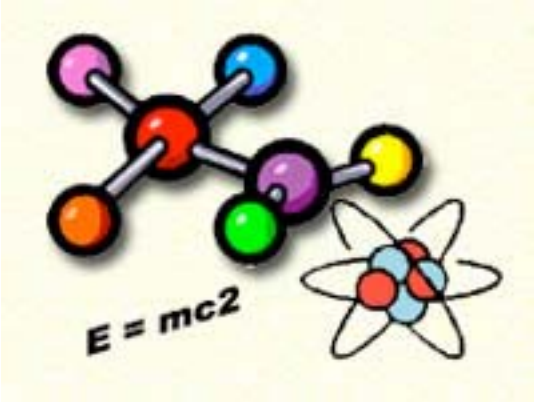
Santa Cruz Beach Boardwalk

ADVANCED

PHYSICS PACKET



INCLUDING RIDE DATA AND 6 RIDE WORKSHEETS

EQUIPMENT NEEDED:

1) Pen is recommended to record data on the Data Log
2) Stopwatch
3) Protractor/ Protractor with weight
4) Calculator

The wearing of jewelry is not recommended.
Measurement devices can be shared with a partner.

CRITICAL SAFETY NOTE:

Any devices carried on the rides must be equipped with a safety strap/wrist tether. You should forbid students from riding any further rides if they are caught without the safety strap being used!! Devices should be made of plastic or rubber. NO GLASS!!

IMPORTANT RIDE MEASUREMENTS:

The use of SI and metric units is strongly recommended.
The information below may be of some use:

Giant Dipper:	Height of first hill	70 ft	21.3 m
	Top speed	55 mph	88 kmph
	Ride time	52 sec	
	Track length	0.5 mi	0.8 km
Ferris Wheel:	50 ft diameter and speed of 4.25 rpm		
Loggers Revenge:	Track Length	1212.3 ft	369.5 m
	Highest point	66.6 ft	20.3 m
	Lowest point	20.5 ft	6.25 m
	Chute drop	42.3 ft	12.9 m
	Ride time	2.75 min	
Pirate Ship:	Length of boat	43.0 ft	13.1 m
	Height of full swing	66.0 ft	20.1 m
	Angle of displacement	75.0 degrees	

GIANT DIPPER - Physics Day Activity - Santa Cruz Boardwalk

Name _____
Date _____ Per _____

Equipment Stopwatch - Use while OBSERVING !!

Physics Preparation /HOMEWORK

1. Give definitions and equations
   a) WORK b) Power

   c) Gravitational Potential Energy

   d) Kinetic Energy

2. When an object is falling _____ Energy is being converted to _____ Energy

MEASUREMENTS - while OBSERVING

1. Time to raise coater from bottom to the top of the first hill: t = sec.

2. Time for entire ride: t = sec.

QUESTIONS AND CALCULATIONS

1. The top of the first hill is 24 m. Calculate the work done on you in raising you to the top
   Use YOUR Weight in Pounds x 2.2 = Newtons) Show Work !!
   (W = Fd) W = joules

2. Calculate the power used to raise you to the top (P = W/t) P = watts

3. Determine your potential energy at the top (GPE = mgh): GPE= joules

4. If all the GPE is converted to kinetic energy, determine your speed at the bottom of the first hill
   ($KE=1/2mv^2$) v = m/sec

5. The track is 850 m long. Determine the average speed for the entire ride (Vavg=d/t)
   v= m/sec

6. Explain why each hill is lower than the one before it.

7. Explain how energy is conserved on the ride.
   Where does the energy come from?
   What energy conversion occur during the ride?

Extra

Measurements/Observations on Ride

1. Draw the shape of each section of track where you experience more than your normal weight.

2. Draw the shape of each section of track where you experience less than your normal weight.

If accelerometer is available

3. Maximum positive "g" force: "gs". Where it occurs:

4. Maximum negative "g" force: "gs". Where it occurs:

This worksheet developed by Independence High School and revised by Aptos HS 2005

PIRATE SHIP - Physics Day Activity - Santa Cruz Boardwalk

Name _____

Date _____ Per _____

Equipment Stopwatch - Use while OBSERVING !!

Physics Preparation /HOMEWORK

This ride is basically a pendulum. Review what you learned about this

1. The period of a pendulum is a) the time for one side to side swing
   b) the time for a complete back and forth swing
2. The period of a pendulum is affected by (circle all that apply)
   a) mass of pendulum b) length of pendulum c) material used

3. Now look up the equation for the period of a pendulum and check your answers above
   T =

MEASUREMENTS - while OBSERVING RIDE

1. Look at the ride . The length of the pendulum from the pivot to the center of the ship is longer than the width of the ship but shorter than the outside support beams. Estimate the length by pacing meters in front of the ride
   Answer Length = m

2, Count the number of riders = _____ Use a stopwatch to time 4 complete swings
   Time for 4 swings = _____ secs 1 swing = Period T = _____ secs

CALCULATIONS

1. Use the pendulum equation –HOMEWORK section – to find Period T using the length you estimated

QUESTIONS:

1. At what point in the ride would a person feel weightless ? _____
   why? _____

2. What kind of energy do the riders have at
   the highest point _____
   the lowest point _____
   between the highest and lowest points _____

EXTRA - If you have the opportunity observe and time the ride fully loaded and lightly loaded .
Record and discuss results

CAROUSEL - Physics Day Activity - Santa Cruz Boardwalk Name _____

Date _____ per _____

Equipment Stopwatch, protractor with weight , calculator - Use while OBSERVING !!

