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.

To find the answers to the questions requires you to 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 on estimating how fast you are going. Your teacher can help you do all this. What is most interesting is trying to relate what is going on with the ride and 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 counter-clockwise 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. This, if a merry-go-round was turning from left to right in front of you, it would move counter-clockwise 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 counter-clockwise. 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 students 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 side 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, or Josie Diguilio (301-249-1500 Ext. 3275 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 coaster 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, the arm of the seat, 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 rider's upside down?

_____
_____

4. Is this ride a true coaster?

_____

Explain you answer:

GOTHAM CITY

4. **RIDDLE ME THIS**
5. **SUPERMAN – RIDE OF STEEL**
6. **BATWING**
7. **THE JOKER'S JINX**
8. **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 for the time the train leaves the top of the hill until the time the train gets to the brakes?

_____

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 JOKER'S JINX

Age group: Middle School and Above

Activity:

A. Observational

1. What makes the ride go forward?
_____

2. Why is this ride slower at the top?
_____

3. Does this ride ever go completely upside down?
_____

8. 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 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

9. Looney Tunes Prop Warehouse

10. Elmer's Around the World in 80 Seconds

11. Foghorn Leghorn's Tinsel Town Train

12. Taz's Film Works

13. Pepe Le Pew's Tea Party

14. Yosemite Sam's Hollywood Flight School

9. 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? _____

10. 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, how long does it take this person to go around once when the seats are leaning outward the most = _____ seconds.

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

3. Can you 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) _____ .

11. 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 whoever brought you to the park. 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 = _____ 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? _____

12. 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 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 = _____ 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 does this ride last?

   3. In 10 turns, how many children could get on this ride _____ (assume all seats were taken)

13. 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) _____

14. YOSEMITE SAM'S HOLLYWOOD FLIGHT SCHOOL:

Age Group: Early Primary (Kindergarten to 1st 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?(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. Which answer choice seems 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? _____

NANTUCKET

15. SHIPWRECK FALLS

16. Cyclone

15. 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 1 hour
   _____

16. 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?

OLDE BOSTON

17. Carousel

18. Tea Cups

19. Flying Carousel

17. 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 appears to be unusual about these mirrors that cause this ?_____
   Have you ever seen mirrors like this?_____

B) Determining the speed of your favorite animal:

1. While standing near the ride, pick out your favorite animal that is found 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 let us 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 = ½ 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:
# of steps _____ X ½ meter = _____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/seconds)
   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 % of the animals in the outer row are elephants?(show your work)

18. 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 what 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 _____?

19. 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 your 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? _____
_____
_____
_____

20. Pirates Flight

21. High Seas

22. Roar

20. 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?

_____

21. 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
_____; 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?
_____

22. 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. What 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

SOUTHWEST TERRITORY

23. Tower of Doom

24. The Wild One

25. Falling Star

26. Sonora Speedway (Go Karts)

23. TOWER OF DOOM

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?

24. 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?_____

25. FALLING STAR

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

   _____

   _____

   _____

26. SONORA 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 1 lap and then for a 2nd lap.

   Time for 1st lap = _____ seconds

   Time for 2nd lap = _____ seconds

   Is the car speeding up or slowing down? _____

BACK AT SCHOOL

Summary Question:

Why is it more exciting (more unusual feelings) to ride these rides than it is to take a trip in a car?

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 SPECS	*Joker's Jinx*
Introduced	1999
Height	78 feet
Length	2,705 feet
Weight	500 tons
Top Speed	60 mph
Ride Duration	1 minute, 30 seconds
Number of Trains	2
Number of Passengers	24
Special Features	Features 30 vertical curves, 25 horizontal curves, four upside-down loops and one corkscrew.
G-Force	4
Manufacturer	Premier Rides

THE SPECS

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.

THE SPECS

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.

THE SPECS

Typhoon Seacoaster

Introduced	1997
Height	60 feet
Length	2,200 feet
Number of Boats	16
Number of Passengers	8
Special Features	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.
Height Restriction	Minimum 42"
Manufacturer	Intamin, Ltd.

