Holiday World & Splashin' SAFARI®

THE THRILL OF S·T·E·M

ACTIVITY MANUAL

Dear Student:

Welcome to Holiday World & Splashin' Safari. Our park's continued success depends on our ability to build rides where you can safely experience as many thrilling forces as possible. After all, very few people would be interested in a ride that moves in a straight line at constant speed!

Included in the Activity Manual are questions and problems regarding the STEM applications involved in our rides. We hope you will take the opportunity to apply the STEM skills you have learned in the classroom to a real-world situation and have fun at the same time. While you are making the observations and taking measurements, we would appreciate it if you would observe the following rules to ensure your safety and the safety of others:

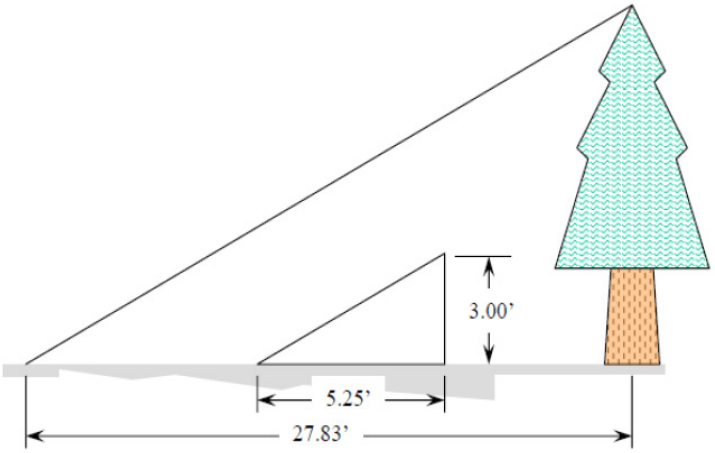
- Your activities must not interfere with the operation of any ride or interfere with a park Team Member's job.
- Students must obey all park safety rules and regulations. Failure to follow rules may result in ejection from the park.
- Students should determine the data they will need before riding.
- No restricted areas or safety zones are to be entered to obtain data readings. All data can be obtained from general public areas. Students should not attempt to take measurements of the ride units.
- Students must follow all rider policies; including riding with all safety restraining devices in place and riding flush against the seat. Riders must not ride sideways, twisted, or leaning forward.
- Students must secure all loose articles in bins provided at each attraction before riding. Non-riding students may hold the materials and wait at the bottom of the exit while the rest of the group rides.
- Show proper respect to other park Guests.

WITH HELP FROM:

PURDUE EXTENSION

PROJECT 1: CHASING SHADOWS

Like most dogs, Holidog likes to chase his tail. But did you know that Holidog also likes to chase his shadow? Yup, you heard that right! He likes to chase his shadow! When The Voyage wooden coaster was first built, he wanted to make sure that it did, in fact, have one of the TALLEST drops on the planet (163 feet tall), so he found a way to measure how tall it was ***without*** using the longest tape measure on the planet. Here's how:



Tree height = *using similar triangle,* $\frac{Y_{tree}}{3'} = \frac{27.83'}{5.25'} \rightarrow Y_{tree} = 15.90'$

First—Find an object that is too tall to measure with a tape measure (roller coaster, building, tree, etc.) This object must have a base that you can access, a shadow, and an "end shadow" that you can access. An "end shadow" is the tip of the shadow made by the object.

Second—Find a smaller nearby object that you can measure for height and shadow length (trash can, sign, friend, etc.)

Third—Collect your measurements (in inches):

Height of the small object _____

Length of the small object's shadow _____

Length of the large object's shadow _____

Last—Set up and solve the following formula.

$$\frac{\text{Small Object Height}}{\text{Small Object Shadow Length}} = \frac{h}{\text{Large Object Shadow Length}}$$

On the back of this sheet sketch a diagram of the objects you chose. Don't forget to draw their shadows. In your diagram, include the height of the objects and the length of their shadows.

How tall is the object you chose?

_____

THIS JUST IN! Autumn Falls has reported that the town 's turkeys are on the loose!

Okay math sleuths, can you help round up the town's turkeys? Stay alert! Those birds are hiding everywhere!

First, get into groups of four and get in line. Enjoy visiting with Grandma Abigail and her cat.

