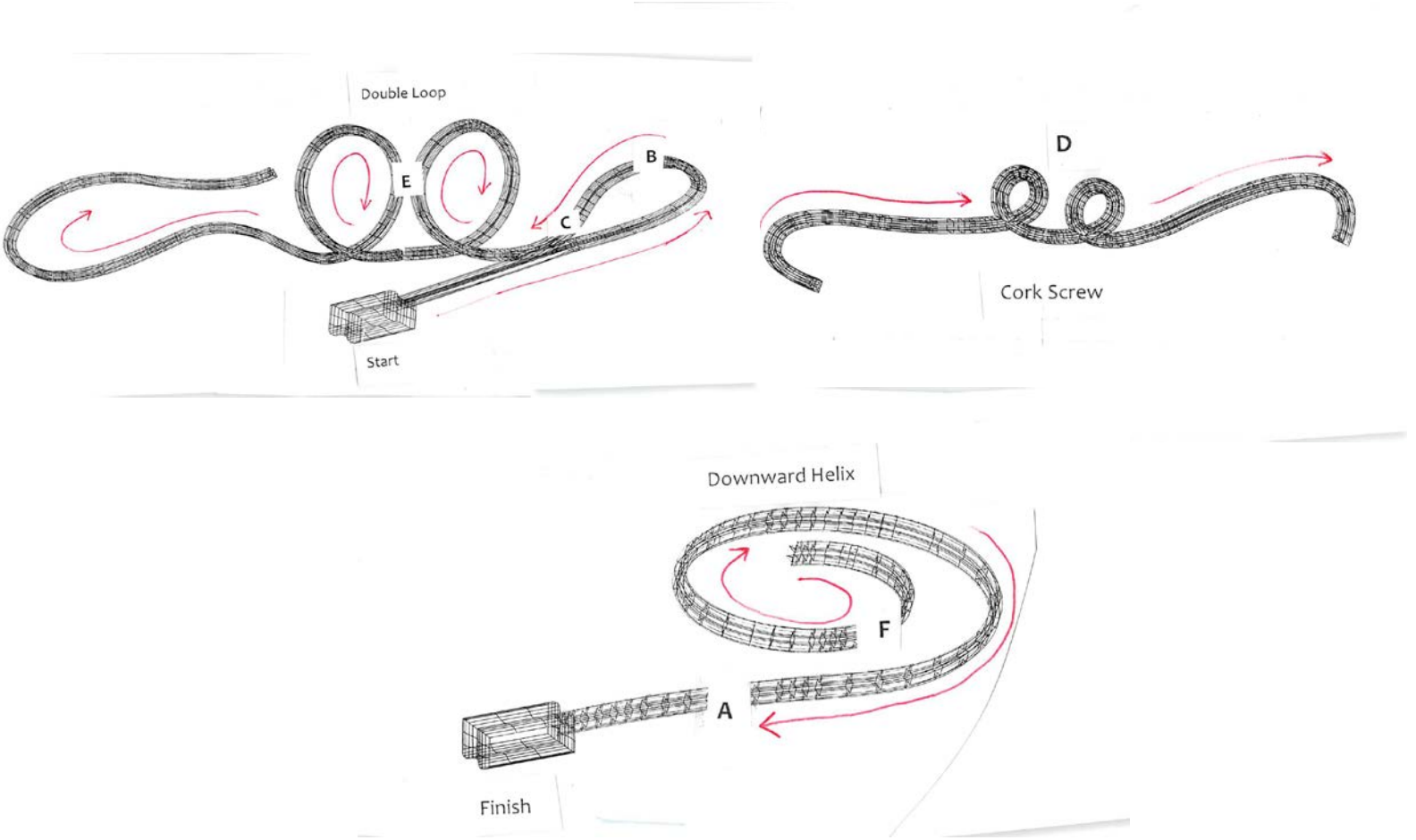
After Ride

3. Complete the table below describing your "Gut Feelings" at each point on the ride. *Use the Gut Feelings at the Park pg. 5 as a reference.*

4. Based on your "Gut Feelings" at each point on the ride, what was the direction of unbalanced forces acting on you? Complete the "Direction of Unbalanced Forces" in the table below. *Use the Gut Feelings at the Park pg. 5 as a reference.*