THE SPECS

The Wild One

Introduced	1986
Height	98 feet
Length	4,000 feet
Top Speed	60 mph
Ride Duration	2 minutes, 30 seconds
Number of Trains	2
Number of Passengers	24
Height Restriction	Minimum 48"
Manufacturer	Charles Dinn
•	

THE SPECS

Batwing

Introduced	2001
Height	115 feet tall!
Length	3,340 feet
Top Speed	More than 50 mph
Ride Duration	2 minutes, 20 seconds
Number of Trains	3
Number of Passengers	24 per train
Manufacturer	Vekoma International

Additional Ride Specifications

The Wild One	< Height of the first hill ***29.9 m*** < Track height at bottom of first hill ***5.2 m*** < Track height at top of second hill ***20.4 m*** < Height of hill before the horizontal loop ***11.6 m*** < Exit height of the horizontal loop ***4.6 m*** < Radius of the horizontal loop ***12.2 m*** < Length of passenger train ***14.5 m*** < Angle of lift incline ***19.5 degrees*** < Length of lift incline ***89.6 m***
Jokers Jinx	< Length of acceleration phase ***61.0 m*** < Time of acceleration phase ***3 seconds*** < Length of train ***14.6 m*** < Speed at end of acceleration phase ***26.7 m/s*** < Difference in height from acceleration phase to bottom of first loop ***1.1 m*** < Radius of curvature of first loop ***21m*** < Height at top of first loop ***28.3 m***
Superman Ride of Steel	< Height of the first hill ***61.0 m*** < Track height at bottom of first hill ***1.2 m*** < Track height at top of second hill ***52.1 m*** < Radius of curvature at top of second hill ***25m*** < Height at entrance of first horizontal loop ***4.9 m*** < Radius of first horizontal loop ***30.5 m*** < Height at exit of first horizontal loop ***6.1 m*** < Height at entrance of second horizontal loop ***5.5 m*** < Radius of second horizontal loop ***22.9 m*** < Height at exit of second horizontal loop ***9.4 m*** < Angle of lift incline ***30.0degrees*** < Length of lift incline ***122 m*** < Length of train ***16.2 m***
Roar	< Height of the first hill ***27.4 m*** < Track height at bottom of first hill ***3.4 m*** < Track height at top of second hill ***21.0 m*** < Angle of lift incline ***25.0 degrees*** < Length of lift incline ***64.8 m*** < Length of train ***18.1 m***

Batwing	<	Height at top of first hill ***35.1 m***
	<	Height of the bottom of the vertical loop ***1.2 m***
	<	Height of the top of the vertical loop ***22.6 m***
	<	Radius of curvature of the bottom the vertical loop ***20.0 m***
	<	Radius of curvature of the top of the vertical loop ***6.0 m***
	<	Angle of lift incline ***32.0 degrees***
	<	Length of lift incline ***66.2 m***
	<	Length of train ***15.3 m***
The Mind Eraser	<	Height of the first hill ***30.5 m***
	<	Height at bottom of first hill ***4.6 m***
	<	Radius of curvature at bottom first hill ***15m***
	<	Radius of curvature at top and bottom of station loop ***17.0 m***
	<	Radius of curvature at top of station loop ***6.0m***
	<	Height at bottom of vertical loop ***5.5 m***
	<	Height at top of vertical loop ***21.6 m***
	<	Angle of lift incline ***32.0 degrees***
	<	Length of lift incline ***57.6 m***
	<	Radius of helix ***8.2 m***
	<	Length of train ***15.0 m***
Shipwreck Falls	<	Length of barge ***6.1 m***
	<	Length of incline ***52.4 m***
	<	Angle of incline ***25 degrees***
Tower of Doom	<	Length of free fall ***38.4 m***
	<	Total height ***42.7 m***
	<	Time of free fall ***2.1sec***
	<	Maximum speed ***24.9 m/s***
Riddle Me This	<	Radius of ride ***4.2 m***
	<	Maximum angle of tilt ***48 degrees***
Pirate's Flight	<	Radius of rotation ***10.4 m***
	<	Length of chains suspending the gondola *6.2 m*
High Seas	<	Length of boat ***14.5 m***
	<	Distance from pivot to center of boat ***12.2 m***
	<	Maximum angle ***75 degrees***
Carousel	<	Radius of inner circle of horses ***4.4 m***
	<	Radius of outer circle of horses ***7.2 m***
Flying Carousel	<	Radius for inner chairs at maximum angular velocity ***7.3 m***
	<	Radius for outer chairs at maximum angular velocity ***8.2 m***

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.

