NICKELODEON UNIVERSE® RIDE SCIENCE
ACTIVITY PACKET

THE SCIENCE BEHIND THE THRILLS!

nickelodeon UNIVERSE®
MALL OF AMERICA®

NICKELODEON UNIVERSE® RIDE SCIENCE
ACTIVITY PACKET

NAME: _____

TABLE OF CONTENTS

NAME: _____

LEARNING GOALS AND OBJECTIVES

This guide book about the rides at Nickelodeon Universe® 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 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®. 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. The 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. Teenage Mutant Ninja Turtles Shell Shock
13. Addendum: Triangulation/Altimeter 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

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

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.

NAME: _____

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: _____

AVATAR AIRBENDER

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 Short Constructive Response 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: _____

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: _____

BACKYARDIGANS' SWING ALONG

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: _____

BRAIN SURGE

- 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

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.

NAME: _____

BRAIN SURGE

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: _____

THE 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: _____

THE CAROUSEL

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: _____

CRAZY CARS

PASSENGERS ON THE NAKED BROTHERS CRAZY CARS WILL EXPERIENCE SUDDEN STOPS, ACCELERATIONS AND OTHER MOVEMENTS DUE TO COLLISIONS FROM MANY DIFFERENT DIRECTIONS.

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 2nd & 3rd Law is apparent

NAME: _____

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: _____

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

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

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

NAME: _____

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: _____

EL CIRCULO DEL CIELO

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: _____

FAIRLY ODD COASTER

CLIMB ABOARD THIS FAIRLY ODD COASTER FOR AN AGGRESSIVE RIDE WITH HAIRPIN TURNS, WHIRLING AND A GRAVITY DEFYING THRILLS.

This ride demonstrates the following science concepts:

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

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: _____

FAIRLY ODD COASTER

Distance: = 1345 feet / hairpin turns: spinning

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?

   _____

   _____

   _____

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 Coaster is 1345 feet and it takes you 1 minute and 25 seconds (or time it yourself) to complete the course what is your average speed to the nearest feet per second.

   _____ feet per second.

NAME: _____

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)
- If a Trig Calculator is not available please use the Tangent Table on the following page along with a regular calculator.

NAME: _____

TANGENT TABLE

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

Degree	Tan	Degree	Tan	Degree	Tan
0	0.0000	31	0.6008	61	1.8040
1	0.0174	32	0.6248	62	1.8807
2	0.0349	33	0.6494	63	1.9626
3	0.0524	34	0.6745	64	2.0603
4	0.0699	35	0.7002	65	2.1445
5	0.0874	36	0.7265	66	2.2460
6	0.1051	37	0.7535	67	2.3558
7	0.1227	38	0.7812	68	2.4750
8	0.1405	39	0.8097	69	2.6050
9	0.1583	40	0.8390	70	2.7474
10	0.1763	41	0.8692	71	2.9042
11	0.1943	42	0.9004	72	3.0776
12	0.2125	43	0.9325	73	3.2708
13	0.2308	44	0.9656	74	3.4874
14	0.2493	45	1.0000	75	3.7320
15	0.2679	46	1.0355	76	4.0107
16	0.2867	47	1.0723	77	4.3314
17	0.3057	48	1.1106	78	4.7046
18	0.3249	49	1.1503	79	5.1445
19	0.3443	50	1.1917	80	5.6712
20	0.3639	51	1.2348	81	6.3137
21	0.3838	52	1.2799	82	7.1153
22	0.4040	53	1.3270	83	8.1443
23	0.4244	54	1.3763	84	9.5143
24	0.4452	55	1.4281	55	11.4300
25	0.4663	56	1.4825	86	14.3006
26	0.4877	57	1.5398	87	19.6362
27	0.5095	58	1.6003	88	28.6362
28	0.5317	59	1.6642	89	57.2899
29	0.5543	60	1.7320	90	- - - - - - -
30	0.5773				

NAME: _____

LOG CHUTE

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

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

NAME: _____

LOG CHUTE
EXPERIMENT ONE: ALUMINUM BOATS

Question: What role does water play in friction?

- Take the approximate 12" x 12" aluminum foil sheet and make a boat that will float.
- Fill plastic tub about ½ full with water.
- 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.
- 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.

_____

_____

_____

1. 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.

_____

_____

_____

2. How does it compare to pulling a boat in the water?

_____

_____

3. Challenge part of lesson if everyone finishes numbers 1-2.

Design a boat that can hold the greatest number of pennies or washers depending on what is available for this experiment.

4. How many pennies did your boat hold? _____ *Congratulations!*

NAME: _____

LOG CHUTE

EXPERIMENT TWO: 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: _____

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

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?

_____

8. How do you feel as you get off this ride?

_____

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: _____

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)
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13	0.2308	44	0.9656	74	3.4874
14	0.2493	45	1.0000	75	3.7320
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19	0.3443	50	1.1917	80	5.6712
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23	0.4244	54	1.3763	84	9.5143
24	0.4452	55	1.4281	55	11.4300
25	0.4663	56	1.4825	86	14.3006
26	0.4877	57	1.5398	87	19.6362
27	0.5095	58	1.6003	88	28.6362
28	0.5317	59	1.6642	89	57.2899
29	0.5543	60	1.7320	90	- - - - - - -
30	0.5773				

NAME: _____

THE 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: _____

THE PEPSI ORANGE STREAK

ZIPPING ALONG --- SPEED!
(IN-CLASS LAB @ SCHOOL)

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: _____

THE PEPSI ORANGE STREAK

ZIPPING ALONG --- SPEED! (continued)

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: _____

THE PEPSI ORANGE STREAK
ZIPPING ALONG --- SPEED!

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	

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: _____

SPLAT-O-SPHERE

THE SPLAT-O-SPHERE IS A 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: _____

SPLAT-O-SPHERE

Sent straight up 60 feet then back down in series of different motions

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.

_____

_____

6. Concentrate on how your body feels as you ride the *Splat-O-Sphere*.

	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	_____	_____

How long ago did you eat? _____ (just curious)

NAME: _____

SPONGEBOB SQUAREPANTS ROCK BOTTOM PLUNGE

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

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.

NAME: _____

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: _____

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: _____

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: _____

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: _____

TEENAGE MUTANT NINJA TURTLES SHELL SHOCK

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: _____

TEENAGE MUTANT NINJA TURTLES SHELL SHOCK

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 are 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 are 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.

NAME: _____

TEENAGE MUTANT NINJA TURTLES SHELL SHOCK

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

NAME: _____

RIDE COMPARISONS

RIDE	# of POINTS	TIME OF RIDE in seconds	TIME in sec POINTS
The Log Chute	6		
The Orange Streak	5		
The Carousel	3		
Backyardigans' Swing Along	4		
Brain Surge	5		

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®

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: _____

NICKELODEON UNIVERSE® INFORMATION
WHILE VISITING NICKELODEON UNIVERSE

To make the trip to Nickelodeon Universe 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 or security guard for help with medical needs.

Lost and Found

Should you lose personal belongings or your group, go to the Guest Services 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.

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 Centennial Middle School teacher, Bruce Pap. John Anderson, a Centennial High School Science teacher, helped consult on this program. Nickelodeon Universe would also like to thank the Science Museum of Minnesota for the original creation of the ride science program. 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.

NAME: _____

COMMENT PAGE

NAME: _____

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?

_____

_____