Math & Science In Action!

Teacher’s Resource Manual
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Dear Teachers & Students,

Our Physics, Math and Science Day programs continue to provide real-world learning in a thrilling, experiential environment. Our goal is to make learning fun. For years, these programs have become annual events in many of our theme parks nationwide. Our company is derived from students and teachers, like yourselves, who one day decided to branch off from common career paths to create an industry full of thrills that today continues to entertain hundreds of millions of visitors each year.

We deliver entertainment primarily through our rides that are founded upon physical and mathematical principles. There exists true science and math behind each unique design of every ride experience. Simple rides like carousels that have routine circular motions with predictable movements, mixed with sound, lights, and other actionable media have thrilled people of all ages for over a century.

Nowadays, extreme roller coaster rides and simulators create unpredictable motion with varying g-forces, speeds subject to weather conditions, and carriages designed to hold people safely in place are all designed by large networks of physicists, mathematicians, architectural & civil engineering designers.

I encourage you to view our industry from this perspective and hope your visit with us inspires the next generation of creative thinking that will carry the next genre of entertainment into the next definable dimension. We thank you for your past patronage and hope that you enjoy our product offering enough to return with your families and friends to experience the entire property.

Ride-on!

Rick Howarth

Six Flags America Park President
Elementary Math and Science Activities at Six Flags America

Amusement park rides are made to be fun for the riders. Some rides spin you around in a circle. Some move you up and down. Some of the rides speed you up and slow you down. The things you see, hear, and feel when you ride help to make the rides interesting.

In order to find the answers to the questions, you must watch the rides very carefully. Sometimes you will use a stopwatch to measure time. You may be asked to measure a distance. You may even be asked to make some simple calculations by estimating how fast you are going. Your teacher can help you do all this. It is the most interesting when you relate what is going on with the ride and think about how it makes you feel.

Have fun as you begin to learn about the science in amusement park rides at Six Flags America!

Enjoy!

Roosevelt High School 301-397-2282
Tom Wysocki – 301-322-0897
To the Teachers:

A trip to Six Flags America is an amusing way of teaching science and mathematics to your students.

We have tried to incorporate this philosophy into this manual targeted for elementary and middle school children.

It is our intention to make this manual educational fun for you and your students. Please let us know anything you liked or disliked about the activities and write down any suggestions or extensions that may be helpful in improving this manual.

We believe that teachers should be the true editors of any activity aimed for students.

We have written activities for every ride at Six Flags America. It was not our intention to have every student observe or test every ride in the park. What it does do is give the teacher more flexibility and variety in deciding what they want the class to accomplish at Six Flags America. You may want to form small groups and assign certain rides for each group. Check the height and age level for each ride and read over the activities. Since some rides have similar questions, you may want to assign rides to a group based on the variety of science and mathematical activities.

Thank you so much for your experience and guidance. Most of all, have fun on your trip to Six Flags America!

Sincerely yours,

Roosevelt High School 301-397-2282
Tom Wysocki – 301-322-0897
Pre-visit Preparation for Students

In order for students to understand some of the terms used on their worksheets and to help them know how to formulate appropriate responses to some of the questions, it is important to have a lesson or two in class before coming to the park.

A. DESCRIBING MOTION IN GENERAL

The various rides at Six Flags America move the riders in many different ways. Some rides move people horizontally (parallel to the ground), some move people vertically (up and down), and some rides do both. Sometimes the people are moved in straight lines and sometimes they are moved along curving paths (see Section B for more detail about circles). One way to describe motion, then, is to indicate its direction (horizontal or vertical, straight or curved). Another property of motion is the speed at which it occurs and whether that speed is increasing or decreasing.

Students should be shown some examples of moving objects (toys, for example) and asked to describe the direction of the motion and whether the object has a constant speed, is speeding up, or is slowing down.

B. DESCRIBING CIRCULAR MOTION

Objects moving in circles may be moving in vertical circles (a Ferris wheel, for example) or horizontal circles (like a merry-go-round). In either case there are two directions the object can be turning. As you stand facing a merry-go-round, the part of the ride closest to you may be moving from left to right in front of you or from right to left. To distinguish these two directions the terms clockwise and counterclockwise are used. They refer to the direction that the hands on a clock turn when the clock is running. For an object moving in a horizontal circle, describe it as though you were looking down on it from above. Thus, if a merry-go-round was turning from left to right in front of you, it would move counterclockwise when viewed from above.

By observing examples that you provide, students should practice describing objects moving in a circle by indicating whether the motion is a horizontal circle or a vertical circle and whether it is clockwise or counterclockwise. They can also state whether the speed is increasing, decreasing, or staying the same.

C. ESTIMATING TIME

In some of the park activities, students are asked to measure the amount of time it takes for a certain motion or event to occur by using a stopwatch. In other activities students are asked to estimate the time. Estimating time can be done by counting “one, two, three,” etc. if this is done at the correct pace. The proper pace can be approximated by saying the word “thousand” in front of each number or the word “Mississippi” after each number, for example, “thousand one, thousand two,” or “one Mississippi, two Mississippi”.

Students should practice measuring time with a stopwatch before they go to the park. They should also practice estimating time by using the counting method until they can do so with some consistency.
D. ESTIMATING DISTANCE

While a meter stick can be used to measure distance or length, there are several ways to estimate distance when a meter stick is unavailable. The normal walking step of an elementary student is about one half meter; so, counting steps and dividing by two gives an estimate of the distance walked in meters. Another way to estimate distance is to realize that the distance between the hands of a student with arms outstretched to the sides is about one meter. A third way to estimate distance is to visualize meter sticks lying end to end covering the distance to be estimated.