Sample Calculations/Answer Key

Coyote Creek

1. RENEGADE RAPIDS

A. 1. Each boat is surrounded by an inner tube.

2. The boat speeds up when the current is more rapid and slows down in quieter water and when the boat hits the sides or obstacles.

3. The water has a rapid current because it is flowing down a significant hill. (A pump returns the water from the bottom of the hill to the top through hidden pipes.)

3. THE MIND ERASER

A. 1. No, the first hill is the highest.

2. The first hill contains a moving chain used to pull the cars up to the top.

3. The riders have their feet higher than their heads 5 different times.

Gotham City

4. RIDDLE ME THIS

A. 1. The rider feels pushed against the outer wall (pushed back).

2. The rider should still feel pushed against the outer wall, but the push feels less when the rider is at the top and greater when the rider is at the bottom.

3. The speed of rotation stays the same.

4. The sensation is that the rider feels pushed against the outer wall of the ride with a force that is greatest at the bottom and least at the top. The rider will feel lighter at the top and heavier at the bottom.

5. The ride turns clockwise as seen from above.

5. SUPERMAN – RIDE OF STEEL

1.
2.
3.
4.

6.BATWING

1. Subjective. There are many answers.
2. No. It is a flying coaster, a flying Dutchman specifically.

7. JOKER'S JINX

1. LIM'S or Electricity or Electrical Fields

a. Kinetic energy has been stored as potential energy
b. Yes, but only at the end of the ride.

Looney Tunes Movie Town

9. LOONEY TUNES PROP WAREHOUSE

A. Observational

1. There are five different colors.
2. The colors are: red, orange, yellow, green, and blue.
3. The rainbow color that is missing is violet.

10. ELMER'S AROUND THE WORLD IN 80 SECONDS

A. Observational

1. The choices that should be checked are: "in a circle", "move up", "move down", and "swing out".
2. As the ride speeds up the rider feels pulled outward away from the center. The balloons swing outward farther as the ride speeds up.

B. Determining the Change in Period

1. When the balloons lean outward the most, the time for a rider to complete one trip around is 7-8 seconds.
2. When the seats point straight down, the ride is moving slower.
3. The sentence should read: "When the seats of this ride lean out the most, the ride was moving <u>faster</u> and the time it took the person to go around once was <u>shorter</u>."

11. FOGHORN LEGHORN'S TINSEL TOWN TRAIN

A. Estimating Length

1. The length of the train is about 9 meters. Students should be able to estimate this within two meters on either side of the correct value.

B. Estimating Speed

1. It takes the entire train 7-7.5 seconds to go past an observer.
2. Except when starting or stopping, the train has a fairly constant speed. If the train did speed up, it would take less time to go past the observer.

C. Mathematical

1. The total number of seats on the train is 8.
   The number of people that can ride the train is about two times the number of seats since each seat holds 1-3 people, so 14-18 people can ride.

12. TAZ'S FILM WORKS

A. Observational

1. The riders closest to the observer move from right to left (the ride turns clockwise as seen from above).

2. a. When the ride is not moving, the swings hang straight down.
   b. When the ride is turning, the swings hang outward.
   c. Objects which are moving along a circular path feel as though they are being pulled outward. This feeling occurs because the object is actually trying to go in a straight line at all times but is being deflected from a straight path into the curved path by some force pulling it inward. The identity of this force depends on the particular object and situation. In this ride the inward pulling force is created by the cables holding the swing seats.

B. Using Your Stopwatch

1. The time is 6-7 seconds.

2. The speed is the same all the time except during the startup and stop.

C. Mathematical Activity

1. The answer here should be an estimate. The actual number of seats is 20.

2. The approximate time is 2-1/2 to 3 minutes. The variation is small because there is an automatic timer for the ride. Differences occur because the ride coasts to a stop

13. PEPE LE PEW'S TEA PARTY

A. 1. The three motions are:
   the entire ride moves riders around a large circle,
   riders also spin in a smaller circle, and
   riders move up and down

14. YOSEMITE SAM'S HOLLYWOOD FLIGHT SCHOOL

A. 1.
   2.

B. Estimating Time

1. When guessing, a wide variety of answers can be expected. The closest answer among those listed is 10 seconds.

2. Students can estimate counting seconds by saying either of these two expressions:
   "thousand and one, thousand and two, thousand and three, etc" or
   "one Mississippi, two Mississippi, three Mississippi, etc"
   Their answers should be around 10 seconds.