Point on the Ride	Gut Feeling	Direction of Unbalanced Force Acting on You
At the bottom of the 1st drop/incline		
At the top of the 1st loop		
At the bottom of the 1st loop		
During the corkscrew		

CANYON BLASTER



5. Match the locations (A,B, C, D, E, and F) on the roller coaster that best match the phrases below:

   a. _____ Maximum Velocity
   b. _____ Maximum Acceleration
   c. _____ Maximum Gravitational Potential Energy
   d. _____ Centripetal Force
   e. _____ High G-force Zone
   f. _____ Greatest Friction Force
   g. _____ Greatest Friction Force

6. Identify two sources of friction the roller coaster train experiences:
   a. _____
   b. _____

EXTREME RIDE THEATER

Before Ride

1. Describe the mood set by the design as you walk up to the *Extreme Ride Theater*.

2. Why is the "Holding Room" an important part of the ride? *Explain your answer.*

After Ride

3. How does the shape of the screen affect the ride experience?

4. Do you move or is it an illusion? *Support your conclusion with evidence.*

5. Close your eyes for part of the ride. *Describe the motion.*

6. How did the ride designers create the feeling of being on a roller coaster?

BC BUS

Before Ride

1. Sketch the *BC Bus* at rest in box and label all pivot points on the ride with asterisks (*).

2. What is the maximum number of people who can ride at one time?

3. Calculate the mass of a full load of people on the ride assuming the average mass of a human is 65 kg. *Show your work.*

After Ride

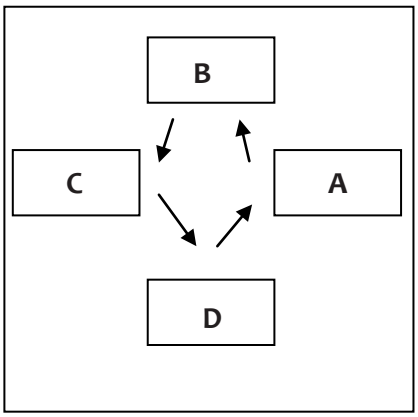
7. At what point do you experience the maximum G-force? *Explain your answer.*

8. At what point do you experience the minimum G-force. *Explain your answer.*

9. Use the accelerometer to measure the maximum G-force.

Max G-force = _____ *Newtons or Pounds*

10. How does this ride compare with the *Inverter*?



11. Complete the table below describing your "Gut Feelings" at each point (A, B, C, and D) on the ride based on the diagram. *Use the Gut Feelings at the Park pg. 5 as a reference.*

12. Use the accelerometer to collect data at each point (A, B, C, and D) on the ride.

13. Based on your "Gut Feelings" at each point on the ride, what was the direction of unbalanced forces acting on you? Complete the "Direction of Unbalanced Forces" in the table below. *Use the Gut Feelings at the Park pg. 5 as a reference.*

Point on the Ride	Gut Feeling	Accelerometer Readings	Direction of Unbalanced Force Acting on You
A			
B			
C			
D			

ROAD RUNNER

Before Ride

1. How does the music add to the excitement of the ride?

2. How long does it take for the *Roadrunner* to make one complete rotation at top speed?

3. What is the maximum number of people who can ride at one time?

4. Calculate the mass of a full load of people on the ride assuming the average mass of a human is 65 kg. *Show your work.*

After Ride

5. Use the accelerometer to measure the maximum horizontal G-force.

   Max G-force = _____ *Newtons or Pounds*

6. Complete the table below describing your "Gut Feelings" at each point on the ride. *Use the Gut Feelings at the Park pg. 5 as a reference.*

7. Based on your "Gut Feelings" at each point on the ride, what was the direction of unbalanced forces acting on you? Complete the "Direction of Unbalanced Forces" in the table below. *Use the Gut Feelings at the Park pg. 6 as a reference.*

Point on the Ride	Gut Feeling	Direction of Unbalanced Force Acting on You
Going Forward		
Going backward		

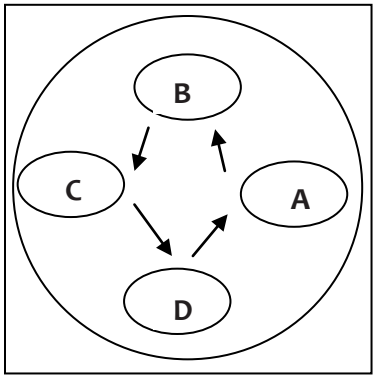
8. As you are riding, do you lean in or out? Why?