Students need to practice estimating distances whose actual values are in the range of one-half meter to several meters.
Tips to the Teacher

1. Equipment needed in the park:
   a) Stopwatch (at least one per group)
   b) Accelerometers (doubling as clinometers for angles of elevation)
   c) Measuring string or knowledge of their pace
   d) Calculator, pen, pencil
   e) Ziploc™ bag for student workbook and equipment (for water rides)
   f) Dry clothes

2. Hand out tickets as they exit the bus. This speeds entry into the park.

3. Remind students to double-check the restraints on each ride. Be sure that they understand that safety is not a joke.

4. Check with park personnel for meal deals or catered outing. Be sure that students are aware that no outside food is allowed in the park.

5. Announce the lateness penalty for either boarding the bus at school or leaving the park.

6. If the student workbooks are due as the bus arrives back at school, you will get them on time but they will be more ragged than if they are due the next day. Have each team leave one copy of the workbook on the bus. That's the one that will be submitted for grading.

7. An interesting option is to allow students to design activities for rides that are not covered in the workbook.

8. Be sure that your students know how to identify your bus. Put a sign in the front window or a scarf on the antenna.

9. If you do not have students check in with you during the day, make a habit of being visible, and check Guest Relations every hour or so. Students can leave notes for you there.

10. Be sure you have a minimum of two adults on each bus in case you need someone to stay with an ill student.

11. Be sure to explain to students that stopwatches should be used for timing rides while watching and not riding.
Trip Checklist

- **Authorization.** Obtain this from both your school and the district administrator.
  Date of trip: ______________

- **Transportation.** Contact the bus company.
  Total cost: ________Number of seats: ________
  Number of hours: ________From _____a.m. to______ p.m.
  Deposit: $_________ Deadline for balance:_________

- **Tickets.** When you call the park, ask for Group Sales (301-249-1500 Ext. 3272 or 3700).
  $ per ticket: ________Deadline for order: __________
  One Complimentary ticket for every 15 pre-paid tickets.

- **Obtain permission slips or student contracts and make copies of them.** Be sure that emergency contact numbers cover all of the hours of the trip and that both parents and the administration each receive copies of the contract.

- **Collection of money and permission slips.** Have student's pay by check (made out to the school). Have them deposit the checks in a manila envelope and sign a numbered line on the outside of the envelope. This will provide you with an automatic count and will help to prevent loss of money. Don't accept ticket money without a permission slip. Don't accept cash under any circumstances.

- **Student workbooks.** Choose the appropriate activities and have the booklets reproduced.

- **Chaperones.** Ask school administrators, parents, and faculty to join you. Their tickets are usually complimentary.

- **Lesson plans.** Have an alternate activity for students who are unable to go on the trip. Try a workbook for which you supply typical data, so students can do the calculations.

- **Professional relations.** Leave a copy of the student workbook in the faculty lounge so that your colleagues will know what students will be doing and what you will be grading.

- **Public relations.** Invite representatives of the yearbook, school, local papers, and TV stations to attend your field trip. Pictures of students doing calculations next to the roller coasters can be very helpful in dispelling opposition to this type of field trip.
Math & Science Day Field Trip Student Contract

Faculty Sponsor: ________________________________

On ____________, students participating in the trip to Six Flags America will leave _______________ School at _______ a.m. by bus and return that day at about __________p.m. The cost of the trip will be $_______, which must be paid by check made out to the school. This agreement, when signed, informs those concerned that the following stipulations are understood and agreed upon prior to departure.

1. Completion of the Math & Science exercises and write-up is mandatory for each student.
2. Each student is responsible for being on time according to the day's schedule.
3. No student is to engage in any activity that might endanger individual safety or cause property damage.
4. No drugs (except those prescribed by a doctor) will be permitted on the trip.
5. Any violation of school district or park policy will result in appropriate disciplinary action. No line jumping is permitted and is reason for ejection from the theme park.

This agreement is meant to alleviate any misunderstanding that this trip is not a serious educational activity. Math & Science Day is an opportunity for students to experience math & science principles in a meaningful and enjoyable way.

Please have your parent(s) or guardian(s) read this agreement and sign it. Both signatures are necessary before space on the trip can be reserved for you.

Important notes:
No student is required to go on the rides in order to earn full credit. Many of the exercises can be done at ground level.

Please list here any medication currently prescribed for you or that you take routinely and any medical information, such as bee sting allergies, which might be needed by First Aid personnel.

Medication: ________________________________________________________________

Other medical information: __________________________________________________

Parent/guardian: __________________________ Signature: _________________________

Emergency contact #s: Business: ______________ Home: ________________________
Safety Precautions

1. Medical records, including information about current medication, should be part of the permission slip. Be sure to carry the slips with you on the trip.

2. Be sure that students are aware of the location of Guest Relations. Let them know that they can leave messages for you there. Before the trip, let parents or guardians know that you will check with Guest Relations for messages periodically.

3. Form groups of four to six students.

4. Shoes or sneakers are a must. Sandals, loose footwear, loose jackets, and long hair are dangerous on some rides. Remind your students that they must observe any posted regulations.

5. Evaluate your measuring devices for safety before you leave school. Avoid anything with sharp ends. Devices must be lightweight and capable of being tethered to the wrist to avoid loss during a ride. Tethered devices are not allowed on round rides (i.e. teacups).

6. Remind students to check that seat belts and harnesses are secured. The rides are designed to be safe. Students should double-check for themselves.

7. The sun can be a problem. Sun block and sun visors are a must on what may be their first full day in the sun this year.

8. Remember -No one is forced to ride. Measurements can be taken from the ground and accelerometer readings can be shared.

