NAME________________________________

Nickelodeon Universe Ride Science

ACTIVITY PACKET TABLE OF CONTENTS

NAME_______________________________

Learning Goals and Objectives

This guide book about the rides at Nickelodeon Universe at MOA was written for *upper level elementary, middle school teachers and their students* to encourage them to see, feel and experience the science behind amusement park rides. It's one thing to read science principles, but more meaningful and thrilling to ride the roller coaster and experience the stomach-in-the-throat sensation and learn the science behind the phenomena. We hope these activities and a trip to Nickelodeon Universe at MOA will excite teachers and students about science in the real world.

Cognitive Goals
Students will

- Have an increased understanding of the following physics concepts after completing the activities and experiencing the rides:
    a. friction
    b. speed
    c. circular motion
    d. centripetal force
    e. Newton's laws of motion
    f. Acceleration, positive and negative
    g. Simple machines
- Calculate the average speed of cars on several rides.
- Use Newton's laws to explain their bodies' reaction to the motion on the rides and measure and record these responses.
- Describe feelings of how their body weight changes while on the rides.
- Perform/create experiments through process of inquiry

Attitudinal Goals
Students will

- Develop an awareness of physical science as it applies to motion and personal experiences.
- Be more motivated to study science.
- Gain an appreciation of the design and engineering behind the rides.
- Understand correlations between school work and the world outside the classroom.
- Gain an appreciation of the applications of science principles they can experience on large-scale amusement park rides and in every-day world.
- Use process of Inquiry to develop better understanding of use of Scientific Method
- Use Writing, Inquiry, Reading, and Collaboration, to become better prepared for classroom and Pre AP physics course work.
- Be more prepared for MCAs, Minnesota Comprehensive Assessments, in Science by collaborating in physics labs, reading, using inquiry, and becoming more familiar with writing evaluations with a (*SCR*), *Short Constructive Response*.

NAME______________________________

Guide Book with Ride Science Activities

This guide book contains several classroom lab activities to do before visiting Nickelodeon Universe at the MOA. You will also find student questions and observations to complete at Nickelodeon Universe followed by a Teacher's answer page. Teachers are encouraged to discuss Nickelodeon Universe experiences in class after the trip. Rides discussed in this guide book include:

1. **Avatar Airbender**
2. **Backyardigans' Swing Along**
3. **Brain Surge**
4. **Carousel**
5. **Crazy Cars**
6. **El Circulo del Cielo**
7. **Fairly Odd Coaster**
8. **Log Chute**
9. **Pepsi Orange Streak**
10. **Splat-O-Sphere**
11. **SpongeBob SquarePants Rock Bottom Plunge**
12. **Shell Shock**
13. **Addendum: <u>Triangulation/Altimeter</u> examples in this Activity Packet: (teacher taking altimeter readings to get degrees for various rides was 6'. Therefore on triangulation activities 6' was added to get final height). Answers need to be adjusted when students do own measurement with altimeter and use own height.**

NAME________________________________

Avatar AirBender

The Avatar Air Bender is like a large Skateboard or Snowboard with 12 seats spinning & turning while traveling up and down on a 220' half pipe track.

This ride demonstrates the following science concepts:

- Newton's laws of Motion
- One half Circular motions – in a 220 foot half pipe track.
- Centripetal force – any force that causes an object to move in a circular path, it means center seeking
- Centrifugal force – a kind of fictitious force causes you to feel as though you are thrown to the outside as the ride moves in a circular path.

NAME________________________________

Students Page
At Nickelodeon
Universe

Avatar AirBender

Concentrate on how your body feels as you ride the:
New Avatar Air Bender

Pulse rate	Before Ride	After Ride
	___________	___________

How do you feel? Check if the answer is "yes."

	Before Ride	After Ride
Dry mouth	__________	__________
Trembling	__________	__________
Dizzy	__________	__________
Sweaty palms	__________	__________
Tense muscles	__________	__________
Unable to move	__________	__________
Rapid breathing	__________	__________
Fear	__________	__________
Upset stomach	__________	__________

NAME_______________________________

Students Page At Nickelodeon Universe

<u>Avatar AirBender</u>

1. Why does this ride cause your body to respond the way it does?
   ____
   ____
   ____

2. You will notice each set of 6 seats go into a spinning motion once the Avatar travels up or down the incline on each side. Please observe and evaluate why the set of seats go into a spin once the Avatar Air Bender starts in motion up and down the incline, and put your hypothesis/evaluation below. You may use a diagram if it would be helpful to you.
   ____
   ____
   ____
   ____

3. How many times does the Avatar Air Bender make it all the way to the top of the track? ________ Times.

4. Once the Avatar Air Bender makes it all the way to the top of the arc the first time it continues to reach the top of the arc on each side several more times. Is gravity all that is needed to accomplish this? In a <u>*Short Constructive Response*</u> please explain your answer.
   ____
   ____
   ____

5. Calculate the distance traveled in feet starting after the first time the Avatar has made all the way to the top? ______ Feet.

NAME________________________________

Teacher's Page At Nickelodeon Universe

Avatar AirBender

Like a **Skateboard or Snowboard** on **220' long track half pipe**

Concentrate on how your body feels as you ride the:
New Avatar Air Bender

Pulse rate	**Before Ride**	**After Ride**
	___________	__________

How do you feel? Check if the answer is "yes."

	Before Ride	**After Ride**
Dry mouth	__________	__________
Trembling	__________	__________
Dizzy	__________	__________
Sweaty palms	__________	__________
Tense muscles	__________	__________
Unable to move	__________	__________
Rapid breathing	__________	__________
Fear	__________	__________
Upset stomach	__________	__________

NAME________________________________

Teacher's Page
At Nickelodeon
Universe

Avatar AirBender

1. Why does this ride cause your body to respond the way it does? **Answers vary**

2. You will notice each set of 6 seats go into a spinning motion once the Avatar travels up or down the incline on each side. Please observe and evaluate why the set of seats go into a spin once the Avatar Air Bender starts in motion up and down the incline, and put your hypothesis/evaluation below. You may use a diagram if it would be helpful to you. **The seats go into a spin because the axle is off set. Seat # 1 is closer to the axle while seat # 4 is farthest away from the axle. Also a diagram would demonstrate this well.**

3. How many times does the Avatar Air Bender make it all the way to the top of the track? **7 Times all the way to Top.**

4. Once the Avatar Air Bender makes it all the way to the top of the arc the first time it continues to reach the top of the arc on each side several more times. Is gravity all that is needed to accomplish this? In a *SCR*, please explain your answer. **More than gravity is needed because the ride would never get back to its original height on the track due to friction and gravity pulling & slowing it down. So electromagnetic/electrical device located it along bottom section of ride, help keep it in motion.**

5. Calculate the distance traveled in feet starting after the first time the Avatar has made all the way to the top? **The distance is measured *after* the 1st time the Avatar reaches the top. Therefore so 6 times 220' = 1320 feet.**

NAME________________________________

Backyardigans' Swing Along_

THE Backyardigans'
SPINS, SWINGS,
AND TILTS
STUDENTS
AROUND A TREE
TRUNK

This ride demonstrates the following science concepts:

- Measuring angles using protractor
- Making Hypothesis and Estimating
- Circular motion – motion around a central axis.
- Centripetal force – any force that causes an object to move in a circular path, it means center seeking
- Centrifugal force – a kind of fictitious force causes you to feel as though you are thrown to the outside as the ride moves in a circular path.
- Newton's Laws

NAME________________________________

Teacher's Page
In Classroom

Backyardigans' Swing Along

EXPERIMENT 7: Spin the Bucket Demonstration

QUESTION:
WHAT KEEPS WATER FROM FLYING OUT OF A SPINNING BUCKET?

Materials
- Bucket or pail – 1 gallon or larger
- Water
- 1m (3') rope
- Mop

Directions
1. Attach the rope securely to the bucket handle.
2. Ask Students to fill the bucket one quarter full with water.
3. Have each student hold the bucket by the rope and quickly spin it around, 360 degrees, at the side of the student's body, taking turns so that everyone has a chance to spin the bucket.

Questions to Ask Students
1. How does your arm feel as you spin the bucket?
2. What must you do to keep the bucket from flying off?
3. If you let go of the bucket while spinning, in what direction would the bucket fly? In what direction would the water fly?

Explanation
Your arm must exert an inward pull to keep the bucket from flying off while you're spinning it. This inward pull that keeps a body moving in a circular path is called centripetal force. Circular motion and centripetal motion go together.

NAME________________________________

Teacher's Page
In Classroom

Backyardigans' Swing Along

EXPERIMENT 8: TURNTABLE TRAPEZE DEMONSTRATION

Materials

- 30 cm (12") plastic cardboard tube with a 6.5 cm (2 ½") diameter (approximate) – mail tub or sturdy gift-wrap tube
- Metal pie pan – 22 cm (9") or larger
- Hammer
- Nail with head
- String or colored yarn
- Hot-glue gun
- Old 33 rpm record
- Turntable with multiple speeds (check second-hand stores)
- Large paper clips
- 16 2.5 cm (1") washers

Directions

1. Using a nail and hammer, punch four holes, evenly spaced, near the edge of the pie plate.
2. Use a hot-glue to attach the end of the mail tube to the center of the pie plate.
3. Hot glue the tube to the center of the record. (Modeling clay also can be used to anchor the tube directly to the turntable eliminating the need for the record.)
4. Loop strings through the holes in the pie pan. Tie a loop in each string four inches from the pie plate, keeping string lengths even.
5. Slip a paper clip through each loop and put a washer on the paper clip.
6. Turn on the turntable at a slow speed and observe the "riders" on the flying trapeze. Have students draw the flying trapeze "riders," making note of the angle and speed. Increase the speed and have them draw what they see.
7. Change the number of washers on one or two of the paper clips. Be careful not to overload any one paper clip. Repeat the experiments at different speeds and have students record the changes they observe.

Questions to Ask students

1. What difference does the speed make?
2. What difference does the number of washers make?
3. Compare the swing angle between an empty paper clip and a loaded one.
4. Does the number of washers affect the swing angle? Experiment with this by varying the number of washers on the paper clips.
5. Predict the angel of swing for a large adult and a small child

Explanation

On theBackyardigans' Swing Along, chains hold the seats the same way the string holds the paper clips and washers on the flying trapeze. As the rider spins in a circular path, the seats and chains swing up and out. Centripetal force makes the seats and riders swing up and out. Centripetal force makes the seats and riders swing up and out. Circular motion and centripetal force go together.

NAME________________________________

**Students Page
At Nickelodeon
Universe**

Backyardigan's Swing Along

QUESTIONS

1. **How long did the ride last?**

2. **What does it feel like as circular speed increases?**

3. **Which goes higher, an empty swing or one with a passenger?**

4. **If looking at this ride from above, what direction is it turning?**

5. **Draw a diagram showing the seat at rest and at full speed. Estimate the angle at which the chains swing out when at full speed.**

6. **Describe the centripetal force on this ride pulling you in toward the center and keeping you in a circular path.**

NAME________________________________

Teacher's Page At Nickelodeon Universe

Backyardigan's Swing Along

QUESTIONS:

1. **How long did the ride last?** *90 seconds. (Note: times will vary.)*

2. **What does it feel like as circular speed increases?** *Riders sense they are being thrown out.*

3. **Which goes higher, an empty swing or one with a passenger?** Both swing to the same height.