When your group enters the car, get ready to begin calling all turkeys!

At the end of the ride, write down your score and find your average to make sure all of the turkeys are accounted for and to see which group will be written into the Autumn Falls Chronicle as the students who saved the town! Grandma and the mayor will be so happy you did!

Find the average by adding each individual score and dividing it by the total number in your group.

Where is Gobbler Getaway?

Located across from Turkey Whirl in the Thanksgiving section

SCORE CARD	
Name	**Scores**
AVERAGE	

If each turkey is worth 50pts, on average how many turkeys did you capture?

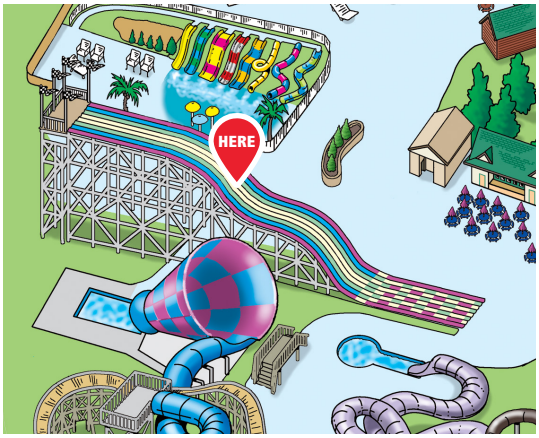
Your Average: _____

If each turkey is worth 50pts, on average how many turkeys did your team capture?

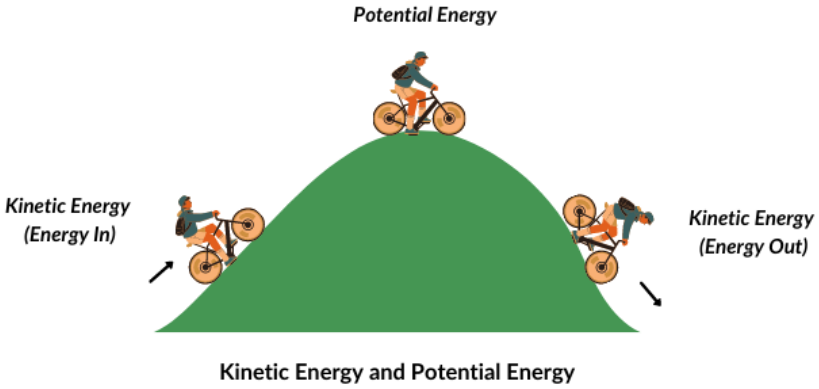
Team Average: _____

All energy can be found in one of two states: potential energy (PE) or kinetic energy (KE). Energy can be transferred from PE to KE and between objects. Energy is measured in Newtons (N), PE is stored energy that is READY TO GO like a bike at the top of a hill or you at the top of the Jungle Racer! KE is the energy of motion or energy ON THE MOVE like a bike rolling down a hill or you soaring down the Jungle Racer! Are you ready to experience potential and kinetic energy?

Where is Jungle Racer?



Located near Zinga in Splashin' Safari.



Helpful Tip: Jungle Racer is 16.5 meters in height

Your Mission:

1. Find the potential energy (PE) of a child with a mass of 45 kg at the top of the Jungle Racer by using the following formula and a calculator:

   PE = mgh where "m" = 45kg; "g" = gravity (9.81m/s^2), and "h" = height of the Jungle Racer

2. Find your maximum kinetic energy (KE) on the Jungle Racer if your maximum velocity was 15 m/s by using the following formula and a calculator:

   KE= ½ mv^2 where "m" = 45kg; "v" = velocity (15m/s)

3. What things could affect how fast you are able to speed down the Jungle Racer? On the back of this sheet of paper, draw the Jungle Racer & label your points of greatest PE & KE.