9. Remind students to follow all safety guidelines listed on park map and at each attraction site.
CONSCIOUS COMMUTING

As you ride to the amusement park, be conscious of some of the science on the way.

A. THINGS TO NOTICE AS YOU RIDE

1. As you start up, which way do you FEEL thrown, forward or backward?

2. If someone were watching from the side of the road, what would that person see happening to you in relation to the bus? What would that person see happening to you in relation to the ground underneath you?

3. How can you explain the difference between what you feel as the bus starts up and what the observer sees? (You may want to use the concept of FRAME OF REFERENCE.)

B. Going at a Constant Speed

THINGS TO NOTICE:

4. Describe the sensation of going at a constant speed. Do you feel as if you are moving? Why or why not? (Try to ignore the effects of road noise.)

5. Are there any forces acting on you in the direction that you are moving? Explain what is happening in terms of the principle of inertia.

C. Rounding Curves

THINGS TO NOTICE:

6. If your eyes are closed, how can you tell when the bus is going around a curve? Try it and report what you notice. (Do NOT fall asleep!)

7. As the bus rounds a curve, concentrate on a tree or a building that would have been STRAIGHT AHEAD. See if you can sense that you are
TRYING TO GO STRAIGHT but are being pulled into the curve by a centripetal force. What is supplying the centripetal force, the seat, your seatmate, the wall, or a combination?

How does this change when the curve is tighter or the bus is going faster?

Write a few sentences about this experience. How does it connect with what happens on the rides at the amusement park?
COYOTE CREEK

1. RENEGADE RAPIDS

2. COYOTE CREEK CRAZY CARS

3. THE MIND ERASER
1. **RENEGADE RAPIDS**

   Activity:

   A. **Observational:**

      1. What prevents the boat from sinking on this ride?
         
         __________________________________________________________
         
         __________________________________________________________

      2. What would make the boat:

         a) Speed up:
          
          __________________________________________________________

         b) Slow down:
          
          __________________________________________________________

      3. What do you think causes the rapid current in the water?
         
         __________________________________________________________
         
         __________________________________________________________
2. **COYOTE CREEK CRAZY CARS**

Age Group: upper elementary & above (5th grade & above)

**Activity:**

Observational: Whenever we are in a collision, we feel our body is being pushed or pulled in some direction.

1. Have a collision where the front of your car gets hit. Which direction do you feel pulled when this collision happens? ____________________________

2. Have a collision where the back of your car gets hit. Which direction do you feel pulled when this collision happens? ____________________________

3. Have a collision where the side of your car gets hit. Which direction do you feel pulled when this collision happens?
   ____________________________

4. From what happened in these three collisions, complete the following sentence: “In a collision, a person always feels pulled ___________ (toward or away from) the collision point.

5. Can you find any clue as to what is used to power this ride?
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
3. **THE MIND ERASER**

Age Group: Middle School & above. (This activity is viewed from the ground and therefore can be done by elementary school children).

**Activity:**

A. **Observational:**

1. Are any of the loops or hills taller than the first hill?

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

2. What is different about the first hill other than its height?

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

3. How many different times are the riders upside down?

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

4. Is this ride a true coaster? Explain your answer.

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
4. RIDDLE ME THIS

5. SUPERMAN – RIDE OF STEEL

6. BATWING

7. THE PENGUIN'S BLIZZARD RIVER
4. **RIDDLE ME THIS**

Age Group: Upper elementary & up (5th grade & up)

**Activity:**

A. **Observational:**

1. Which way do you feel pushed in the beginning of the ride?

   ____________________________________________________________
   ____________________________________________________________

2. Which way do you feel pushed as the ride tips?

   ____________________________________________________________
   ____________________________________________________________

3. What happens to the speed as this ride tips and falls?

   ____________________________________________________________
   ____________________________________________________________

4. When ride tips, what sensations does your body feel?

   ____________________________________________________________
   ____________________________________________________________

5. Does this ride go clockwise or counter-clockwise?

   ____________________________________________________________
   ____________________________________________________________
5. **SUPERMAN - RIDE OF STEEL**

Age group: Middle School

**Activity:**

A. Observational

1. How long is the ride from the time the train leaves the station until the time the train gets to the brakes?

_____________________________________________________________________

1. The total track is 5350’ long. What is the average speed of the entire ride?

_____________________________________________________________________

2. How long is the ride in seconds from the time the train leaves the top of the hill until the time the train stops?

_____________________________________________________________________

3. The track is 4002’ long from the top of the hill to the station. What is the average speed of the train after it leaves the lift hill?

_____________________________________________________________________
6. **BATWING**

   Age group: Early Primary

   **Activity:**

   A. Observational

   1. What are some reasons this ride is scary to some people?

   ________________________________________________________________

   2. Is this coaster a suspended coaster?

   ________________________________________________________________
7. **THE PENGUIN’S BLIZZARD RIVER**

Age Group: Upper elementary & up (5th grade & up)

**OVERVIEW**
A raft 2.40 m in diameter is lifted up a hill and then descends down a flume and through two twists before splashing into Chiller Bay. Spectators can fire water cannons at the riders as they pass through Chiller Bay.