4. **If looking at this ride from above, what direction is it turning?** *Clockwise.*

5. **Draw a diagram showing the seat at rest and at full speed. Estimate the angle at which the chains swing out when at full speed.** *Riders swing out as in the drawing to the right at approximately 20-30 degrees*

6. **Describe the centripetal force on this ride pulling you in toward the center and keeping you in a circular path.** *The chain and chair are holding you in and keeping you in a circular path*.

.

NAME________________________________

Brain Surge

This interactive, circular ride allows guests to be in control of their own movements. You may spin round and round, upside down or backwards, however you choose, each time you ride is different! Feel the Surge as this 16 person ride moves you in every direction.

This ride demonstrates the following science concepts:

- Circular motion – motion can be in a straight line, angular, or circular.
- Centripetal Force
- Newton's Laws
- Distances and speeds in circular motion
- Vertical climbs and descents while spinning and rotating

NAME________________________________

Teacher's Page
In Classroom

Brain Surge

EXPERIMENT 5: HOW FAST ROUND AND ROUND AND UP AND DOWN?

QUESTION: ON AN OUTSIDE SEAT, ARE YOU TRAVELING FASTER, SLOWER, OR AT THE SAME SPEED AS AN INSIDE SEAT?

Materials

- Old record player
- 2 -3 pennies
- Meter ruler

Directions

1. Have students tape a penny near the edge of the turntable and a second penny near the spindle.
2. Tell the students to measure the distance from spindle to the center of each penny. Have them make a drawing of the turntable and pennies and record the measurements.
3. Turn on the turntable and have them observe the revolving pennies. Ask them if one appears to be going faster than the other.
4. Ask students to mark a start-stop spot on the base of the turntable so they can note each revolution. Using a stopwatch, tell them to time 10 revolutions of the penny. To calculate the time it takes to complete one revolution, ask students to record the time and divide by 10. Tell them to repeat this a second time. If their second answer is inconsistent with their first, tell them to repeat the experiment until their answers are consistent.
5. Have students calculate the average speed of one revolution using the following formula:

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

Calculating Circular Distance

To calculate the distance around a circular object, the circumference, the formula is $2\pi r$, $\pi = 3.14$ and r=radius (the distance from the spindle to the penny).

Questions to Ask Students

1. Which penny appears to be going faster?
2. After completing the math, which penny actually travels faster?
3. What other examples can you think of in which two or more things revolve simultaneously around an axis?

NAME________________________________

Teacher's Page
In Classroom

Brain Surge

Explanation
The penny on the outer ring is traveling a greater distance in the same period of time than the inside penny. To answer the speed question, the penny on the outside is also traveling faster. The difference is small when comparing the average speeds of the pennies, but on the carousel the difference is greater.

Taking it Further

1. Ask students about playing crack the whip. People at the end of the line travel faster and farther than those closer to the middle. This is why crack the whip can be dangerous.

2. To further develop the concept of circumference, wrap string or yarn once around both large and small balls. Mark the distance around and compare the lengths. Which distance or length would take longer to travel?

NAME________________________________

Students Page
At Nickelodeon
Universe

Brain Surge

QUESTIONS:

1. **How long does the ride last** (measure time while waiting in line)? _______________

2. **How many revolutions per minute (rpm) does the passenger) travel? _______**rpm

3. **Determine the distance traveled in one revolution by the outside passenger. Repeat for inside passenger of the ride. Because it's impractical to take a tape measure to measure the circumference of this ride, use the following equations: (we have measured radius for you.)**

   Circumference = $2\pi r$, $\pi = 3.14$ and r = the radius

   Radius for inside passenger: 22 feet
   Radius for outside passenger: 24 feet

   3a. Distance traveled by inside passenger = ______

   3b. Distance traveled by outside passenger = _____

4. **Do you think you could travel one complete revolution around the Brain Surge traveling upside down? If so what was this experience like for you?**

5. **Do you think if you were traveling upside down for one revolution without a shoulder restraint harness that you could do this without falling out on your head? If you were not harnessed what could help you remain in the seat upside down without falling out beside the safety harness? Write your hypothesis here:**

NAME_______________________________

Teacher's Page At Nickelodeon Universe

Brain Surge

QUESTIONS:

1. **How long does the ride last** (measure time while waiting in line)? *Answer: = about 2 minutes*

2. **How many revolutions per minute (rpm) does the passenger) travel?** 1 rpm 6.57 sec. estimate: 6 to 7 seconds ***Answer = 8.5 to 10 Revolutions per minute***

3. **Determine the distance traveled in one revolution by the outside passenger. Repeat for the inside passenger of the ride. Because it's impractical to take a tape measure to measure the circumference of this ride, use the following equations:**

   Circumference = $2\pi r$, $\pi = 3.14$ and r = the radius

   Radius for inside passenger: 22 feet
   Radius for outside passenger: 24 feet

   3a. **Distance traveled by inside passenger = *138.16'***

   3b. **Distance traveled by outside passenger = *150.72'***

4. **Do you think you could travel one complete revolution around the Brain Surge traveling upside down?**
   Answer: = *Yes this can be done☺*
   If so what was this experience like for you? *Varies?*

5. **Do you think if you were traveling upside down for one revolution without a shoulder restraint harness that you could do this without falling out on your head? If you were not harnessed what could help you remain in the seat upside down without falling out beside the safety harness? Write your hypothesis here:**
   More speed would mean more centripetal force which would mean more friction to hold you up against the outside edge of seat.

NAME________________________________

Carousel

TAKE A GENTLE JOURNEY AROUND AND AROUND ON TIGERS, HORSES, AND CATS.

This ride demonstrates the following science concept:

- Circular motion – motion can be in a straight line, angular, or circular.
- Centripetal Force
- Distances and speeds in circular motion

NAME________________________________

Teacher's Page
In Classroom

Carousel

EXPERIMENT 5: HOW FAST ROUND AND ROUND AND UP AND DOWN?

QUESTION: ON AN OUTSIDE HORSE, ARE YOU TRAVELING FASTER, SLOWER, OR AT THE SAME SPEED AS AN INSIDE HORSE?

Materials

- Old record player
- 2 -3 pennies
- Meter ruler

Directions

1. Have students tape a penny near the edge of the turntable and a second penny near the spindle.
2. Tell the students to measure the distance from spindle to the center of each penny. Have them make a drawing of the turntable and pennies and record the measurements.
3. Turn on the turntable and have them observe the revolving pennies. Ask them if one appears to be going faster than the other.
4. Ask students to mark a start-stop spot on the base of the turntable so they can note each revolution. Using a stopwatch, tell them to time 10 revolutions of the penny. To calculate the time it takes to complete one revolution, ask students to record the time and divide by 10. Tell them to repeat this a second time. If their second answer is inconsistent with their first, tell them to repeat the experiment until their answers are consistent.
5. Have students calculate the average speed of one revolution using the following formula:

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

Calculating Circular Distance

To calculate the distance around a circular object, the circumference, the formula is $2\pi r$, $\pi = 3.14$ and r=radius (the distance from the spindle to the penny).

Questions to Ask Students

4. Which penny appears to be going faster?
5. After completing the math, which penny actually travels faster?
6. What other examples can you think of in which two or more things revolve simultaneously around an axis?

NAME________________________________

Teacher's Page
In Classroom

Carousel

Explanation
The penny on the outer ring is traveling a greater distance in the same period of time than the inside penny. To answer the speed question, the penny on the outside is also traveling faster. The difference is small when comparing the average speeds of the pennies, but on the carousel the difference is greater.

Taking it Further

3. Ask students about playing crack the whip. People at the end of the line travel faster and farther than those closer to the middle. This is why crack the whip can be dangerous.

4. To further develop the concept of circumference, wrap string or yarn once around both large and small balls. Mark the distance around and compare the lengths. Which distance or length would take longer to travel?

NAME________________________________

Students Page At Nickelodeon Universe

Carousel

QUESTIONS

1. **How long does the ride last** (measure time while waiting in line)? _______________seconds

2. **How many revolutions per minute (rpm) does the pig (or any other animal) travel? _______**rpm

3. **Determine the distance traveled in one revolution by the outside animals. Repeat for the inside circle of the animals. Because it's impractical to take a ball of string to measure the circumference, use the following equations:**

Circumference = $2\pi r$, $\pi = 3.14$ and r = the radius

Radius of inside horse: 2.87m
Radius of outside horse: 4.47m

Distance traveled by inside horse = ______

Distance traveled by outside horse = ______

Which ring of animals travels a greater distance, the inner ring or the outer ring?

____

Just for FUN while you wait.

4. **If you were an Ornithologist how many feathered friends will you see as the Carousel spins? (Even though the dragon has wings it does not count) ____**

5. **There are two feline carousel animals with something in their mouths. If they were to bring these gilled creatures to a place east of the Nickelodeon Universe but still in the MOA where do you suppose they would be going? _______________**

6. **If you were asked to count Hare on this Carousel how many would there be?_______**

7. **Estimate the total number of light bulbs on this ride. ______**

NAME______________________________

Teacher's Page At Nickelodeon Universe

Carousel

QUESTIONS

1. **How long does the ride last?** 120 seconds. (Note: Answer will vary.)

2. **How many revolutions per minute (rpm) does the pig (or any other animal) travel?** *= 4 rpm*

3. **Determine the distance traveled in one revolution by the outside animals. Repeat for the inside circle of the animals. Because it's impractical to take a ball of string to measure the circumference, use the following equations:**

Circumference = $2\pi r$, $\pi = 3.14$ and r = the radius

Radius of inside horse: 2.87m
Radius of outside horse: 4.47m

Distance traveled by inside horse = *18.0m*

Distance traveled by outside horse = *28.0m*

Which ring of animals travels a greater distance, the inner ring or the outer ring? *The outer ring*

Just for FUN while you wait.

4. **If you were an Ornithologist how many feathered friends will you see as the Carousel spins? (Even though the dragon has wings it does not count)** *there are 3 (Chicken, Ostrich and eagle on the back of lion)*

5. **There are two feline carousel animals with something in their mouths. If they were to bring these gilled creatures to a place east of the Nickelodeon Universe but still in the MOA where do you suppose they would be going?** *You would be going to The Underwater Adventures Aquarium east of the park.*

6. **If you were asked to count Hare on this Carousel how many would there be?** *2 rabbits a brown one and a white one*

7. **Estimate the total number of light bulbs on this ride.** *1730*

NAME________________________________

Crazy Cars

This ride demonstrates the following science concepts:

- The human body's response to momentum/bashing power and how it relates to mass and acceleration. Students focus on how this ride makes them feel and how their body responds to unnatural bumping motions.
- Law of Conservation of Momentum
- Newton's 2^{nd} & 3^{rd} Law is apparent

PASSENGERS ON THE Naked Brothers Crazy Cars will experience sudden stops, accelerations and other movements due to collisions from many different directions.

NAME_______________________________

Student's Page
At Nickelodeon
Universe

Crazy Cars

1. **When you are moving forward, which kind of hit will increase your momentum the most: head on, rear end, from the side**
Please explain your answer using the *Law of Conservation of Momentum*.