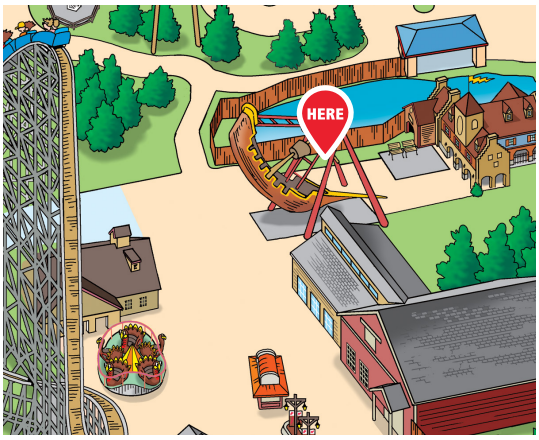
PROJECT 4: THE PILGRIM'S PENDULUM

The Mayflower was at sea for 66 days before it landed at Plymouth Rock, but The Mayflower at Holiday World wraps up its journey in just minutes. How much time does it take to get from the highest point on the Mayflower to the other? It's much less than 66 days!

Here's a helpful mathematical equation to get you started:

$$T = 2\pi\sqrt{\frac{l}{g}}$$

Where is Mayflower?



Located near Gobbler Getaway in the Thanksgiving section

T = Time; i.e., the time for one swing of the Mayflower (seconds) Hint: This is the how long it takes to get from the top of one side to another.

l= length from the fixed point at the top of the pendulum to the center of mass of the boat (11.58 meters)

g = gravitational constant (9.8 m/sec^2)

$\pi \approx 3.14$ (pi)

Part A: Use a calculator to find "T" or the amount of time it takes for the boat to make one complete swing at it's highest point.

Answer: _____

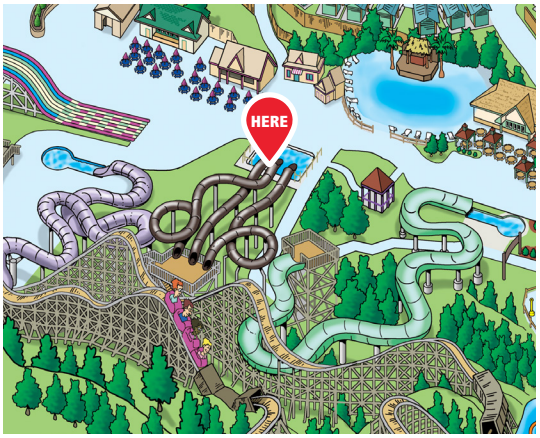
Part B: Now, it's time to jump on board and take an exhilarating ride on the high seas! On your journey, at the biggest swing of the boat, count how many seconds it takes to swing from Point A to Point B. You will need to do this by counting seconds in your head. Record your data on the line below.

Seconds: _____

Part C: Are your answers from Part A and Part B similar? If not, what factors do you think may have caused the inconsistency in the answers?

It's time to SLIDE! Head over to Otorongo to learn how science plays a major role in your ride down these three dark slides.

Where is Otorongo?



Located near Muziki Bay in Splashin' Safari

Here is your task:

Slide down each slide while timing yourself by counting…one-thousand-one, one-thousand-two, one-thousand-three…and so on. Be sure to start counting at the top and stop counting as soon as you hit the water at the end. Record the results (or have someone else do it for you…you'll be wet!) of all three slides in the table below and find the rate (speed) in feet per second by dividing the length of the slide by the time (seconds) that it took you to reach the bottom.

Slide	Length (Feet)	Time (Seconds)	Rate (Distance/Time)
Oto	179 ft.		
Ron	260 ft.		
Go	326 ft.		

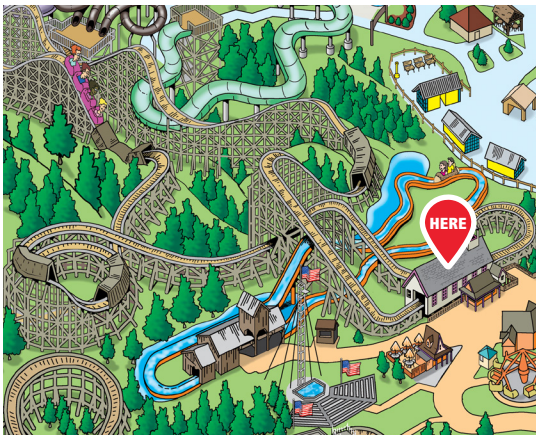
1. What is the fastest slide?