3. Stopwatch values should be 9-10 seconds.

4. Compare the answers obtained by the three methods above.

5. The stopwatch should produce the most consistent results.

Nantucket

15. SHIPWRECK FALLS

A. Observational

1. The splash follows a path similar to path (c) which is a parabola shape.
2. This path is approximately the path followed by any object which is thrown, kicked, or in some other way projected into flight. Kicked or thrown footballs follow this path. A baseball follows this path when it is thrown or hit.
3. The splash does not hit the same spot each time it occurs. It is most likely affected by the number of people in the boat and where they are sitting. It might also be affected by any wind which is blowing.

B. Mathematical

1. The ride lasts for about 100 seconds.
2. The time delay between rides is not always the same, but it typically is about 60 seconds.
3. The boat can hold about 15 riders.
4. To calculate the number of people who can ride in 1 hour, first figure out how many times the ride can run in 1 hour. There are 3,600 seconds in an hour. Add together the time for one ride and one delay between rides. Divide this time into 3,600 seconds, but remember that the hour does not have to end with a delay, so the fractional part of the answer when you divide may mean there is time for one more ride. After you find out how many times the ride can run, multiply that number by the number of people the boat can hold to get the total number of riders. The actual calculations look like this:

   100 s + 60 s = 160 s

   3,600 s / 160 s = 22.5 (that's 22 rides with 80 seconds left over)

   Since 80 seconds is not time enough for another ride, the total is 22 rides.

   22 rides x 15 riders per ride = 330 riders in 1 hour

16. CYCLONE

A. Observational

1. a. Motion in a large circle (the entire ride)
   b. Motion in a small circle (the cluster of 4 seats)
2. The time is about 5 seconds.
3. The big circle motion is clockwise; the small circle motion is counterclockwise.
4. The rider feels pulled in different directions at different times. These include forward, backward, to the left, and to the right.
5. Because of the sequence of the forces described above, the body moves in a somewhat rectangular pattern with respect to the sea

Olde Boston

17. CAROUSEL

A. Observational

1. There are 9 different kinds of animals on the Carousel. They are elephant, giraffe, tiger, male lion, female lion, ostrich, camel, rhinoceros, and black panther.
2. The mirrors cause the animals to appear to be galloping. The mirrors are not ordinary mirrors because they have curved surfaces. Curved mirrors may be seen at such places as fun houses, and simpler curved mirrors are the passenger side rear view mirror on a car and the security mirrors seen in some stores.

B. Determining the speed of your favorite animal

1. The time it takes an animal to go all the way around once is 22 seconds.
2. The number of steps needed to walk around the edge of the ride once is about 50-60 steps, so the total distance around the ride is 25-30 m.
3. The average speed of the animal is thus about 25 m / 22 s = 1.1 m/s.
4. The speed of the animal is slower than 4 m/s.

C. 1. There are 2 elephants out of a total of 14 animals in the outer row. The percent of elephants is (2/14)x100% = 14%.

18. TEA CUPS

A. Observational

1. The three circular motions which occur on this ride are:
   a. the entire ride spins in a large circle
   b. each cluster of three teacups spins in a circle
   c. each individual teacup spins if the occupants make it do so
2. a. The largest circle motion is always clockwise.
   b. The cluster of three cups motion is always counter-clockwise.
   c. The individual teacups can have either direction for their motion because they are controlled by the occupants.

B. Mathematical

1. a. The period for the largest circle is 8 s.
   b. The period for the teacup depends on what the occupants are doing.
2. Answer a. should be the same as before. Answer b. will vary.
3. As described above, answer b. is the one that should differ the most. The other answer should be the same for all the teacups. There may be some difference in the other answer because of variations in the use of the stopwatch.

19. FLYING CAROUSEL

A. Observational

1. When the ride is operating, it appears that all of the seats fly out the same amount, whether occupied by large people or small people.
2. The empty seats fly out the same amount as the occupied seats.
3. Both the inner seats and the outer seats fly out the same amount. You can tell this because they seem to be the same distance apart when the ride is running as they are when the ride is stopped.
4. Students might say that the colors remind them of the colors in a rainbow. Other answers are obviously possible.
5. The list should be the following or the reverse of the following:
   red, orange, yellow, green, blue, violet, red
6. Again, students might say this reminds them of the colors in a rainbow or maybe they saw them in a different ride at the park.
7. The middle section of this ride and the ceiling each move in a circular motion. The two rotate in opposite directions.