2. **Record what happens in a collision when watching bumper cars collide in a head on collision. In a *short constructive response* please write your answers below explaining why the cars moved as they did.**

3. **Why do the bumper cars have rubber bumpers?**

4. **Why wouldn't you design a bumper car with very soft bumpers?**

5. **Please explain how Newton's 2nd Law on acceleration of an object relates to how these crazy bumper cars accelerate both positively and negatively.**

6. **Hypothesize why a more massive adult in the crazy bumper car would have more bashing power than a smaller elementary/middle school student in another crazy bumper car?**

7. **Newton's 3rd Law states that whenever an object exerts a force on a second object, the second object exerts an equal and opposite force on the ___________________________.**

NAME______________________________

Teacher's Page
At Nickelodeon
Universe

Crazy Cars

1. **When you are moving forward, which kind of hit will increase your momentum the most: head on,** *rear end*, **from the side**
(Momentum may be transferred from one car to another with no loss. This is called the law of conservation of momentum. Momentum is conserved, the momentum of one car decreases while the momentum of the other increases.)

2. **Record what happens in a collision when watching bumper cars collide in a head on collision Please write your answers here and explain why the cars moved as they did.** *Depending on the mass of the riders answers will vary. If equal in mass and speed they should bounce/react equally, if one has more mass it would have more momentum. Momentum/Bashing Power = Mass x Velocity*

3. **Why do the bumper cars have rubber bumpers?** *To absorb some of the shock/impact*

4. **Why wouldn't you design a bumper car with very soft bumpers?**
The bumper would not absorb the enough of impact/answers vary

5. **Please explain how Newton's 2nd Law on acceleration of an object relates to how these crazy bumper cars accelerate both positively and negatively.** *Acceleration depends on both Mass and Net force, so more mass would need more net force to both accelerate and slow down. More mass more bashing power.*

6. **Hypothesize why a more massive adult in the crazy bumper car would have more bashing power than a smaller elementary/middle school student in another crazy bumper car?**
Again if equal in acceleration more mass = more bashing power/momentum

7. **Newton's 3rd Law states that whenever an object exerts a force on a second object, the second object exerts an equal and opposite force on the** *first object*.
Heaviest when hit bottom and start going up, lightest @ top when starting down.

NAME________________________________

> **Notes to help students compare and contrast similarities and differences b/w simple machines & rides.**

Nickelodeon Universe & Ride Physics Notes

Here are a few notes that may help you understand Simple Machines and Nickelodeon Universe rides may have more in common than you realize.

Six Simple Machines are:

pulley, screw, wheel & axle, ramp or inclined plane, wedge, and lever.

Some examples:
Gears are **wheels with teeth**.

A **screw** is like a **ramp wrapped around a pole or stick.**

A **Spiral Staircase** is like a screw. The **stairs wrap around a pole**.

A **wheel** is **several levers around a fulcrum or axle**.

A **Complex Machine** is a combination of **Simple Machines**.

NAME________________________________

El Circulo Del Cielo

This ride demonstrates the following science concept:

- Circular motion – motion can be in a straight line, angular, or circular.
- Centripetal Force
- Distances and speeds in circular motion
- Mathematics concepts
- Simple Machines
- Sight Seeing☺

TAKE THIS SERENE, VERTICLE JOURNEY AROUND AND AROUND UP AND DOWN AND SEE WHAT THE REST OF NICKELODEON UNIVERSE IS UP TO.

NAME________________________________

Students Page At Nickelodeon Universe

El Circulo Del Cielo

Rises up to a diameter of 63 feet
15 Gondolas
Can seat 6 children or 4 adults each gondola
Maximum weight of 680 lbs each gondola

This ride is good if you like to go around and sight see☺
(For you Mathematicians: Calculator might be helpful but not necessary)

1. The El Circulo Del Cielo would be the best example of which of the 6 simple machines? _____________________________

2. A wheel such as this is many ________________ pivoting on a fulcrum?

3. Compare and contrast the El Circulo Del Cielo to the Carousel.
____
____
____

4. Please compare or make analogies about the El Circulo Del Cielo to as many spinning things as you can.
____
____
____
____

5. To the nearest revolution how many revolutions per minute does the El Circulo Del Cielo go? _________________

NAME________________________________

Students Page At Nickelodeon Universe

El Circulo Del Cielo

(Continued)

6. When looking at the El Circulo Del Cielo from the side that you enter there are 60 lights on each spoke or lever, and 30 at the base of each triangle. If you were in charge of maintenance and needed to order all new lights for this ride how many would you order? __________

7. Your math teacher has asked you to bring back the circumference of the El Circulo Del Cielo to the nearest foot. You tell her you do not have a tape measure that long and besides it could be dangerous. She tells you she is sorry but can you find a safe way to find out because it is still due. (She is a good teacher)

   What is the formula for finding circumference and what is the circumference of the El Circulo Del Cielo?

   ____

8. At full weight capacity what would the maximum amount of weight be if every Gondola was full to capacity? ___________lbs.

9. What is the maximum number of people allowed on the El Circulo Del Cielo? _____________

NAME________________________________

Teacher's Page At Nickelodeon Universe

El Circulo Del Cielo

Rises up to a diameter of 63 feet
15 Gondolas
Can seat 6 children or 4 adults each gondola
Maximum weight of 680 lbs each gondola

This ride is good if you like to go around and sight see☺
(For you Mathematicians: Calculator might be helpful but not necessary)

1. The El Circulo Del Cielo would be the best example of which of the 6 simple machines? **Wheel & Axle**

2. A wheel such as this is many **levers** pivoting on a fulcrum?

3. Compare and contrast the El Circulo Del Cielo to the Carousel**: Students list similarites and differences: venn diagram etc. answers vary**

4. Please compare or make analogies about the El Circulo Del Cielo to as many spinning things as you can. **Helicopter rotors, bowling balls, earth, tornados spin in circle etc.**

5. To the nearest revolution how many revolutions per minute does the El Circulo Del Cielo go**? It spins 2 times in 58 seconds: rounded = 2**

NAME________________________________

Teacher's Page At Nickelodeon Universe

El Circulo Del Cielo

(Continued)

6. When looking at the El Circulo Del Cielo from the side that you enter there are 60 lights on each spoke or lever, and 30 at the base of each triangle. If you were in charge of maintenance and needed to order all new lights for this ride how many would you order? *There are 60 lights on each spokes or levers x 15 = 900. Plus 30 lights on bottom of each triangle made by spokes in wheel and 15 bottoms = 30 x 15 = 450 + 900 = 1350 . Times 2 sides* = **total of 2700 lights in all**

7. Your math teacher has asked you to bring back the circumference of the El Circulo Del Cielo to the nearest foot. You tell her you do not have a tape measure that long and besides it could be dangerous. She tells you she is sorry but can you find a safe way to find out because it is still due. (She is a good teacher)

   What is the formula for finding circumference and what is the circumference of the El Circulo Del Cielo?

   Circumference = pi x diameter or 2 x pi x radius. Diameter of El Circulo Del Cielo = (63) 63 x 3.14 = 197. 82' rounded off = 198'

8. At full weight capacity what would the maximum amount of weight be if every Gondola was full to capacity? **680 lbs. x 15 = 10,200 lbs**.

9. What is the maximum number of people allowed on the El Circulo Del Cielo? **6 children x 15 = 90 maximum # people**

NAME________________________________

Fairly Odd Coaster

This ride demonstrates the following science concepts:

- Gravity – This is the force that pulls objects toward the earth.
- Newton's Laws
- Positive & Negative Acceleration

Climb aboard this fairly odd coaster for an aggressive ride with hairpin turns, whirling and a gravity defying thrills.

Distance: = 1345 feet / hairpin turns: whirling, with quick spinning, downward movements from steep hills.

The Fairly Odd Coaster has one lift section that is powered by an electric motor. This is an aggressive ride with many sharp turns.

NAME________________________________

Students Page At Nickelodeon Universe

<u>Fairly Odd Coaster</u>

<u>Distance: = 1345 feet / hairpin turns: spinning:</u>

<u>The Fairly Odd Coaster has one lift section that is powered by an electric motor. This is an aggressive ride with hairpin turns</u>.

1. A force is a push or a pull. Forces may cause objects to move, change direction or speed. Can you describe 1 or 2 places where you felt the most force on this ride and explain why?
   ____
   ____
   ____

2. Forces that cancel each other out are called balanced forces. Their net result or force is zero (so no movement occurs) as when you are waiting to take off and start the ride. At times the forces acting on you do not cancel each other out as in this Fairly Odd Coaster. These forces are called unbalanced forces. A _____________force is when there is movement and change in direction, (on this ride a lot of change in direction).

3. What is the force acting on you pulling you down?
   ____

4. On the space below can you apply Newton's First Law to evaluate why you feel like you are being thrown out of your seat while the coaster car is racing down to the end of this ride? Please write your answer in a *short constructive response.*
   ____
   ____
   ____

5. Please evaluate why it is important to be harnessed and strapped in while on this ride?
   ____
   ____
   ____

6. If the distance for this Fairly Odd Coater is 1345 feet and it takes you 1 minute and 25 seconds (*<u>or time it yourself</u>*) to complete the course what is your average speed to the nearest feet per second.________ feet per second.

NAME_______________________________

Teacher's Page
At Nickelodeon
Universe

Fairly Odd Coaster

Distance: = 1345 feet / hairpin turns: whirling:

The Fairly Odd Coaster has one lift section that is powered by an electric motor. This is an aggressive ride with hairpin turns.

1. A force is a push or a pull. Forces may cause objects to move, change direction or speed. Can you describe 1 or 2 places where you felt the most force on this ride and explain why? **Going around sharp curves or drops, because Newton's 1st law states an object in motion will stay in motion in a straight line unless acted upon by outside for. So turns cause outside of car to use centripetal force to hold you in curved path instead of a straight line like your body wants to go.**

2. Forces that cancel each other out are called balanced forces. Their net result or force is zero (so no movement occurs) as when you are waiting to take off and start the ride. At times the forces acting on you do not cancel each other out as in this Fairly Odd Coaster. These forces are called unbalanced forces. A **Net or Unbalanced** force is when there is movement and change in direction, (on this ride a lot of change in direction).

3. What is the force acting on you pulling you down? **Gravity**

4. On the space below can you apply Newton's First Law to evaluate why you feel like you are being thrown out of your seat while the coaster car is racing down to the end of this ride? Similar to # 1, **Going around sharp curves or drops, because Newton's 1st law states an object in motion will stay in motion in a straight line unless acted upon by outside force. So turns cause outside of car to use centripetal force to hold you in curved path instead of a straight line like your body wants to go.**

5. Please evaluate why it is important to be harnessed and strapped in while on this ride? **Safety reasons, Newton's laws, etc. answers vary**

6. If the distance for this Fairly Odd Coater is 1345 feet and it takes you 1 minute and 25 seconds to complete the course what is your average speed to the nearest feet per second. **15. 8 feet per second rounded off = 16 fps**.