**GOALS**
- Observing
- Measuring
- Collecting Data
- Applying Data
- Identifying Variables

**MATERIALS**
- Stopwatch
- Paper
- Pencil

**DIRECTIONS/ACTIVITY**

1. Select a spot near the Penguin’s Blizzard River to observe one of the rafts. Make sure you have a clear view.
2. Using a stopwatch, determine the time it takes the raft to pass a point at the top of the flume and at the bottom of the flume.
3. Time at least 3 different rafts.
4. Create a data table to display your observations.
5. Did you get the same results for each raft?
6. What variables contribute to the difference in times?
7. Could you get the same results each time? How?
EXTENSIONS/ENRICHMENT

1. Why is there water on the slide and not just at the bottom?

2. At what point on this ride is the speed the greatest?

3. What causes the raft to rotate as it moves down the flume?
LOONEY TUNES MOVIE TOWN

8. Looney Tunes Prop Warehouse

9. Elmer’s Around the World in 80 Seconds

10. Foghorn Leghorn’s Tinsel Town Train

11. Taz’s Film Works

12. Pepe Le Pew’s Tea Party

13. Yosemite Sam’s Hollywood Flight School
8. **LOONEY TUNES PROP WAREHOUSE**

Age Level: Kindergarten to 4th grade

Activity:

A) Observational and Recall:

1. One part of Looney Tunes Prop Warehouse is a large number of punching bags hanging on ropes. The bags are of different colors. How many different colors can you see? ________

2. Write down the colors you see_______________________________________
   ___________________________________________________________________

3. The colors in the rainbow are red, orange, yellow, green, blue, and violet. What color in a rainbow is missing at the Looney Tunes Prop Warehouse? __________________________
ELMER’S AROUND THE WORLD IN 80 SECONDS

Age Level: Kindergarten to 3rd grade

Activities:

A) Observational:

1. Put a check by each thing that happens to you during this ride.
   - Move up
   - Move down
   - Move backward
   - Move forward
   - Move upside down
   - Move in a circle
   - Swing out
   - Swing in

2. What happens to you as the ride speeds up (do you feel anything)? __________


B) Determining the Change in Period:

1. Pick a person on this ride. Using your stopwatch, find how long it takes this person to go around once when the seats are leaning outward the most.
   
   Time = ___________ seconds.

2. When the seats point straight down, is the ride moving faster or slower? _______

3. Finish this statement: When the seats of this ride leaned outward the most, the ride was moving (faster or slower) ___________, and the time it took the person to go around once was (longer or shorter) ____________ .
10. **FOGHORN LEGHORN’S TINSEL TOWN TRAIN**

Age Level: Kindergarten to 2nd grade

Activities:

A) **Estimating Length:**

1. Do you know how big a meter stick is? If not, ask your teacher or a chaperone. Imagine that meter sticks are laid end to end next to the train. How many sticks would it take to equal the length of the train? Train = _____________ meters.

B) **Estimating Speed:**

1. Using a stopwatch, see how many seconds it takes the entire train to go past you. Time = ______________ seconds.

2. As the train goes around and around the track, does its speed seem to change?

   If the train moved faster, would it take more or less seconds to go past you?

C) **Mathematical:**

1. How many total seats are on this train? ____________

   What is the maximum amount of people that can ride this train? _______
11. **TAZ’S FILM WORKS**

Age Level: Early Primary (1st grade)

Activities:

A) **Observational:**

1. Stand so you're looking toward the ride. Which way does the ride turn? Do the riders closest to you move from left to right or from right to left? _______

2. While looking at the ride:
   a) Which direction do the seats hang when the ride is not moving? _____

   b) Which direction do seats hang when the ride is moving? _____

   c) What makes the swings move into that position?

B) **Using Your Stopwatch**

1. Find the time it takes a rider to go once around on this ride.
   Time = ___________ seconds

2. Does this ride seem to go around at the same speed all the time?

C) **Mathematical Activity:**

1. By standing in one spot and watching the ride, how many seats do you think there are? ________

2. Using your stopwatch, time how many minutes this ride lasts.

3. In 10 turns, how many children could get on this ride? Assume all seats are taken.) ________
12. **PEPE LE PEW’S TEA PARTY**

Age Group: Early Primary (Kindergarten, 1st grade)

Activity:

A) Observational:

1. This ride gives the rider *three* different motions all at the same time. Describe the three motions:
   
a) ________________________________
   
b) ________________________________
   
c) ________________________________
13. **YOSEMITE SAM’S HOLLYWOOD FLIGHT SCHOOL:**

Age Group: Early Primary (Kindergarten to 1\textsuperscript{st} grade)

Activities:

A) Observational:

1. How many different kinds of sounds can you hear that come from this ride? Describe each kind of sound you hear. (Note: the operator may have sound turned off.)

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

2. Does the “plane sound” change or just stay the same? ____________

B) Estimation Time: How long does it take a plane to go around once on this ride?

Here are three ways to determine this:

1. Guessing: Pick a plane (look at its number). Guess how many seconds it takes this plane to go around the circle. Choose the answer that seems the closest:
   a) 2 seconds  b) 10 seconds  c) 20 seconds  d) 60 seconds

2. Ask your teacher how to estimate seconds by counting. Using this way of counting, see how long it takes the plane to go around once. __________

3. Using your stopwatch, time how many seconds it takes the plane to go around once. __________ seconds

4. Which of the three answers are the same? ______________________

5. Which answer do you think is the best? ______________________
CHESAPEAKE

14. Shipwreck Falls

15. Cyclone

16. Carousel

17. Tea Cups

18. Flying Carousel

19. Pirates Flight

20. High Seas

21. Roar
14. **SHIPWRECK FALLS**

Age Group: Middle Primary and Above (third grade & above)

**Activities:**

A. **Observational:**

1. Draw a picture that most resembles the path of the splash.

2. In a football game, at what times do you see the football following this path? ____________________________________________________________

_________________________________________________________________

What about in a baseball game?