2. Check your friends' results. Did they find that the same slide is fastest?

3. Why do you think this slide was quickest?

Draw a sketch of The Legend in the space below.
(Take a ride to learn the layout or take a look at a park map)

Where is The Legend?



Located across from the Pepsi Oasis in the Halloween Section

RIDE FACTS

Track Length: 4,042 ft.

Height: 116 ft. (highest to lowest point on ride)

Tunnels: Five

Ride Time: 2 minutes

Top Speed: 65 miles per hour

Height:_____ Number of Loops:_____

Number of Turns:_____ Number of Corkscrews:_____

- Place a 1 next to a point on your roller coaster where the cars accelerate
- Place a 2 at a point on your roller coaster where the cars decelerate
- Place a 3 next to the point where cars have the greatest potential energy
- Place a 4 next to the point where cars have the greatest kinetic energy.
- Place a 5 at a point where the rider experiences a g-force greater than 1 g.
- Place a 6 at a point where the rider experiences a g-force less than 1 g.

Pair off in groups of two. Compare answers and identify similarities and differences in answers.

Where is Thunderbird?

Located near Crow's Nest in the Thanksgiving Section

RIDE FACTS

Track Length: 3,035 feet

Ride Height: 140' at Immelmann loop's peak

Ride Elements:
Launch, using LSM technology
140' Immelmann loop
125' Vertical Loop
Elevated Horseshoe
Elevated Spiral
Zero-G roll
S curve
Fly-through barn
Carousel
360 in-line twist (barrel roll)

Top Speed: 60 miles per hour

Ride Time: 1 minute, 18 seconds

Thunderbird made its maiden voyage on April 25, 2015. Thunderbird was the first launched wing roller coaster in the United States. Instead of using a lift hill, the park's first major steel roller coaster features a zero-to-60 mph launch in 3 ½ seconds, followed by multiple inversions.

Physics and you on the Thunderbird:
Determine your momentum, force and energy experienced while riding Thunderbird.

1. Your weight in pounds: _____
Convert to kilograms (your weight / 2.2 lbs): _____kg

Maximum speed on Thunderbird is 60 mph (26.8 meters per second - m/s)
Momentum is mass (in kilograms - kg) times velocity (m/s)

2. Find your momentum: _____ kg m/s

Force is the change in momentum per change in time (3.5 seconds); units are Newtons (kg m/s^2)

3. Find your force: _____ N
(a newton is approximately one stick of butter…that's a lot of butter!)

Energy can be determined by finding your kinetic energy = ½ mv^2. Energy is measured in Joules – J

4. Find your energy: _____ J
(a joule is approximately one stick of butter moved one meter)

Now take a ride on Thunderbird to experience the physics you just learned!

PROJECT 8: GEOMETRY SCAVENGER HUNT

When engineers and architects were building Holiday World & Splashin' Safari, they used all sorts of geometric shapes. These shapes can be found all over the park.

How many of each of these geometric shapes can you find hiding throughout the park? Once you find a shape, write down where you found it and sketch a picture. You may find them in several places.

Shape	Definition	Examples
Triangle	A closed plane figure bounded by three straight lines meeting at three vertices.	
Rectangle	A parallelogram with 4 right angles.	
Square	An equilateral rectangle. A plane geometric figure with 4 sides of equal length and 4 right angles.	
Pentagon	A five-sided polygon.	
Hexagon	A six-sided polygon.	
Octagon	An eight-sided polygon.	
Trapezoid	A quadrilateral with two parallel sides of unequal length.	
Circle	A closed plane curve every point of which is equidistant from a given fixed point, the center.	
Prism	A polyhedron with two parallel and congruent polygonal bases, so that all parallel cross-sections are also congruent with the bases, and therefore all sides are parallelograms.	
Pyramid	A polyhedron with one polygonal face (the base) and all other faces triangular with a common vertex.	
Cylinder	A tubular solid figure with a circle base.	
Cone	A solid figure having a plane (two-dimensional) curve as its base and tapering to a point (the vertex).	
Sphere	A three-dimensional closed surface every point of which is equidistant from a given point (the center).	

Shape	Where did you find it?	Draw a Picture of the shape you found!
Triangle		
Rectangle		
Square		
Pentagon		
Hexagon		
Octagon		
Trapezoid		
Circle		
Prism		
Pyramid		