NAME________________________________

Teacher's Page in classroom & at Nickelodeon Universe

Ride Height Measurement by using Triangulation & Altimeter

The following 2 pages on Triangulation may be used on the rides:

- **Log Chute**
- **Pepsi Orange Streak**
- **SpongeBob SquarePants Rock Bottom Plunge**

Materials needed to Make Altimeter:

- Degrees from protractor 0 degrees to 90 (a large cut out pattern of protractor to glue on to piece of cardboard would work well).
- string 8 to 10 inches
- washer to tie on end of string
- regular straw to sight through on altimeter

Remember when measuring the height of the hill on the ride we are going to attempt to get an altitude by using your home made Altimeter.

Height = Base * (Y/X)

Height = height of the object
Base = horizontal distance from the object
Y = measured from the altimeter (horizontally
X = measured from the altimeter (vertically)
(Don't forget to add your own height to the calculated height!)

Steps for figuring height of Amusement Rides:

- Measure distance from Coaster/Ride sight to where you stand with altimeter
- Stand at your measured distance away from Coaster or Ride spot
- Look through straw of altimeter
- Have partner read the degrees number on altimeter
- Use trig calculator (calculator that has a Tan function)
- Press Tan button,
- Then put the number in from the degrees on altimeter
- Then press = or enter button
- Then press multiplication function button
- Then put distance of how far base is, example: Distance from Ride site to where you stand looking through straw of altimeter)
- Then press = or enter button, this will tell you height from your eye level to height of Coaster/Ride
- Now take that number and add your height (from your eye level to ground, so if you are 5'4'' you might add 5 feet or so to the total)

NAME________________________________

- If a Trig Calculator is not available please use the Tangent Table below along with a regular calculator.

Tangent Table

Degree	Tan	Degree	Tan	Degree	Tan
0	0.0000				
1	0.0174	31	0.6008	61	1.8040
2	0.0349	32	0.6248	62	1.8807
3	0.0524	33	0.6494	63	1.9626
4	0.0699	34	0.6745	64	2.0603
5	0.0874	35	0.7002	65	2.1445
6	0.1051	36	0.7265	66	2.2460
7	0.1227	37	0.7535	67	2.3558
8	0.1405	38	0.7812	68	2.4750
9	0.1583	39	0.8097	69	2.6050
10	0.1763	40	0.8390	70	2.7474
11	0.1943	41	0.8692	71	2.9042
12	0.2125	42	0.9004	72	3.0776
13	0.2308	43	0.9325	73	3.2708
14	0.2493	44	0.9656	74	3.4874
15	0.2679	45	1.0000	75	3.7320
16	0.2867	46	1.0355	76	4.0107
17	0.3057	47	1.0723	77	4.3314
18	0.3249	48	1.1106	78	4.7046
19	0.3443	49	1.1503	79	5.1445
20	0.3639	50	1.1917	80	5.6712
21	0.3838	51	1.2348	81	6.3137
22	0.4040	52	1.2799	82	7.1153
23	0.4244	53	1.3270	83	8.1443
24	0.4452	54	1.3763	84	9.5143
25	0.4663	55	1.4281	85	11.4300
26	0.4877	56	1.4825	86	14.3006
27	0.5095	57	1.5398	87	19.0811
28	0.5317	58	1.6003	88	28.6362
29	0.5543	59	1.6642	89	57.2899
30	0.5773	60	1.7320	90	-------------

NAME________________________________

LOG CHUTE

RIDERS ON the LOG CHUTE TRAVEL A WATER-FILLED STEAM IN LOG-SHAPED CARS AND PLUNGE OVER A 11.43-METER (37.5 FOOT) WATERFALL FOR A WET AND WILD HEART-POUNDING EXPERIENCE

This ride demonstrates the following science concepts:

- The role of water moving loads that float – friction in water versus on land.
- The mass and force relationship (how big a splash).
- Using triangulation to calculate log chute hill height

NAME________________________________

Teacher's Page
In Classroom

LOG CHUTE

EXPERIMENT 1: ALUMINUM BOATS

QUESTION:
WHAT ROLE DOES WATER PLAY IN THIS RIDE?

Materials

- 30 cm X 30 cm (12" X 12") piece of aluminum foil (approximate) – 1 per student
- Masking Tape
- Tubs with water or the sink – 1 for every 2 groups
- Pennies – approximately 20 per student
- String – 30 cm (12") per student

Directions

1) Hand out a sheet of aluminum foil to each student. Have them make an aluminum foil boat. Tell them to design the bow (front end) so they can attach a string to pull it through the water. (The bow may need to be reinforced with tape).
2) Have students float the boat in a tub of water and add pennies, one at a time. The pennies represent a load the boat might carry. Tell them to pull the boat through the water, have them take it out of the water and try pulling it on a flat surface.

Questions to Ask Students

1) Which is easier: pulling the boat through the water or pulling it across the rough surface? Why?
2) What role does water play in floating boats?

Explanation

The boat moves more freely through water because there is low friction between the boat and the water. In this experiment and on the Log Chute, water reduces friction. Friction is a force that resists motion along a surface. Friction can be either high or low depending on the materials moving over or by one another.

Taking it Further

Using approximately a 30-by-30-centimeter (12-by-12-inch) piece of aluminum foil, challenge students to design and build an aluminum foil boat that will hold the greatest number of pennies.

NAME________________________________

Student's Page
In Classroom

LOG CHUTE

QUESTION:
WHAT ROLE DOES WATER PLAY IN FRICTION?

EXPERIMENT 1: ALUMINUM BOATS

1. Take the approximate 12" x 12" aluminum foil sheet and make a boat that will float.
2. Fill plastic tub about 1/2 full with water.
3. Design the bow (front) so you can attach a string to pull it through the water. The bow may need to be reinforced with tape. If so ask Mr. P. for a piece of tape.
4. One student at a time float your boat in the tub of water and add pennies one at a time, about 5 should work well. Then pull boat through water. Write down results.
5. After you have attempted to pull the boat through water take boat out of the water and try pulling it on the lab top. Write down the results. How does it compare to pulling a boat in the water?

----

6. Challenge part of lesson if everyone finishes numbers 1-4. Design a boat that can hold the greatest number of pennies or washers depending on what is available for this experiment.

6. How many pennies did your boat hold? ______ Congratulations!

NAME________________________________

Teacher's Page
In Classroom

LOG CHUTE

EXPERIMENT 2: THE CRATER CONNECTION

Materials

- Ping-pong ball – 1 per group
- Golf ball – 1 per group
- Pan or 4-liter (1 gallon) bucket – 1 per group
- Sand – 2-3 gallons
- Meter or yard stick – 1 per group

Directions

1) Have students put about 5 cm (two inches) of sand in the bucket and smooth it out.
2) Tell students to hold the meter stick upright in the bucket. From 50 centimeters, have them drop one ball into the sand, move the meter stick, and repeat with the other ball.
3) Have students observe the difference in craters created by the two balls and measure and record the diameter and depth of the craters.
4) Have students drop the balls from both higher and lower heights, measure the craters, and record their data. Have them make a chart to record the following data for each ball: dropping height, diameter if crater and depth of impact crater.

Questions to Ask Students

1) What is the relationship between the size of the crater and the dropping height?
2) How are the craters alike and how are they different?
3) Based on this experiment, ask students to predict which will create a more impressive splash, an empty log boat or full log boat. What evidence do they have to support their answer?
4) How does the length and slope of the hill affect the splash?
5) Ask students to predict who will get more wet, riders in the front of the log boat or riders in the back.

Explanation

The golf ball is heavier than the ping-pong ball (yet close to the same size). Newton's second law states: The greater the mass, the greater the force. This law is represented by the equation Force = Mass x Acceleration, or f=ma. The full log boat has more force to transfer to the water, thus a larger splash.

Taking it Further

Repeat with other balls of similar size. Chart the data.

NAME________________________________

Student's Page
In Classroom

LOG CHUTE

EXPERIMENT 2: THE CRATER CONNECTION

1. **What is the relationship between the size of the crater and the dropping height?**

2. **How are the craters alike and how are they different?**

3. **Just for fun, which do you think will create a more impressive splash, an empty log boat or a full log boat? What evidence do you have to support your answer?**

4. **How does the length and slope of the hill affect the splash?**

5. **Who do you think will get wetter, riders in the front of the log boat or riders in the back?**

NAME________________________________

Teacher's Page
In Classroom

LOG CHUTE

EXPERIMENT 2: THE CRATER CONNECTION

1. **What is the relationship between the size of the crater and the dropping height?**
   The higher the dropping height the larger the crater

2. **How are the craters alike and how are they different?**
   Students will notice and discuss observations on shape, depths etc.

3. **Just for fun, which do you think will create a more impressive splash, an empty log boat or a full log boat? What evidence do you have to support your answer?**
   A full ride makes bigger splash. More mass = more bashing power

4. **How does the length and slope of the hill affect the splash?**
   Longer, steeper hills create more speed, therefore more of a splash.

5. **Who do you think will get wetter, riders in the front of the log boat or riders in the back?**
   Generally riders in front get wetter.

NAME________________________________

Students Page At Nickelodeon Universe

LOG CHUTE

Circulate the Average Speed of Passengers on the Log Chute

Length of the Trough	464 Meters
Time from Start to Finish	_ minutes = ___ seconds Note: Time will vary
Average Speed, m/sec.	____ m/sec
____m/sec =? mph	____ mph

Questions

1) **How does the water continue to flow?**

2) **Of all the people in the boat, how many came off dry? Where do the driest ride?**

3) **Which makes a bigger splash at the end of this ride, an empty boat or a boat full of kids?**

4) **What causes the boat to come to a stop?**

5) **At the bottom of the large hill, do passengers lunge forward or backward? Please answer in a short constructive response with a Newton's Law.**

6) **What happens to your body as the boat begins its journey?**

7) **How does your body respond as you go around curves?**

Conversion Chart

m/sec	mph
.50	1.1
1.00	2.2
1.50	3.4
2.00	4.5
2.50	5.6
3.00	6.7
3.50	7.8
4.00	8.9
4.50	10.1
5.00	11.2
5.50	12.3
6.00	13.4
6.50	14.5
7.00	15.7
8.00	17.9
9.00	20.2
10.00	22.4

NAME________________________________

Students Page At Nickelodeon Universe

8) **How do you feel as you get off this ride?**

LOG CHUTE
(Continued)

9) **Using Triangulation with a Trig Calculator, (or Tangent Table with regular calculator if Trig Calculator not available), Altimeter, and tape measure, with a partner please calculate the height of the last hill on the Log Chute and round to nearest foot. You are unable to measure from the last hill straight out for a base, so therefore we have premeasured this for you. If you stand directly in line with the #1 Steering Wheel for the small Rafts your *Base length for the Log Chute's Hill* is: 34 *feet*. If you want or need to measure further use your string made tape to give you more of a base distance. Please put your answer for your calculation below:**

What is Altimeter Reading: (how many degrees?) = _____ **degrees**
Log Chute final hill height =_________Feet

If needed you may use the classroom notes below to help you find your answer:
Remember when measuring the height of the hill on the ride we are going to attempt to get an altitude by using your home made Altimeter.
Height = Base * (Y/X)
Height = height of the object
Base = horizontal distance from the object
Y = measured from the altimeter (horizontally
X = measured from the altimeter (vertically)
(Don't forget to add your own height to the calculated height!)