_________________________________________________________________

_________________________________________________________________

3. Does the splash always hit the same mark?

_________________________________________________________________

_________________________________________________________________

4. If not, what do you think would cause it to differ?

_________________________________________________________________

_________________________________________________________________
B. Mathematical:

1. How long does the ride take from start to finish? _________________ seconds

2. What is the time delay between rides? _________________ seconds

3. What is the maximum number of people that can ride in the boat?

4. Determine the maximum number of people that can ride Shipwreck Falls in one hour.

__________________________________________________________________
15. **CYCLONE**

Age Group: Upper Elementary & Above (5th grade & up)

Activities:

A) Observational:
   1. Identify the two circular motions of this ride.
      a) _____________________________
      b) _____________________________
   2. Measure the time it takes to go around the big circle once. _________
   3. Are the cars turning in the same direction? ____________
      Describe: ________________________
   4. While on the ride, name all the directions you feel pushed:
      ______________________________
   5. What geometric figure do you find your body is making in the seat as you ride the Cyclone?
16. **CAROUSEL**

Age Level: All ages with adult supervision.

Activities:

A) Observational

1. How many different kinds of animals are on the outside row of this ride? _______
   Name them. ________________________________________________________________
   ________________________________________________________________

2. There are mirrors around the center of the ride. As the ride is moving, look at the legs of the animals in the mirrors. What do they appear to be doing? ________________
   _______________________________________________________________________
   What about the mirrors might cause this effect? ________________________________
   Have you ever seen mirrors like this before? ________________________________

B) Determining the speed of your favorite animal:

1. While standing near the ride, pick out your favorite animal on the outside row. Start your stopwatch when that animal passes directly in front of you. Stop the watch when the animal passes in front of you again.

   Write your answer here. _______ seconds

   This is the amount of time it took your animal and the ride to go around once. In science, this is known as the period.

2. Now determine how far this animal moves when it goes around one time. We are going to assume that a person’s average step or pace is half a meter long.

   When the ride is over, count how many steps (paces) it takes you to walk around the edge of the ride once. Number of steps (paces): _______

   If we assume that each step is ½ meter, the distance around the ride is:
   \[ \text{# of steps} \times \frac{1}{2}\text{ meter} = \text{total meters animal moved around the ride} \]

   You have just determined the **Perimeter** of this circle or its **Circumference**!
3. To find out the speed of your animal, just divide the distance by the time.
   Average speed (meters/second)
   Time for once around (seconds)
   Distance around the ride (meters)

4. Did your animal go faster or slower than 4 meters/second? __________

C) Additional mathematical activity (percentage):

1. What percentage of the animals in the outer row are elephants? (Show your work.)
17. **TEA CUPS**

Age Level: Middle primary & up (2nd grade & up)

**Activities:**

A) Observational:

1. Name the three different size circles this ride makes:
   
   a) 
   
   b) 
   
   c) 

2. If you viewed this ride from above, draw the different size circles you would see:

3. As you watch the ride and the different size circles, label in the picture which circles are:
   
   a) Always going “clockwise”
   
   b) Always going “counter-clockwise”
   
   c) Goes both “clockwise and counter-clockwise”
B) Mathematical:

1. Compare how long it takes a cup to complete a:
   
   a) Big circle = _______ seconds
   b) Small circle =_______ seconds

   This is called the **Period** of the circle.

2. Now pick a different cup and determine the period for:
   
   a) Big circle = _______ seconds
   b) Small circle = _______seconds

3. In comparing the periods of the big circle and the small circle, which period seems to vary more in its speed? ____________________________
18. **FLYING CAROUSEL**

Age Level: 4th grade & up.

Activity:

A) Observational:

1. As the ride is moving, do large people seem to fly out further than small people? ______________

2. Does an empty seat fly out further than one with a person? ______________

3. Do inner seats fly out further than outer seats? ______________

4. What do the colors on the ceiling of the ride remind you of? ____________

5. Starting with the red stripe of color, list all the colors you see, in order, until you get to the next red stripe. ________________________________________________

6. Can you think of somewhere else that you have seen these colors in the same order? ______________________________________________________

7. What do you notice about the motion of the middle section of this ride compared to the motion of the ceiling where the swings are attached? ______________

____________________

______________________________________________

__________________________________

____________________________________________________
19. **PIRATES FLIGHT**

Age Group = Middle elementary & Above (4th grade & above)

**Activity:**

A. **Observational:**

1. When the ride is not moving, is the seat pointing straight down?

__________________________

How does the position of this seat change once you are moving?

_____________________________

What do you think determines how far this position changes?

_______________________________

2. When the ride is in motion, what direction is your head tilting?

__________________________

What direction do you feel pushed? __________________

_______________________________

3. When the ride touches ground, which way do you feel pulled?

__________________________

Why do you think this is so?

_______________________________
20. **HIGH SEAS**  
Grade Level: Upper elementary & above (5th grade & above)

Activities:

A. **Observational:**

1. Determining the period of the swing (swing time)
   
   Time how long a back & forth swing takes at various stages during the ride. This is known as the period of the swing. Take at least four different readings.
   
   a. _______ seconds  
   b. _______ seconds  
   c. _______ seconds  
   d. _______ seconds

2. Does the swing time vary during this ride?  
   ________________________________________________________________

3. At what point during the ride did your weight feel the lightest?  
   ________________________________________________________________

   When does it feel the heaviest? ____________________________________

B. **Critical Thinking**

If your teacher has talked about Potential Energy and Kinetic Energy, see if you can answer the next two questions.

1. At what point on this ride is Potential Energy the highest?  
   ________________________________________________________________

2. At what point is Kinetic Energy the greatest?  
   ________________________________________________________________
21. **ROAR (ROLLER COASTER)**

Age Group: Middle School & above. This activity should not be done by elementary school children since it must be done on the ride.