Before Ride

1. Sketch the ride and label all points where the rider is able to flip the chair with asterisks (*).

2. Observe the ride as it starts out.
   As it moves in a horizontal orbit, what do you notice about the cars in relationship to the ride?

3. Continue to watch the ride as it changes from horizontal to vertical.
   Now what do you notice about the cars in relationship to the ride?



4. Why do the cars change their positions? *Explain your answer.*

After Ride

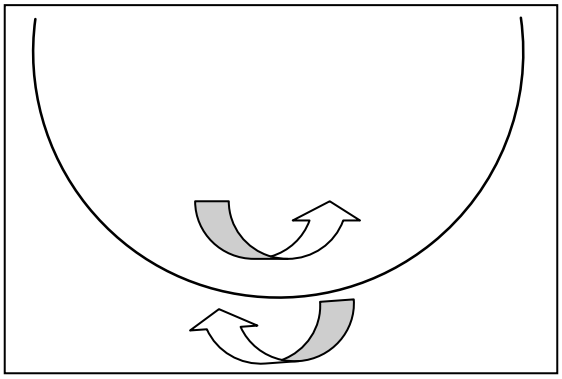
5. Complete the table:

When ride is spinning vertically, at what point-	**Point on Ride (A, B, C, or D)**
Are you going the fastest?	
Are you going the slowest?	
Do you feel the heaviest?	
Do you feel the lightest?	

SAND PIRATES

Before Ride

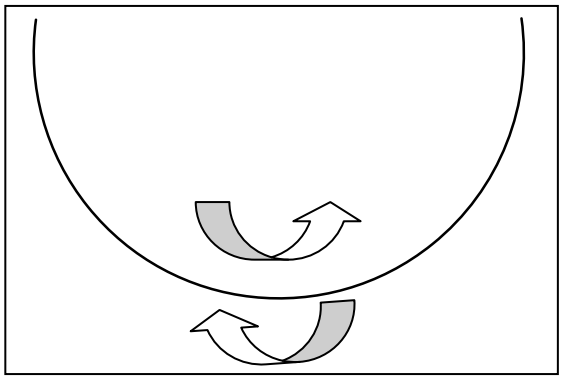
1. Label the following points on the ride:
   a. Greatest potential energy- "PE"
   b. Greatest kinetic energy- "KE"
   c. Potential energy and kinetic energy are equal- "PE = KE"



2. What force is causing the ship to swing downwards?

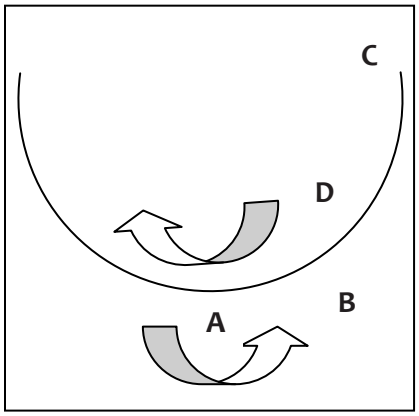
After Ride

3. Label the following points on the ride:
   b. Traveling the fastest- "F" and slowest- "S"
   c. Pull of gravity feels the strongest- "GF" and feels the weakest- "gf"



4. Use the accelerometer to collect data at each point (A, B, C, and D) on the ride:

Point on the Ride	Accelerometer Readings
A- At rest	
B- Halfway going up	
C- At the highest point	
D- Halfway going down	



5. Where did the maximum acceleration occur?

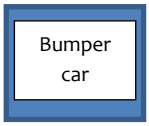
6. Do you feel the same swinging forward as you do swinging backward?