Steps for figuring height of Amusement Rides:

- Measure distance from Coaster/Ride sight to where you stand with altimeter
- Stand at your measured distance away from Coaster or Ride spot
- Look through straw of altimeter
- Have partner read the degrees number on altimeter
- Use trig calculator (calculator that has a Tan function)
- Press Tan button,
- Then put the number in from the degrees on altimeter
- Then press = or enter button
- Then press multiplication function button
- Then put distance of how far base is, example: Distance from Ride site to where you stand looking through straw of altimeter)
- Then press = or enter button, this will tell you height from your eye level to height of Coaster/Ride
- Now take that number and add your height (from your eye level to ground, so if you are 5'4'' you might add 5 feet or so to the total)

NAME________________________________

- If a Trig Calculator is not available please use the Tangent Table below along with a regular calculator.

(Use this Tangent Table with regular Calculator if Trig Calculator is not available)

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4	0.0699	34	0.6745	64	2.0603
5	0.0874	35	0.7002	65	2.1445
6	0.1051	36	0.7265	66	2.2460
7	0.1227	37	0.7535	67	2.3558
8	0.1405	38	0.7812	68	2.4750
9	0.1583	39	0.8097	69	2.6050
10	0.1763	40	0.8390	70	2.7474
11	0.1943	41	0.8692	71	2.9042
12	0.2125	42	0.9004	72	3.0776
13	0.2308	43	0.9325	73	3.2708
14	0.2493	44	0.9656	74	3.4874
15	0.2679	45	1.0000	75	3.7320
16	0.2867	46	1.0355	76	4.0107
17	0.3057	47	1.0723	77	4.3314
18	0.3249	48	1.1106	78	4.7046
19	0.3443	49	1.1503	79	5.1445
20	0.3639	50	1.1917	80	5.6712
21	0.3838	51	1.2348	81	6.3137
22	0.4040	52	1.2799	82	7.1153
23	0.4244	53	1.3270	83	8.1443
24	0.4452	54	1.3763	84	9.5143
25	0.4663	55	1.4281	85	11.4300
26	0.4877	56	1.4825	86	14.3006
27	0.5095	57	1.5398	87	19.0811
28	0.5317	58	1.6003	88	28.6362
29	0.5543	59	1.6642	89	57.2899
30	0.5773	60	1.7320	90	------------

NAME________________________________

Teacher's Page
At Nickelodeon
Universe

LOG CHUTE

Calculate the Average Speed of Passengers on the Log Chute

Length of the Trough	464 Meters
Time from Start to Finish	5 minutes = 300 seconds Note: Time will vary
Average Speed, m/sec.	1.54 m/sec
m/sec = ? mph	See Chart Below

Questions

1) **How does the water continue to flow?**
   - A pump carries the water to the top of each hill.

2) **Of all the people in the boat, how many came off dry? Where do the driest ride?**
   - For the driest ride, sit in either the middle or the back.

3) **Which makes a bigger splash at the end of this ride, an empty boat or a boat full of kids?**
   - A full boat will make a bigger splash.

4) **What causes the boat to come to a stop?**
   - The track has a stopping device. The impact of the boat coming down the final hill also helps to slow the boat considerably.

5) **At the bottom of the large hill, do passengers lunge forward or backward? SCR with a Newton's Law.**
   - Passengers lunge forward. Newton's first law states: A body in motion will stay in motion unless acted upon by an outside source. Passengers continue to move when the log boat stops.

6) **What happens to your body as the boat begins its journey?**
   - Passengers are pushed back into their seats.

7) **How does your body respond as you go around curves?**
   - On a right-hand turn, your body tends to be pushed into the left-hand side of the log boat. On a left-hand turn your body tends to be pushed into the right-hand side of the boat. Remember Newton's first law of motion: A body goes in a straight line unless acted on by an outside force.

Conversion Chart

m/sec	mph
.50	1.1
1.00	2.2
1.50	3.4
2.00	4.5
2.50	5.6
3.00	6.7
3.50	7.8
4.00	8.9
4.50	10.1
5.00	11.2
5.50	12.3
6.00	13.4
6.50	14.5
7.00	15.7
8.00	17.9
9.00	20.2
10.00	22.4

NAME________________________________

Teacher's Page At Nickelodeon Universe

LOG CHUTE
(Continued)

8) **How do you feel as you get off this ride?** Answers vary

9) Using Triangulation with a Trig Calculator, (or Tangent Table with regular calculator if Trig Calculator not available), Altimeter, and tape measure, with a partner please calculate the height of the last hill on the Log Chute and round to nearest foot. You are unable to measure from the last hill straight out for a base, so therefore we have premeasured this for you. If you stand directly in line with the #1 Steering Wheel for the small Rafts your *Base length for the Log Chute's Hill* is: ***34 feet***. If you want or need to measure further use your string made tape to give you more of a base distance. Please put your answer for your calculation below:
What is Altimeter Reading: (how many degrees?) = **_____ degrees**
Log Chute final hill height =_________Feet

Answer to #9 only (*Teacher's ht. about 6'*)

The **upper part** of the Log Chute Ride is **46 degrees**
The **lower part** of the Log Chute Ride is **44 degrees**

Therefore answer Upper = tan, 46 degrees x 34'base = 35.2' + teacher ht.6'
= 41.2' for upper part about chest height

Therefore answer Lower = tan, 44 degrees x 34'base =32.83' + teacher 6' ht.
= **38.83' for lower** part of car sitting on track

NAME_______________________________

Pepsi Orange Streak

PASSENGERS ON THE Pepsi Orange Streak JOURNEYS 817 METERS FOR MAXIMUM THRILLS AND A BIRD'S EYE VIEW OF THE PARK

This ride demonstrates the following science concepts:

- The relationship between the mass (weight) of an object and the force it exerts (Newton's second law: Force = mass x acceleration, F=ma).

- Newton's first law: A body moves in a straight line unless acted upon by an outside force. This explains why students lunge forward and slam into the side of a car while on the ride.

- Using Triangulation to calculate coaster hill height

- Average speed = $\frac{\text{distance}}{\text{time}}$

NAME________________________________

Teacher's Page
In Classroom

Pepsi Orange Streak

QUESTION:
HOW WILL YOUR BODY RESPOND TO CURVES ON the Pepsi Orange Streak?

EXPERIMENT 3: ROLL MARBLE ROLL

Materials

- Marbles – 2 per group
- 60 cm x 10 cm (24" x 4") pieces of poster board – 1 per group
- A smooth surface

Directions

1. Have students roll a marble over a smooth surface (a table or the floor) and watch it travel in a straight line.
2. Ask students to curve gently the piece of poster board. With one student holding the curve perpendicular to smooth surface, have another roll the marble in the direction of the curved poster board.
3. Tell students to observe the ball's path as it hits and exits the curve.
4. Tell students to create a sharper curve and roll the ball again. Have them predict the spot where they would catch the marble after it leaves the curve.
5. Ask students to draw the marble's path for each roll.

Questions to Ask Students

1. How does a marble roll if it is not interrupted?
2. How does the curve change the marble's path?
3. What does the sharpness of the curve have to do with the marble's path?
4. The poster-board curve causes the ball to change direction. Predict how your body would respond to traveling around a curve on *The Pepsi Orange Streak*. (For an explanation, see below.)

Explanation

The marble will roll in a straight line until it hits the curve. Newton's first law states: A body moves in a straight line motion unless acted upon by an outside force (the curve). When the marble leaves the curve, it continues in a straight line. It does not continue in the circular path set up by the curves.

NAME________________________________

Teacher's Page
In Classroom

Pepsi Orange Streak

EXPERIMENT 4: ZIPPING ALONG – SPEED!

Materials

- Foam-pipe insulation, sliced lengthwise (approximately 3 meters per group) or Mattel Hot Wheel™ track
- Small marbles – 1 per group
- Meter sticks – 1 per group
- Stopwatch – 1 per group
- Masking tape
- Textbooks – 4 – 6 per group

Directions

1. Prior to the lesson, slice the foam-pipe insulation in half lengthwise.
2. Have students connect the pieces of pipe insulation with masking tape.
3. Tell students to measure and record the length of the track.
4. Tell students to use the books to set up the full length of the track to include both hills and valleys. Have them use tape, where necessary, to attach the track to chairs, tables, books, or shelves.
5. Tell students to roll a marble down the track. Have them adjust the hills and valleys to allow the marble to run the full length of the track.
6. When the marble runs successfully from one end of the track to the other, ask students to use a stopwatch to time the marble. Tell them to record the time of the first run, then complete a second run and record its time.
7. Have students draw a picture of the track and indicate where the marble is moving the fastest and the slowest.

To Calculate Average Speed

$$\text{Average speed} = \frac{\text{distance}}{\text{time}}$$

To determine miles per hour, think of "per" as meaning "divided by." For example, the distance is 10 meters and the time is five seconds. The average speed is to meters per second.

Questions to Ask Students

1. What makes a faster or slower race course? What variables result in a fast track?
2. On what part of the track is the ball rolling the fastest?
3. How would raising or lowering the starting height change the average speed?

Explanation

The ball's speed will increase most rapidly where the hills are steep.

Please see following page questions that go with this class lab. You will notice during this lab the students are very excited. Collaboration is needed in this lab.

NAME________________________________

Student's Page
In Classroom

Pepsi Orange Streak

Zipping Along --- Speed!
(In Class Lab @ School)

Questions:

1. **What makes a faster or slower course?**

   What variables result in a fast track?

2. **On what part of the track is the ball rolling the fastest?**

3. **How would raising or lowering the starting height change the average speed?**

4. **What is the average speed of your racetrack?**
   (Remember average speed = Distance divided by average time) or

$$\text{Average Speed} = \frac{\text{Distance}}{\text{Time}}$$

5. **Think of a catchy name for your Roller Coaster and make or draw a small Sign for your Coaster below in the space provided.**

6. **For whom would your roller coaster be designed, (toddlers, elementary kids, teenagers, adults or all people) and why?**

NAME________________________________

Student's Page
In Classroom

Pepsi Orange Streak

Zipping Along --- Speed!
(In Class Lab @ School)

7. How does your ride demonstrate Newton's 1st Law?

8. How does your ride demonstrate Newton's 2nd Law?

9. How does your ride demonstrate Newton's 3rd Law?

10. Draw a diagram below please label the portion of your roller coaster that shows where the marble has the following, by putting the correct letter in the space provided on the diagram.

A. Potential Energy B. Kinetic Energy C. Most Speed

D. Negative Acceleration E. Gaining Speed

NAME________________________________

Teacher's Page
In Classroom

Pepsi Orange Streak

Zipping Along --- Speed!