**Activity:**

A. **Observational:**

1. How many times do you feel your body pushed to the left and the right during the ride? 

2. During which part of the ride do you feel lifted off your seat?

3. Describe your sensations of weight when you are:
   a) climbing a hill
   b) at the top of a hill
   c) going down a hill
   d) at the bottom of the hill
MARDI GRAS

22. Voodoo Drop

23. The Wild One

24. Zydeco Zinger

25. Big Easy Speedway (Go Karts)
22. **VOODOO DROP**

Age Group: Middle School & above (This activity is viewed from the ground and therefore can be done by elementary school children.)

Activity:

A) Observational:

1. Does this ride go up at constant speed?

2. Does this ride go down at constant speed?

3. What makes the ride go up?

4. What makes the ride come down?

5. What device have you ridden that reminds you of this ride?

6. When does the ride stop falling freely?

7. When do you think you are moving the fastest on this ride?

8. If your teacher has talked about “Potential Energy,” when is it the highest on this ride?

9. If your teacher has talked about “Kinetic Energy,” when is it the highest on this ride?
23. **THE WILD ONE**

Age Group: Middle School and above (This activity is viewed from the ground and therefore can be done by elementary school children.)

Activities:

A) Critical Thinking:

1. The roller coaster does not have a motor or engine on the train. At some spots, the train is pulled along by a chain under the track. What part of this ride is the train being pulled by this chain?

2. Watch the ride. How does the train get up the hills where it is not getting a pull by the chain?

3. Why is this ride called a “Coaster?”

B) Mathematical:

1. What is the maximum number of people that can ride this roller coaster?_______________________
24. ZYDECO ZINGER

Grade Level: Upper Elementary & Above (5th grade and above)

Activity:

A) Observational:

1. When during this ride do you feel the heaviest (when you feel pushed hardest against the seat)?

__________________________________________________________________
__________________________________________________________________

2. When during this ride do you feel the lightest?

__________________________________________________________________
__________________________________________________________________

3. What other feelings do you have at different parts of this ride?

__________________________________________________________________
__________________________________________________________________

4. What is it about this ride that causes the feelings you described above?

__________________________________________________________________
__________________________________________________________________
25. **BIGEASY SPEEDWAY (Go Karts)**

Age level: Middle School & above (This activity is viewed from the ground & therefore can be done by elementary school children.)

Activities:

A) Observational:

4. Does it appear that the cars are going at the same speed all the time?

If not, where on the track do the cars seem to slow down?

Where do they usually speed up?

B) Mathematical:

1. Pick out a moving car. Using a timer, time it for one lap and then for a second lap.

   Time for 1\textsuperscript{st} lap = \underline{______________} seconds

   Time for 2\textsuperscript{nd} lap = \underline{______________} seconds

   Is the car speeding up or slowing down? \underline{_________________________}
BACK AT SCHOOL

Summary Question:

Why is it more exciting to ride these rides than it is to take a trip in a car? Why or why not?
What were some of the most unusual feelings you experienced today?
# RIDE SPECIFICATIONS/INFORMATION

## THE SPECS

### Superman – Ride of Steel
- **Introduced**: 2000
- **Height**: 200 feet tall - 20 stories! 190 foot first drop
- **Length**: 5,350 feet of track (more than 1 mile)
- **Top Speed**: 75 mph (maximum acceleration on first drop)
- **Ride Duration**: 3 minutes, 20 seconds
- **Number of Trains**: 2
- **Number of Passengers**: 32
- **Manufacturer**: Intamin

### The Mind Eraser
- **Introduced**: May 1995
- **Height**: 115 feet
- **Length**: 2,170 feet
- **Top Speed**: 55 mph
- **Ride Duration**: 2 minutes, 5 seconds
- **Number of Trains**: 2
- **Number of Passengers**: 16
- **Special Features**: A wicked corkscrew sequence following an inverted steel loop.
- **Height Restriction**: Minimum 52"
- **Manufacturer**: Vekoma, Inc.

### ROAR
- **Introduced**: 1998
- **Height**: 90 feet
- **Length**: 3,200 feet
- **Top Speed**: 50 mph
- **Number of Trains**: 2
- **Number of Passengers**: 24
- **Colors**: Bare Wood
### Special Features
- **Features a half-mile track with 6 reversals and 20 crossovers, plus a 180-degree spiraling second drop that subjects riders to several moments of weightlessness and a 230-foot roofed tunnel.**

### G-Force
- 3.5

### Manufacturer
- Great Coasters International, Inc.

### Typhoon Seacoaster

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduced</td>
<td>1997</td>
</tr>
<tr>
<td>Height</td>
<td>60 feet</td>
</tr>
<tr>
<td>Length</td>
<td>2,200 feet</td>
</tr>
<tr>
<td>Number of Boats</td>
<td>16</td>
</tr>
<tr>
<td>Number of Passengers</td>
<td>8</td>
</tr>
<tr>
<td>Special Features</td>
<td>Beginning with a 30-foot incline, a rotating platform spins boats 150 degrees at the crest of the slope until the boats are facing backwards! Then they’re dropped through a high-speed channel and travel backward through a chute. Finally, they climb up 60 feet in the air and plummet to the bottom through the mouth of a skull.</td>
</tr>
<tr>
<td>Height Restriction</td>
<td>Minimum 42”</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>Intamin, Ltd.</td>
</tr>
</tbody>
</table>