Before Ride

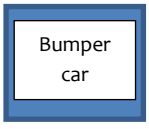
1. Forces:

Gravity	Gravity gives weight to physical objects and causes them to fall toward the ground when dropped.
Friction	Friction is the force resisting the relative motion of surfaces sliding against each other.
Air Resistance	Specific type of friction, in which air provides the resistance to motion.
Normal Force	Normal force is the contact force exerted on an object by a surface that prevents the object from penetrating the surface.
Motor	Push provided to your car by motor.
Push from another car	Push provided from another car during a collision.

a) Using the forces provided above, draw a free body diagram showing all of the forces acting on your car when you are traveling at a constant speed of 5 m/s.



b) Using the forces provided above, draw a free body diagram showing all of the forces acting on your car when your car experiences acceleration due to a head-on collision.



After Ride

2. During a head-on collision, you feel like you are about to fly out of your seat and are only held in place by your seatbelt. This is because your body wants to continue forward at the velocity you had before the collision. This is an example of which Law of Motion?

3. If your car is hit head-on by another, what determines whether your car continues to move forward or starts to move backward after the collision?

4. During a collision, explain *two* ways that kinetic energy is being transferred to another form.

SLING SHOT

Before Ride

1. The *Slingshot* travels upwards at a speed of 12 m/s.

   a. How long does it take for the riders to *ascend* the tower? *Record in seconds (s) using stopwatch.*

   t = _____ *seconds*

   d. If s = d ÷ t, what is the distance the riders are lifted up? Calculate the distance assuming a speed of 12 m/s. *Show your work.*

   d = _____ *meters*

After Ride

2. Record the acceleration, identify the unbalanced forces acting on you at each point, and the type of acceleration they are causing (i.e., + acceleration, - acceleration, directional change):

Point on the Ride	Accelerometer Readings	Unbalanced Force	Type of Acceleration (speed up, slow down, direction change)
Ascent			
Fall			
Braking			

EL LOCO

Before Ride

1. *El Loco* cars climb the initial lift at a speed of 4 m/s.

   a. How long does it take for the riders to *ascend* the first hill?
   Record in seconds (s) using stopwatch.

   t = _____ *seconds*

   e. If s = d ÷ t, what is the distance the riders are lifted up? Calculate the distance assuming a speed of 4 m/s. *Show your work.*

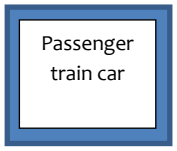
   d = _____ *meters*

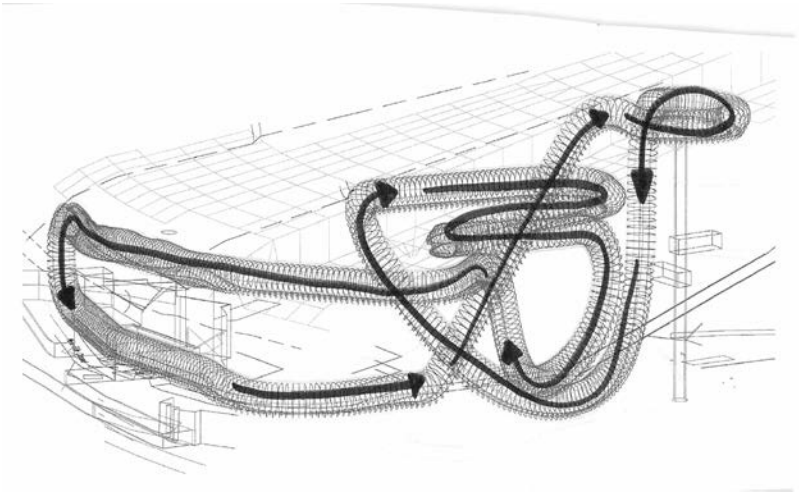
2. What is the potential energy for the 1st peak? $PE = m \times g \times h$
   Mass of the car with riders = 3,000 kg
   Gravity constant = 9.8 m/s^2

   PE = _____

After Ride

3. Why do you not fall out while you are upside down? Draw a free body diagram showing all of the forces acting on your car when you go through a loop.





4. Label an example of the following points on the ride:
   a. Maximum potential energy- "PE"
   b. Maximum kinetic energy- "KE"
   c. Positive acceleration- "+A"
   d. Negative acceleration- "-A"
   e. Acceleration due to direction change- "*A"