(In Class Lab @ School)

Questions:

1. **What makes a faster or slower course?**
   Faster = long steeper hills Slower = short hills not steep, more curves & loops

   What variables result in a fast track?
   Fast track = Higher and steeper start, long steep hills

2. **On what part of the track is the ball rolling the fastest?**
   @ bottom

3. **How would raising or lowering the starting height change the average speed?**
   Raising the height = Faster average speed,
   Lowering the height = slower average speed

4. **What is the average speed of your racetrack?**
   (Remember average speed = Distance divided by average time) or

   Varies **Average Speed =** $\frac{\text{Distance}}{\text{Time}}$

5. **Think of a catchy name for your Roller Coaster and make or draw a small Sign for your Coaster below in the space provided.**

   Students draw & name coasters / answers vary

6. **For whom would your roller coaster be designed, (toddlers, elementary kids, teenagers, adults or all people) and why?**
   Answers vary

NAME________________________________

Teacher's Page
In Classroom

Pepsi Orange Streak

Zipping Along --- Speed!
(In Class Lab @ School)

7. How does your ride demonstrate Newton's 1st Law?
Object @ rest remains @ rest, object in motion remains in motion, in straight line, unless acted upon by outside force = track

8. How does your ride demonstrate Newton's 2nd Law?
Acceleration of marble depends on net force, (gravity, steepness, etc, and mass of marble.

9. How does your ride demonstrate Newton's 3rd Law?
*When marble pushes against track the track pushes equally back **(also** there is the force of **centripetal force** acting on marble where the track is keeping marble in circular path.)*

10. Draw a diagram below please label the portion of your roller coaster that shows where the marble has the following, by putting the correct letter in the space provided on the diagram.

A. Potential Energy B. Kinetic Energy C. Most Speed

D. Negative Acceleration E. Gaining Speed

(See student's drawings / labeling)

NAME________________________________

Teacher's Page
In Classroom

Pepsi Orange Streak

Taking it Further

1. Ask students how slowly they can make the marble travel along the nine-meter track. Tell them they can use books or other materials to create hills and valleys. Ask them to design a track that allows the marble to roll for at least five seconds. Ask students to describe the design features of a slow track. Have them draw a picture of their successful track design.

2. Have students devise their own experiments at the playground slide with marbles, a meter stick, and a stopwatch.

3. The next time the students ride in a car ask them to sit on their hands. As the car rounds a curve to the left, have students note what direction their body tends to go. As they round a curve to the right, what direction does their body go? Here is Newton again confirming your feelings: A body remains in a straight line unless acted upon by an outside force.

NAME________________________________

Student's Page At Nickelodeon Universe

Pepsi Orange Streak

Calculate the Average Speed of Passengers on the Pepsi Orange Streak

Length of the Track	817 m
Time from Start to Finish for one run	2 min. 30 sec. = 150 sec. Note: Answers will vary

Questions

1. **Where do you sit for the wildest ride?**

2. **How do hills change from start to finish for this ride?**

3. **How many times do motors pull the cars up hills on the Orange Streak?**

4. **What pulls the cars down the hills?**

5. **Using** Triangulation with Tangent Table or Trig Calculator if available, Altimeter, and tape measure, with a partner please calculate the height of the 1st hill on **Pepsi Orange Streak** and round to nearest foot. If you are unable to measure base from the 1st hill you may use this as a base measurement. Straight out from base of 1st hill on Pepsi Orange Streak to Statue of Tak Attack Cave Boy is 57 feet. Stand right in front of Tak the Cave Boy for 57' base measurement. Please put your answer for your calculation below.

What was your Altimeter reading in degrees? __ Height of Pepsi Orange Streak 1st Hill using Triangulation = ____ Feet

6. **Sketch part of the ride and note where**
    a. **A motor moves the cars**
    b. **The cars are moving the fastest**
    c. **The cars are moving the slowest**
    d. **The cars lose speed**
    e. **The cars gain speed**

NAME________________________________

Teacher's Page
At Nickelodeon
Universe

Pepsi Orange Streak

Calculate the Average Speed of Passengers on the Pepsi Orange Streak

Length of the Track	817 m
Time from Start to Finish for one run	2 min. 30 sec. = 150 sec. Note: Answers will vary
Average Speed, m/sec.	5.44 m/sec
__m/sec = mph	mph

Questions

1. **Where do you sit for the wildest ride?**
Riders in the back will experience the wildest ride. A motor works to pull the cars up the first hill. Then the pull gravity takes over and the cars speed down the hill. The cars in the rear start the downhill plunge with higher speed than those in the front. Conversely, those in the front experience the tamest ride, while those in the middle experience the least amount of speed changes.

2. **How do hills change from start to finish for this ride?**
The hills get progressively shorter.

3. **How many times do motors pull the cars up hills on the Orange Streak?**
Twice.

4. **What pulls the cars down the hills?**
Gravity

5. **Using** Triangulation with Tangent Table or Trig Calculator if available, Altimeter, and tape measure, with a partner please calculate the height of the 1st hill on **Pepsi Orange Streak** and round to nearest foot. If you are unable to measure base from the 1st hill you may use this as a base measurement. Straight out from base of 1st hill on Pepsi Orange Streak to Statue of Tak Attack Cave Boy is 57 feet. Stand right in front of Tak the Cave Boy for 57' base measurement. Please put your answer for your calculation here. ___ Feet = height of Pepsi Orange Streak 1st Hill. = at **57' tangent angle degree = 38 degrees x 57' = 44.53' add teacher ht. of 6' = 50.53 feet**

6. **Sketch part of the ride and note where**
    f. **A motor moves the cars**
    g. **The cars are moving the fastest**
    h. **The cars are moving the slowest**
    i. **The cars lose speed**
    j. **The cars gain speed**
    k. Sketches vary; Check over to see students drawings/labels

NAME________________________________

Splat – O – Sphere

The Splat-O-Sphere is ride for experiencing g forces from a sudden vertical lift of about 60' along with surprising drops for a quick feeling of weightlessness along with a series of different motions for a feeling of many other sensations along the ride.

This ride demonstrates the following science concepts:

- Gravity – This is the force that pulls objects toward the earth.
- Microgravity – Rapid vertical elevation changes result in feelings of low weight, or feelings of twice one's weight (2 g's).
- Newton's laws

NAME________________________________

Student's Page
At Nickelodeon
Universe

<u>Splat – O – Sphere</u>

<u>Sent straight up 60 ' then back down in series of different motions</u>

1. Compare and contrast similarities and differences observed between the Splat-O-Sphere and the Avatar AirBender.

 ____
 ____
 ____
 ____
 ____

2. If sitting on your hands when the ride is going full speed what do you feel when the ride reaches its lowest point? In a *short constructive response* please explain why using a Newton Law.

 ____
 ____
 ____

3. If sitting on your hands when the ride is going full speed what do you feel when the ride reaches its highest point?

 ____
 ____
 ____

4. How long does this ride last? ______________________________

5. Describe your body's movement on this ride.

 ____
 ____
 ____

NAME________________________________

Student's Page
At Nickelodeon
Universe

Splat – O – Sphere

6. Concentrate on how your body feels as you ride the

Pulse rate:	**Before Ride**	**After Ride**
	___________	__________

How do you feel? Check if the answer is "yes."

	Before Ride	**After Ride**
Dry mouth	__________	__________
Trembling	__________	__________
Dizzy	__________	__________
Sweaty palms	__________	__________
Tense muscles	__________	__________
Unable to move	__________	__________
Rapid breathing	__________	__________
Fear	__________	__________
Upset stomach	__________	__________

How long ago did you eat? ____________ (Just curious)

NAME________________________________

Teacher's Page
At Nickelodeon
Universe

Splat – O – Sphere

1. Compare and contrast similarities and differences observed between the Splat-O-Sphere and the Avatar AirBender.
   Students should note: Splat-O-Sphere movement is vertical where as Avatar AirBender has circular/half pipe type of motion where centripetal force is taking effect.
   Also on Splat-O-Sphere students will notice similar to Tak Attack that at times there is more g force (when @ bottom going up) and at other times almost a weightlessness feeling (when @ top going down).

2. If sitting on your hands when the ride is going full speed what do you feel when the ride reaches its lowest point? (using SCR)
   Students will feel more g force, & weight on hands because of Newton's 1st, an object in motion wants to stay in motion.

3. If sitting on your hands when the ride is going full speed what do you feel when the ride reaches its highest point?
   Students will feel almost weightless.

4. How long does this ride last?
   Answers may vary, approximately 45 seconds.

5. Describe your body's movement on this ride.
   Answers vary, usually exciting to be sent straight up about 60' then back down to ground in series of different motions.

NAME________________________________

Teacher's Page At Nickelodeon Universe

Splat – O – Sphere

6. Concentrate on how your body feels as you ride the

Pulse rate	**Before Ride**	**After Ride**
	__________	__________

How do you feel? Check if the answer is "yes."

	Before Ride	**After Ride**
Dry mouth	__________	__________
Trembling	__________	__________
Dizzy	__________	__________
Sweaty palms	__________	__________
Tense muscles	__________	__________
Unable to move	__________	__________
Rapid breathing	__________	__________
Fear	__________	__________
Upset stomach	__________	__________

How long ago did you eat? ___________ (Just curious)

(Answers will vary)

NAME________________________________

SpongeBob SquarePants Rock Bottom Plunge

The **SpongeBob SquarePants Rock Bottom Plunge is** a ride that takes *you slowly straight up your first hill with mechanical assistance. You will have time to anticipate what it is going to feel like as you reach the top of this ride and it turns you head over heels dropping you straight down and into many loops, spirals, twist and turns. This is an aggressive ride which comes to a stop at Bikini Bottom bus stop.*

This ride demonstrates the following science concepts:

- Newton's first law: A body moves in a straight line unless acted upon by an outside force. This explains why students lunge forward and slam into the side of a car while on the ride.
- The relationship between the mass (weight) of an object and the force it exerts (Newton's second law: Force = mass x acceleration, F=ma).
- Using Triangulation to calculate hill heights
- Average speed = $\frac{\text{distance}}{\text{Time}}$

NAME________________________________

Student's Page At Nickelodeon Universe

SpongeBob SquarePants Rock Bottom Plunge

*Track length is **415 meters long**. As you slowly ride straight up your first hill with mechanical assistance you will have time to anticipate what it is going to feel like as you reach the top of this ride and it turns you head over heels dropping you straight down and into many loops, spirals, twist and turns is an aggressive ride which comes to a stop at Bikini Bottom bus stop.*

Concentrate on how your body feels as you ride the SpongeBob SquarePants Rock Bottom Plunge.

	Before Ride	**After Ride**
Pulse Rate		

How do you feel? Check if the answer is "yes."

	Before Ride	**After Ride**
Dry Mouth	☐	☐
Trembling	☐	☐
Dizzy	☐	☐
Sweaty Palms	☐	☐
Tense Muscles	☐	☐
Unable to move	☐	☐
Rapid Breathing	☐	☐
Fear	☐	☐
Upset Stomach	☐	☐

NAME________________________________

Student's Page At Nickelodeon Universe

SpongeBob SquarePants Rock Bottom Plunge

1. Using Triangulation with a Tangent Table or Trig Calculator, Altimeter, and tape measure, with a partner please calculate the height of the first hill to nearest foot on SpongeBob SquarePants Rock Bottom Plunge. (If you do not have tape measure you could use the following as a base distance. It is 47 feet from the base of the 1st large hill to the Pineapple Poppers Palm Tree Sign. Stand right next to this sign when using altimeter.)