### The Wild One

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduced</td>
<td>1986</td>
</tr>
<tr>
<td>Height</td>
<td>98 feet</td>
</tr>
<tr>
<td>Length</td>
<td>4,000 feet</td>
</tr>
<tr>
<td>Top Speed</td>
<td>60 mph</td>
</tr>
<tr>
<td>Ride Duration</td>
<td>2 minutes, 30 seconds</td>
</tr>
<tr>
<td>Number of Trains</td>
<td>2</td>
</tr>
<tr>
<td>Number of Passengers</td>
<td>24</td>
</tr>
<tr>
<td>Height Restriction</td>
<td>Minimum 48”</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>Charles Dinn</td>
</tr>
</tbody>
</table>

### Batwing

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduced</td>
<td>2001</td>
</tr>
<tr>
<td>Height</td>
<td>115 feet tall</td>
</tr>
<tr>
<td>Length</td>
<td>3,340 feet</td>
</tr>
</tbody>
</table>
### Additional Ride Specifications

<table>
<thead>
<tr>
<th>Ride Name</th>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The Wild One</strong></td>
<td>Height of the first hill</td>
<td><strong>29.9 m</strong></td>
</tr>
<tr>
<td></td>
<td>Track height at bottom of first hill</td>
<td><strong>5.2 m</strong></td>
</tr>
<tr>
<td></td>
<td>Track height at top of second hill</td>
<td><strong>20.4 m</strong></td>
</tr>
<tr>
<td></td>
<td>Height of hill before the horizontal loop</td>
<td><strong>11.6 m</strong></td>
</tr>
<tr>
<td></td>
<td>Exit height of the horizontal loop</td>
<td><strong>4.6 m</strong></td>
</tr>
<tr>
<td></td>
<td>Radius of the horizontal loop</td>
<td><strong>12.2 m</strong></td>
</tr>
<tr>
<td></td>
<td>Length of passenger train</td>
<td><strong>14.5 m</strong></td>
</tr>
<tr>
<td></td>
<td>Angle of lift incline</td>
<td><strong>19.5 degrees</strong></td>
</tr>
<tr>
<td></td>
<td>Length of lift incline</td>
<td><strong>89.6 m</strong></td>
</tr>
<tr>
<td><strong>Superman Ride of Steel</strong></td>
<td>Height of the first hill</td>
<td><strong>61.0 m</strong></td>
</tr>
<tr>
<td></td>
<td>Track height at bottom of first hill</td>
<td><strong>1.2 m</strong></td>
</tr>
<tr>
<td></td>
<td>Track height at top of second hill</td>
<td><strong>52.1 m</strong></td>
</tr>
<tr>
<td></td>
<td>Radius of curvature at top of second hill</td>
<td><strong>25 m</strong></td>
</tr>
<tr>
<td></td>
<td>Height at entrance of first horizontal loop</td>
<td><strong>4.9 m</strong></td>
</tr>
<tr>
<td></td>
<td>Radius of first horizontal loop</td>
<td><strong>30.5 m</strong></td>
</tr>
<tr>
<td></td>
<td>Height at exit of first horizontal loop</td>
<td><strong>6.1 m</strong></td>
</tr>
<tr>
<td></td>
<td>Height at entrance of second horizontal loop</td>
<td><strong>5.5 m</strong></td>
</tr>
<tr>
<td></td>
<td>Radius of second horizontal loop</td>
<td><strong>22.9 m</strong></td>
</tr>
<tr>
<td></td>
<td>Height at exit of second horizontal loop</td>
<td><strong>9.4 m</strong></td>
</tr>
<tr>
<td></td>
<td>Angle of lift incline</td>
<td><strong>30.0 degrees</strong></td>
</tr>
<tr>
<td></td>
<td>Length of lift incline</td>
<td><strong>122 m</strong></td>
</tr>
<tr>
<td></td>
<td>Length of train</td>
<td><strong>16.2 m</strong></td>
</tr>
<tr>
<td><strong>Roar</strong></td>
<td>Height of the first hill</td>
<td><strong>27.4 m</strong></td>
</tr>
<tr>
<td></td>
<td>Track height at bottom of first hill</td>
<td><strong>3.4 m</strong></td>
</tr>
<tr>
<td></td>
<td>Track height at top of second hill</td>
<td><strong>21.0 m</strong></td>
</tr>
<tr>
<td></td>
<td>Angle of lift incline</td>
<td><strong>25.0 degrees</strong></td>
</tr>
<tr>
<td></td>
<td>Length of lift incline</td>
<td><strong>64.8 m</strong></td>
</tr>
<tr>
<td></td>
<td>Length of train</td>
<td><strong>18.1 m</strong></td>
</tr>
</tbody>
</table>