Skull Island

20. PIRATE'S FLIGHT

A. 1. The seat hangs straight down when the ride is at rest, but hangs outward (farther from the center of the ride) when the ride is moving. The faster the ride is moving, the farther outward the seats swing.

2. By observing people on this ride you can see that most people have their head tilting inward (toward the center of the ride). Riders feel as though they are being pulled outward, away from the center.

3. As the ride touches the ground, riders feel pulled forward. This is because they have a tendency to keep moving forward when the ride is being stopped by friction with the ground. The feeling is the same one you feel when you are riding in a car and the driver applies the brakes.

21. HIGH SEAS

A. Observational

1. Make sure that students are timing a complete swing (from one endpoint over to the other endpoint and back). The period is approximately 6-8 seconds.

2. Some variation in the swing time occurs because the "boat" receives a push each time it passes through the low point of its swing. Of course, some variation is due to inconsistencies in the use of the stopwatch and judging the endpoints.

3. A rider should feel the lightest at the two endpoints of the swing and heaviest at the bottom of the swing.

B. Critical Thinking

1. Potential energy is associated with height, so the potential energy is greatest at the two endpoints of the swing because those points represent the highest points in

the ride.

2. Kinetic energy is associated with speed, so the kinetic energy is greatest at the bottom of the swing because that is the point where the ride is moving the fastest.

22. ROAR (ROLLER COASTER)

A. 1.

2. Riders might feel lifted off their seats as they go over the top of a hill.

3. a. Climbing a hill, the rider's weight should feel close to normal until approaching the top, when weight would begin to feel less.
   b. At the top, the rider's weight would feel much less (possibly zero).
   c. Going down a hill, the rider's weight should feel close to normal until near the bottom, when weight would begin to feel greater than normal.

Southwest Territory

23. TOWER OF DOOM

A. 1. Yes, the upward speed is constant except for the start and end points.

2. No, the downward speed increases as you fall.

3. A motor uses electric energy to life the riders.

4. The force of gravity makes the ride move downward.

5. Perhaps an elevator.

6. The free fall ends about ¾ of the way down toward the ground from the top.

7. The greatest speed occurs right at the end of the free fall.

8. The potential energy is greatest at the top of the ride.

9. The kinetic energy is greatest at the point where the free fall ends (about ¾ of the way to the bottom).

24. THE WILD ONE

A. Critical Thinking

1. The train is pulled by the chain from the beginning of the ride up to the top of the first large hill.

2. The train coasts up all the hills except the first one. The train slows down as it is climbing each hill, but gets to the top before it comes to a stop. (In energy terms,

the train gets up each hill by converting kinetic energy into gravitational potential energy.)

3. From the top of the first hill, all the way through the rest of the ride, the train coasts up and down the hills. Friction gradually slows it down, but the friction is small enough that the train can coast the long distance that the track covers.

B. Mathematical

1. The maximum number of riders is approximately 24 people (12 seats x 2 people).

25. FALLING STAR

A. 1. The rider's weight seems greatest near the bottom.

2. The rider's weight seems least near the top.

3. Some of the feelings will be similar to those in an elevator. In addition the rider may feel pulled to one side or the other at times.

4. The feelings are caused by changes in the speed of the rider and changes in the direction the rider is moving. These changes are collectively called "acceleration".

26. SONORA SPEEDWAY (GO KARTS)

A. Observational

1. No, the speed of a car varies and the speeds of different cars are different. In general, cars slow down at the curves and speed up on the straight sections of the track.

B. Mathematical

1. Answers here can vary considerably, depending on what the measured car is doing. Try to time cars that make it all the way around the track without any "mishaps".

Back at School

There is more up and down motion in some of these rides.
Also, the changes in speed and direction are made much more quickly in these rides than in a car.
In some of the rides you are more out in the open than you are in a car.

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
http://www.cnn.com/TRAVEL/DESTINATIONS/9706/roller.coasters/coasters.html

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