What is your Altimeter reading in degrees? ____ What is the total height of the 1st Hill? = ____ Feet

2. Approximately how long does it take you to travel up the first hill? _____ Seconds

3. Approximately how much time does it take once you start your drop down the first hill? ___ Seconds

4. Observe and evaluate the height of the hills, turns and twists after the first towering hill. Compare and contrast your findings of these heights from start to finish. Please put your findings below. A diagram may be helpful in your findings.

   ____
   ____
   ____
   ____
   ____

5. As you are riding the SpongeBob SquarePants Rock Bottom Plunge car please observe the following:
   * How many times do you go up hill? ___
   * How many times do you go upside down? ___

NAME________________________________

Student's Page At Nickelodeon Universe

SpongeBob SquarePants Rock Bottom Plunge

6. Please design/draw a diagram of your own coaster and label the following on:

- Where is there the most Potential Energy
- Where is there the most Kinetic Energy
- Where is there negative acceleration
- Where is Potential Energy being converted into Kinetic Energy
- Where is Kinetic Energy being converted into Potential Energy

(You may put diagram in space below: Please give it a name.)

Name of Your Coaster: ____

7. If you wanted your parents/guardian to get you a new Yo-Yo how could you reason with them that playing and learning with a yo-yo could help you better understand the physics involved with riding a roller coaster?

____
____
____
____

NAME________________________________

Teacher's Page At Nickelodeon Universe

SpongeBob SquarePants Rock Bottom Plunge

*Track length is **415 meters long**. As you slowly ride straight up your first hill with mechanical assistance you will have time to anticipate what it is going to feel like as you reach the top of this ride and it turns you head over heels dropping you straight down and into many loops, spirals, twist and turns, is an aggressive ride which comes to a stop at Bikini Bottom bus stop.*

Concentrate on how your body feels as you ride the SpongeBob SquarePants Rock Bottom Plunge.

	Before Ride	**After Ride**
Pulse Rate		

How do you feel? Check if the answer is "yes."

	Before Ride	**After Ride**
Dry Mouth	☐	☐
Trembling	☐	☐
Dizzy	☐	☐
Sweaty Palms	☐	☐
Tense Muscles	☐	☐
Unable to move	☐	☐
Rapid Breathing	☐	☐
Fear	☐	☐
Upset Stomach	☐	☐

(Answers Vary)

NAME_______________________________

Teacher's Page At Nickelodeon Universe

SpongeBob SquarePants Rock Bottom Plunge

1. Using Triangulation with a Trig Calculator, Altimeter, and tape measure, with a partner please calculate the height of the first hill on SpongeBob SquarePants Rock Bottom Plunge. ***Students may use Tangent Table or Trig Calculator, some type of tape measure or measuring device to measure how far back from first hill of SpongeBob SquarePants Rock Bottom Plunge, and altimeter (or with pre-measured base Answer =) Base @ 47 feet so @ 47 feet the altimeter reading is approximately 53 degrees so tangent for 53 degrees is 1.327 x base of 47' = 62.369' (plus teacher ht. of 6') = total ht. of 68.369 ft. or 68' rounded off to nearest ft.***

2. Approximately how long does it take you to travel up the first hill? ***Approximately 22 Seconds.***

3. Approximately how much time does it take once you start your drop down the first hill? ***Approximately 38 Seconds***

4. Observe and evaluate the height of the hills, turns and twists after the first towering hill. Compare and contrast your findings of these heights from start to finish. Please put your findings below. A diagram may be helpful in your findings. ***Students generally should note that hill become shorter in height & length.***

5. As you are riding the SpongeBob SquarePants Rock Bottom Plunge car please observe the following:

   * How many times do you go up hill? ***= 6 times up a hill***

   * How many times do you go upside down? ***3 times upside down***

NAME_______________________________

Teacher's Page At Nickelodeon Universe

SpongeBob SquarePants Rock Bottom Plunge

6. Please design/draw a diagram of your own coaster and label the following on:

- Where is there the most Potential Energy
- Where is there the most Kinetic Energy
- Where is there negative acceleration
- Where is Potential Energy being converted into Kinetic Energy
- Where is Kinetic Energy being converted into Potential Energy

(You may put diagram in space below: Please give it a name.)

Name of Your Coaster: _______________________________________

Check student Diagrams and Labels

7. If you wanted your parents/guardian to get you a new Yo-Yo how could you reason with them that playing and learning with a yo-yo could help you better understand the physics involved with riding a roller coaster? Please put your reasoning here. ***Answers will vary depending on what kind of negotiator student is but points could be made that by working with yo-yo you can demonstrate, P.E. , K. E. , positive and negative acceleration, where there P. E. converting into K. E. , where there is K. E. converting into P. E. etc.***

NAME________________________________

Teenage Mutant Ninja Turtles Shell Shock

This ride demonstrates the following science concepts:

- Circular motion – motion around a central axis.
- Centripetal force – any force that causes an object to move in a circular path, it means center seeking
- Centrifugal force – a kind of fictitious force causes you to feel as though you are thrown to the outside as the ride moves in a circular path.
- Newton's Laws
- Gravity – This is the force that pulls objects toward the earth.
-
- Distances and speeds in circular motion
- Mathematics concepts
- Sight Seeing (Depending on how you like to use your wings?) ☺

This Spinning, Whirling, Flying type ride is tilted and will carry the 12 single-rider gondolas up at an angle. The gondola brakes then are released and each rider is then able to roll over by using the control wings. Each rider then may decide whether the ride is going to be a thrill ride or just a scenic excursion. Since the boom is tilted riders go up to heights of approximately 72 feet and come down each revolution around a central axle/control tower.
Riders pass through an entrance themed to look like the Ninja Turtles' underground sewer headquarters before boarding the ride featuring a turtle shell on the back.

NAME________________________________

Teacher's Page
In Classroom

Teenage Mutant Ninja Turtles Shell Shock

EXPERIMENT 7: Spin the Bucket Demonstration

QUESTION:
WHAT KEEPS WATER FROM FLYING OUT OF A SPINNING BUCKET?

Materials
- Bucket or pail – 1 gallon or larger
- Water
- 1m (3') rope
- Mop

Directions
1. Attach the rope securely to the bucket handle.
2. Ask Students to fill the bucket one quarter full with water.
3. Have each student hold the bucket by the rope and quickly spin it around, 360 degrees, at the side of the student's body, taking turns so that everyone has a chance to spin the bucket.

Questions to Ask Students
1. How does your arm feel as you spin the bucket?
2. What must you do to keep the bucket from flying off?
3. If you let go of the bucket while spinning, in what direction would the bucket fly? In what direction would the water fly?

Explanation
Your arm must exert an inward pull to keep the bucket from flying off while you're spinning it. This inward pull that keeps a body moving in a circular path is called centripetal force. Circular motion and centripetal motion go together.

Bonus: If you want to have some fun Teachers can try this it is:
Behind your podium have another bucket looking the same but full of small pieces of torn up paper: exchange the water bucket with the paper bucket and tell students you need to get the water out of the bucket quickly and with the imposter bucket throw paper at your audience. Even though there was no water in bucket you may have some wet spots after this demo. Have Fun!

NAME________________________________

Teacher's Page
In Classroom

Teenage Mutant Ninja Turtles Shell Shock

EXPERIMENT 8: TURNTABLE TRAPEZE DEMONSTRATION

Materials
- 30 cm (12") plastic cardboard tube with a 6.5 cm (2 ½") diameter (approximate) – mail tub or sturdy gift-wrap tube
- Metal pie pan – 22 cm (9") or larger
- Hammer
- Nail with head
- String or colored yarn
- Hot-glue gun
- Old 33 rpm record
- Turntable with multiple speeds (check second-hand stores)
- Large paper clips
- 16 2.5 cm (1") washers

Directions
1. Using a nail and hammer, punch four holes, evenly spaced, near the edge of the pie plate.
2. Use a hot-glue to attach the end of the mail tube to the center of the pie plate.
3. Hot glue the tube to the center of the record. (Modeling clay also can be used to anchor the tube directly to the turntable eliminating the need for the record.)
4. Loop strings through the holes in the pie pan. Tie a loop in each string four inches from the pie plate, keeping string lengths even.
5. Slip a paper clip through each loop and put a washer on the paper clip.
6. Turn on the turntable at a slow speed and observe the "riders" on the flying trapeze. Have students draw the flying trapeze "riders," making note of the angle and speed. Increase the speed and have them draw what they see.
7. Change the number of washers on one or two of the paper clips. Be careful not to overload any one paper clip. Repeat the experiments at different speeds and have students record the changes they observe.

Questions to Ask students
1. What difference does the speed make?
2. What difference does the number of washers make?
3. Compare the swing angle between an empty paper clip and a loaded one.
4. Does the number of washers affect the swing angle? Experiment with this by varying the number of washers on the paper clips.
5. Predict the angel of swing for a large adult and a small child

Explanation
On the **Shell Shock** the gondola bars hold the seats the same way the string holds the paper clips and washers on the flying trapeze. As the rider spins in a circular path, the rider has the feeling of swinging out due to Newton's 1st Law an object wants to stay in motion in a straight line not a circular line. Centripetal force makes the seats and riders center seeking therefore circular motion and centripetal force go together.

NAME_______________________________

Students Page At Nickelodeon Universe

Teenage Mutant Ninja Turtles Shell Shock

QUESTIONS:

1. **How long does this ride last?**

2. **What does it feel like as circular speed increases?**

3. **The distance from the Shell Shock fulcrum angling down the boom arm to Gondola seat directly at end of arm is a 41 foot radius: for a full diameter of 82 feet. If the Shell Shock takes 9 seconds to make 1 revolution, what would its average speed be in feet per second? (Bonus question: what is the average speed if converted to miles per hour?)**

4. **If looking at this ride from the Operator's area that controls the ride, what direction is the Shell Shock turning?**

5. **Draw and label a diagram showing the Shell Shock at rest, estimate the angle at which the boom arm angles out. (Does the angle of the arm change as the ride starts?)**

6. **Describe the centripetal force on this ride pulling you in toward the center and keeping you in a circular path.**

7. **As a passenger is revolving around the Shell Shock in a rather large orbit with the top of their head towards the Shell Shock fulcrum would they feel more or less of a force on their bottom side?**

8. **As a passenger is revolving around the Shell Shock in a rather large orbit with their bottom side (butt) towards the Shell Shock fulcrum would they feel more or less of a force on their bottom side?**

NAME________________________________

Students Page At Nickelodeon Universe

9. Bonus Question Shell Shock/ Ride Height Measurement:

Using Triangulation information:

a. Using Triangulation with Tangent Table, Calculator and Altimeter, with a partner please **calculate the height of the fulcrum/boom arm on Shell Shock.** Looking at the Axle/Fulcrum of Shell Shock there is **3 parallel Flanges** sticking out. Each is about 1 inch thick by 4 inches wide by about 4 feet long. We will **use the Middle Flange as a Guide** to aim your Altimeter. The **middle flange has no visible bolts**. ***Aim Altimeter at Middle of this Middle Flange***. (***Flanges on both sides of it are same size*** *but there are* ***9 bolts on each of these steel flanges).***

b. You are unable to measure for a base, so therefore we have **premeasured this for you**. If you ***standing directly in front of Tall Support Post for Pepsi Orange Streak Coaster, located directly in front of Ice Cream shop/Cool Treats facing directly to Shell Shock Fulcrum*** *middle flange with no visible bolts,* ***you have a base of 54 feet:***

c. Altimeter is aimed at middle fulcrum flange with no visible Bolts: Please put your answer for your calculation below:

Altimeter Reading: = _____ **degrees**
Decimal Tangent = _____ (decimal tangent times base)
Middle Flange **height =_____Feet (not including eye level height :)**
(Remember to add height from your eye level to ground to total :)

****Answer: TOTAL Height to Middle of Middle Flange = _____***

If needed you may use the classroom notes below to help you find your answer:
Remember when measuring the height we are going to attempt to get an altitude by using your home made Altimeter.
Steps for figuring height of Amusement Rides:

- Stand at your measured base distance away from Ride spot
- Look through straw of altimeter
- Have partner read the degrees number on altimeter
- Take this tangent decimal number & multiply times base distance
- Take this number and add your height (from your eye level to ground, so if you are 5’4’’ you might add 5 feet or so to the total)

NAME_______________________________

- If a Trig Calculator is not available please use the Tangent Table below along with a regular calculator.