### Ride Specifications Table

<table>
<thead>
<tr>
<th>Top Speed</th>
<th>More than 50 mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ride Duration</td>
<td>2 minutes, 20 seconds</td>
</tr>
<tr>
<td>Number of Trains</td>
<td>3</td>
</tr>
<tr>
<td>Number of Passengers</td>
<td>24 per train</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>Vekoma International</td>
</tr>
<tr>
<td>Ride</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Batwing</td>
<td>Height at top of first hill 35.1 m</td>
</tr>
<tr>
<td></td>
<td>Height of the bottom of the vertical loop 1.2 m</td>
</tr>
<tr>
<td></td>
<td>Height of the top of the vertical loop 22.6 m</td>
</tr>
<tr>
<td></td>
<td>Radius of curvature of the bottom the vertical loop 20.0 m</td>
</tr>
<tr>
<td></td>
<td>Radius of curvature of the top of the vertical loop 6.0 m</td>
</tr>
<tr>
<td></td>
<td>Angle of lift incline 32.0 degrees</td>
</tr>
<tr>
<td></td>
<td>Length of lift incline 66.2 m</td>
</tr>
<tr>
<td></td>
<td>Length of train 15.3 m</td>
</tr>
<tr>
<td>The Mind Eraser</td>
<td>Height of the first hill 30.5 m</td>
</tr>
<tr>
<td></td>
<td>Height at bottom of first hill 4.6 m</td>
</tr>
<tr>
<td></td>
<td>Radius of curvature at bottom first hill 15m</td>
</tr>
<tr>
<td></td>
<td>Radius of curvature at top and bottom of station loop 17.0 m</td>
</tr>
<tr>
<td></td>
<td>Radius of curvature at top of station loop 6.0 m</td>
</tr>
<tr>
<td></td>
<td>Height at bottom of vertical loop 5.5 m</td>
</tr>
<tr>
<td></td>
<td>Height at top of vertical loop 21.6 m</td>
</tr>
<tr>
<td></td>
<td>Angle of lift incline 32.0 degrees</td>
</tr>
<tr>
<td></td>
<td>Length of lift incline 57.6 m</td>
</tr>
<tr>
<td></td>
<td>Radius of helix 8.2 m</td>
</tr>
<tr>
<td></td>
<td>Length of train 15.0 m</td>
</tr>
<tr>
<td>Shipwreck Falls</td>
<td>Length of barge 6.1 m</td>
</tr>
<tr>
<td></td>
<td>Length of incline 52.4 m</td>
</tr>
<tr>
<td></td>
<td>Angle of incline 25 degrees</td>
</tr>
<tr>
<td>Voodoo Drop</td>
<td>Length of free fall 38.4 m</td>
</tr>
<tr>
<td></td>
<td>Total height 42.7 m</td>
</tr>
<tr>
<td></td>
<td>Time of free fall 2.1 sec</td>
</tr>
<tr>
<td></td>
<td>Maximum speed 24.9 m/ s</td>
</tr>
<tr>
<td>Riddle Me This</td>
<td>Radius of ride 4.2 m</td>
</tr>
<tr>
<td></td>
<td>Maximum angle of tilt 48 degrees</td>
</tr>
<tr>
<td>Pirate’s Flight</td>
<td>Radius of rotation 10.4 m</td>
</tr>
<tr>
<td></td>
<td>Length of chains suspending the gondola 6.2 m</td>
</tr>
<tr>
<td>High Seas</td>
<td>Length of boat 14.5 m</td>
</tr>
<tr>
<td></td>
<td>Distance from pivot to center of boat 12.2 m</td>
</tr>
<tr>
<td></td>
<td>Maximum angle 75 degrees</td>
</tr>
<tr>
<td>Carousel</td>
<td>Radius of inner circle of horses 4.4 m</td>
</tr>
<tr>
<td></td>
<td>Radius of outer circle of horses 7.2 m</td>
</tr>
<tr>
<td>Flying Carousel</td>
<td>Radius for inner chairs at maximum angular velocity 7.3 m</td>
</tr>
<tr>
<td></td>
<td>Radius for outer chairs at maximum angular velocity 8.2 m</td>
</tr>
</tbody>
</table>
GLOSSARY OF TERMS

**Motion:** takes place whenever an object changes its location. Any object which is not staying in the same place is moving, even if it later comes back to the same place.

**Vertical:** up and down. A telephone pole or a tree trunk is usually an example of a vertical line.

**Horizontal:** side to side. A flat road or the surface of a calm lake forms a horizontal line.

**Cycle:** one complete pattern of any event or motion which repeats itself. For a ride which involves moving in a circle, a cycle is one complete trip around the circle.

**Period:** the amount of time it takes for a repeating event to complete one cycle. If it takes 15 seconds for a carousel to make one revolution, the period of the carousel is 15 s.

**Clockwise:** used for circular motion to describe which way the object moves around the circle. If you look at a clock which has hands that rotate, the direction that the hands rotate is called clockwise. A carousel is said to be turning clockwise if, as you stand near it and watch, the riders closest to you are moving from right to left.

**Counter-clockwise:** moving around a circle in the direction opposite to the manner described in the previous description.

**Speed:** a measure of the rate at which an object changes position. Speed is measured in meters/second. An object with a steady speed of 2 m/s moves a distance of 2 meters in one second. You can determine the speed of an object by measuring the amount of time it takes the object to move some measured distance. When you divide the distance by the time it takes to move that distance, you get the average speed of the object.

**Rainbow colors:** the colors which occur in a natural rainbow. These colors (not all of them are always clearly visible) occur in the same order in all rainbows. The six colors in order are: red, orange, yellow, green, blue, and violet. The color “indigo” is sometimes included between blue and violet, but this color is often omitted since it is less familiar.
Amusement Park Web Sites

National Amusement Park Historical Association
http://www.napha.org/

Paramount Great America
http://www.pgathrills.com/

America Coaster Enthusiasts
http://www.aceonline.org/

Roller Coaster Physics
http://141.104.22.210/Anthology/Pav/Science/Physics/book/home.html
This is an excellent resource written by Tony Wayne. There are over 150 pages available in pdf format.

Midway Physics Day in South Carolina
http://solomon.physics.sc.edu/~tedeschi/midway/bigtop.html

Virtual Roller Coaster-Annenberg/CPB Project
http://www.learner.org/exhibits/parkphysics/

Roller Coaster G-Forces Applet
http://www.glenbrook.k12.il.us/gbssci/phys/mmedia/circmot/rcd.html

Quick Time Roller Coaster Movies From CNN

Model Roller Coaster Physics Project
http://www.gunn.palo-alto.ca.us/physlab/plab99/labs/nmorley/rollercoaster.htm

Six Flags America
http://www.sixflags.com