(Use this Tangent Table with regular Calculator if Trig Calculator is not available)

Tangent Table

Degree	Tan	Degree	Tan	Degree	Tan
0	0.0000				
1	0.0174	31	0.6008	61	1.8040
2	0.0349	32	0.6248	62	1.8807
3	0.0524	33	0.6494	63	1.9626
4	0.0699	34	0.6745	64	2.0603
5	0.0874	35	0.7002	65	2.1445
6	0.1051	36	0.7265	66	2.2460
7	0.1227	37	0.7535	67	2.3558
8	0.1405	38	0.7812	68	2.4750
9	0.1583	39	0.8097	69	2.6050
10	0.1763	40	0.8390	70	2.7474
11	0.1943	41	0.8692	71	2.9042
12	0.2125	42	0.9004	72	3.0776
13	0.2308	43	0.9325	73	3.2708
14	0.2493	44	0.9656	74	3.4874
15	0.2679	45	1.0000	75	3.7320
16	0.2867	46	1.0355	76	4.0107
17	0.3057	47	1.0723	77	4.3314
18	0.3249	48	1.1106	78	4.7046
19	0.3443	49	1.1503	79	5.1445
20	0.3639	50	1.1917	80	5.6712
21	0.3838	51	1.2348	81	6.3137
22	0.4040	52	1.2799	82	7.1153
23	0.4244	53	1.3270	83	8.1443
24	0.4452	54	1.3763	84	9.5143
25	0.4663	55	1.4281	85	11.4300
26	0.4877	56	1.4825	86	14.3006
27	0.5095	57	1.5398	87	19.0811
28	0.5317	58	1.6003	88	28.6362
29	0.5543	59	1.6642	89	57.2899
30	0.5773	60	1.7320	90	------------

NAME________________________________

Teacher's Page At Nickelodeon Universe

Teenage Mutant Ninja Turtles Shell Shock

QUESTIONS:

1. How long does this ride last?

Answer: rides may vary, approximately 60 to 90 seconds

2. What does it feel like as circular speed increases?

Answers vary

3. The distance from the Shell Shock fulcrum angling down the boom arm to the Gondola seat directly at the end of arm is a 41 foot radius: for a full diameter of 82 feet. If the Shell Shock takes 9 seconds to make 1 revolution, what would its average speed be in feet per second? (Bonus question: what is the average speed if converted to miles per hour?)

Answer: = diameter x pie = circumference: 82' x 3.14 = 257.48 feet in 9 seconds = divided by 9 = 28.6 feet per second on the shock attack (MPH 28.6 x 60 sec. x 60 min. this product divided by 5280 feet = 19.5 almost 20 MPH)

4. If looking at this ride from the Operator's area controlling the ride, what direction is the Shell Shock turning?

Answer: = it is turning Counter Clockwise

5. Draw and Label a diagram showing the Shell Shock at rest, estimate the angle at which the boom arm angles out. (Does the angle of the arm change as the ride starts?)

Answer: The boom arm drawing should angle out at approximately 25-30 degrees: & Yes the boom angle increases as ride starts

6. Describe the centripetal force on this ride pulling you in toward the center and keeping you in a circular path.

Answer: The massive boom arm hooked to the axle and the seat you are in cause the centripetal force that holds you in a circular path instead of letting you fly off in a straight line as in Newton's 1st law.

7. As a passenger is revolving around Shell Shock in a rather large orbit with the top of their head towards the Shell Shock fulcrum would they feel more or less of a force on their bottom side?

Answer: top of head towards fulcrum more force would be on bottom side: due to Newton's 1st your body wants to fly out in straight line

8. As a passenger is revolving around the Shell Shock in a rather large orbit with their bottom side (butt) towards

a. the Shell Shock fulcrum would they feel more or less of a force on their bottom side?

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<u>Answer: with bottom side towards fulcrum: less force on bottom & more force would be on shoulders in harness: due to Newton's 1st a body wants to fly out in straight line but shoulder harness holds passenger in.</u>

9. <u>Bonus Question Shell Shock/ Ride Height Measurement:</u>
Using Triangulation information:

a. Using <u>Triangulation</u> with <u>Tangent Table, Calculator and Altimeter,</u> with a partner please **calculate the height of the fulcrum/boom arm on Shell Shock.** Looking at the Axle/Fulcrum of Shell Shock there is **3 parallel Flanges** sticking out. Each is about 1 inch thick by 4 inches wide by about 4 feet long. We will **<u>use the Middle Flange as a Guide</u>** to aim your Altimeter. The **middle flange has no visible bolts**. ***Aim Altimeter at Middle of this Middle Flange***. ***(Flanges on both sides of it are same size*** *but there are* ***9 bolts on each of these steel flanges).***

b. You are unable to measure for a base, so therefore we have **premeasured this for you**. If you ***standing directly in front of Tall Support Post for Pepsi Orange Streak Coaster, located directly in front of Ice Cream shop/Cool Treats facing directly to Shell Shock Fulcrum*** *middle flange with no visible bolts,* ***<u>you have a base of 54 feet:</u>***

c. ***Altimeter is aimed at middle fulcrum flange with no visible Bolts:***
Please put your answer for your calculation below:

Altimeter Reading: = **29 degrees**
Tangent Reading of: = .5543 (Multiply by Base of 54')

***Middle Flange* height: = 29.93 feet rounded to 30'**

Add height from eye level: my teacher height = 6'in this study

TOTAL Height to Middle of Middle Flange = <u>36' total</u>
(Accept <u>34 to 38 feet gives 2 feet leeway</u> each way)

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Teachers Answer Page

RIDE COMPARISONS

Which ride gives you the longest ride for the point?

RIDE	#of POINTS	TIME OF RIDE in seconds	TIME in sec. / POINTS
The Log Chute	6	5 min 0 sec = 300 sec	$\frac{300}{6} = 50$
The Orange Streak	5	2 min 30 sec = 150 sec	$\frac{150}{5} = 30$
The Carousel	3	2 min 0 sec = 120 sec.	$\frac{120}{3} = 40$
Backyardigans' Swing Along	4	1 min 30 sec = 90 sec	$\frac{90}{4} = 22$
Brain Surge	5	1 min 30 sec = 90 sec	$\frac{90}{5} = 18$

Note: Ride times will vary. The times given are the minimum ride lengths. On less busy days, ride lengths may be longer.

Ranks: From best for the buck to worst

1. The Log Chute
2. The Carousel
3. The Orange Streak
4. Backyardigan's Swing Along
5. Brain Surge

NAME________________________________

BACK ON THE BUS TO SCHOOL

Leaving Nickelodeon Universe at MOA

1. As the bus starts to move, do you feel thrown forward, or backward?

Once the bus is traveling at a constant speed

2. Describe how it feels to be going at a constant speed.

3. How do you know you are moving?

4. Close your eyes. How can you tell when the bus is going around a curve? Describe your feelings.

5. 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 ahead. See if you can sense that you are trying to go straight but are being pulled into the curve by centripetal force.

NAME________________________________

Visiting Nickelodeon Universe

To make the trip to Nickelodeon Universe at MOA as safe as possible, please follow these rules, including but not limited to: no smoking, observe the safety rules while on the rides and in the park; use inside voices; no loud music, running, throwing objects, spitting, or littering; don't block or interfere with the passage of others; obey the requests of management or security.

First Aid
Contact any Nickelodeon Universe employee at MOA or security guard for help with medical needs.

Lost and Found
Should you lose personal belongings or your group, go to the Guest Relations office located on the north side of the park on the first level.

Lockers
Should you decide to use the lockers, they can be found on the lower level of the park on the north side. The cost is one dollar.

Special Needs Students
All guests with a permanent or temporary disability must meet certain requirements so they can ride safely. Disabilities may include riders who

- Have a neck brace
- Have an arm or leg cast
- Have stitches in their hand
- Are non-ambulatory

Ride Safety
While on the rides, please obey posted rules and follow the instructions of the ride operators.

NAME________________________________

EXPLORE… RIDE SCIENCE

RIDE SCIENCE FOR ELEMENTARY & MIDDLE SCHOOL Students

Thank you for your interest in **Explore… Ride Science**. This program has been made possible through the efforts of Nickelodeon Universe @ MOA. It uses curriculum to teach students basic physical science and physics concepts with easy-to-do classroom activities. It culminates with a field trip to the Nickelodeon Universe at MOA where students can apply what they have learned on the rides.

Enclosed is your curriculum packet, which includes science activities for your students, project ideas for you, and directions on how to book your field trip to Nickelodeon Universe at MOA.

NAME________________________________

COMMENT PAGE:

NAME________________________________

Student's Page At Nickelodeon Universe

Off the Topic of Physics

If you wanted to meet someone at the spot where the Old Metropolitan Stadium home plate used to be and is now located in Nickelodeon Universe, where would you meet them?

____

____

If you wanted to show someone the exact seat to which *Harmon Killebrew* ***hit* his longest home run at Metropolitan Stadium where would you show them?**

____

____

NAME______________________________

Teacher's Page At Nickelodeon Universe

Off the Topic of Physics

If you wanted to meet someone at the spot where the Old Metropolitan Stadium home plate used to be and is now located in Nickelodeon Universe, where would you meet them?

The Mall of America, which opened in 1992, stands on the site of what is now nostalgically called "the *Old* Met." *A brass plaque in the shape of home plate, embedded in the floor in the northwest corner of Nickelodeon Universe, commemorates the site's days as a sports venue.*
answer = Near the entrance to Spongebob Squarepants Rock Bottom Plunge approximately 20' east of entrance

If you wanted to show someone the exact seat to which *Harmon Killebrew hit* his longest home run at Metropolitan Stadium where would you show them?

Near the opposite corner, mounted high on the wall, by the Log Chute, is a red stadium chair denoting the precise landing spot (including elevation) of Harmon Killebrew's 520-foot (160 m) home run, a blast to the upper deck in deep left-center field on June 3, 1967. This was the longest homer Killebrew ever hit, and the longest ever hit in Metropolitan Stadium.