Physics Preparation /HOMEWORK

1. Equation for speed (velocity) =

2. For anything to move it a circle it needs a force in which direction ? _____

3. Circumference of a circle =

OBSERVATION AND MEASUREMENT

1. How many rows of horses are there ?

2. Use paces approx 1meter each to estimate the radius of the ride Outside horse Inside horse
r = _____ _____ m.

3. Measure the time for 1 complete rotation = PERIOD _____ sec.
Does the time vary depending on position ? _____

4. On an OUTSIDE horse
Use lateral accelerometer to measure the angle that the weight swings out: _____ degrees

The tangent of the angle is equal to the "g" force =

To find actual acceleration multiply by 9.8 m/s2 = m/s2

5. On an INSIDE horse
Use lateral accelerometer to measure the angle that the weight swings out: _____ degrees

The tangent of the angle is equal to the "g" force =

To find actual acceleration multiply by 9.8 m/s2 = m/s2

CALCULATIONS AND QUESTIONS

1. Determine your tangential (linear) velocity using radius Outside Inside

(v =circum/period) _____ _____ m/sec

2. Calculate your centripetal acceleration ($a_C = v^2/r$): _____ _____ m/sec^2

3. Which position had the most centripetal acceleration ?

4. Did you get similar answers with the accelerometer and the velocity calculation?

Music

1. This ride has lots of music. Study the Ragtime Automated Music on the West side of the exit
Briefly explain the mechanisms used to play 2 of the instruments

BUMPER CARS - **Physics Day Activity - Santa Cruz Boardwalk** Name _____
Date _____ Per _____

Equipment Stopwatch - Use while OBSERVING !!

Physics Preparation /HOMEWORK
1. Equation for speed (velocity) =
2. Define types of collisions Elastic _____
   Inelastic _____
3. What is momentum ? in words _____
   Equation:

4. Explain CONSERVATION OF MOMENTUM _____
5. Explain the terms and give an example of each
   Conductor of electricity _____ example _____
   Non-conductor of electricity _____ example _____

MEASUREMENTS - while OBSERVING RIDE
1. The distance between the two end pillars is 11 m .
   Time a car going full speed from pillar to pillar: _____ sec.

2. Calculate the speed of the car _____: m/sec.

QUESTIONS:
1. How is the ride powered? _____
2. What materials are used for the ceiling? _____ floor? _____
   why? _____
3. What type of collisions occur on this ride? (Elastic/inelastic) Explain your answer.

4. Draw vector diagrams to show the momentum of 2 cars before and after collision.

1. Head on collision Both cars moving		
2. One car at rest. Moving car strikes it from back		
3. Collision at right angles		

This worksheet developed by the Independence High School and Revised by Aptos HS 2005

ROCK & ROLL - Physics Day Activity - Santa Cruz Boardwalk

Name _____
Date _____ per _____

Equipment Stopwatch, protractor, calculator - Use while OBSERVING !!

Physics Preparation /HOMEWORK

1. Equation for speed (velocity) =

2. For anything to move in a circle it needs a force in which direction ? _____

3. Definition of period _____

   frequency _____

4. Circumference of a circle =

MEASUREMENTS

1. Use paces approx 1meter each to estimate the radius of the arms **r** = _____ m.

2. Measure the time for 5 complete rotations: _____ sec.

   Divide by 5 to get time for 1 rotation = period - **T** _____ sec.

3. Use protractor to measure the angle that the car swings out: _____ degrees
   The tangent of the angle is equal to the "g" force

   what is your estimated "gs"? _____ gs

4. *** Estimate the weight of the car: _____ lb
   Estimate the mass of the car (2.2 lbs converts to 1 kg) _____ kg

CALCULATIONS AND QUESTIONS

1. Determine your tangential (linear) velocity (v =circum/period) _____ m/sec

2. Calculate your centripetal acceleration ($a_c = v^2/r$): _____ m/sec^2

3. Calculate the Force on the metals arms (centripetal force):
   ($F_c = ma_c$) F_c = _____ N

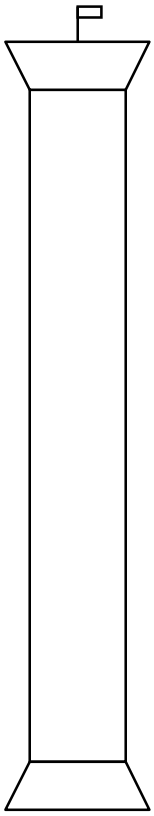
4. Why do the cars swing out ?

DOUBLE SHOT - Physics Day Activity - Santa Cruz Boardwalk

Name _____
Date _____ Per _____

Equipment Stopwatch - Use while OBSERVING !!

(computerized accelerometers would work well for this ride - see alternate guidelines)



Physics Prepation / HOMEWORK

1. What is the maximum acceleration of an object in "Free Fall" on earth ?
2. What is the equation for the distance fallen in "free fall"

   d =

OBSERVATIONS

1. Listen to the ride and look at the column in the center.

   What do you think is providing the power ? _____

2. The ride goes UP _____ times , drops DOWN _____ times
3. Describe the two times which appear to have the highest acceleration

   a) _____

   b) _____

4. The POSTED height of 125feet is to the very TOP including the warning lights.

   At the right sketch the path and estimate the distance of the first 2 stages

   RISE 1 _____ ft DROP1 _____ ft

   Convert to meters using 1 m = 3.3 ft

   RISE 1 _____ ft DROP1 _____ ft

MEASUREMENTS
Use your stopwatches to measure the time of the first rise and first drop.
Do each twice and take averages.
Do not try to use a single stop watch for both times on the same run of the ride

	Trial 1	Trial 2	Average
Rise 1			
Drop 1			

CALCULATIONS

1. Review Drop 1 and estimate how much of the time is spent braking
   Use your timing data and subtract braking time to estimate free fall time

2. Calculate the distance fallen in Drop 1 if it was in free fall

3. How does this compare with your estimated distances ?

RIDE IT

1. Where did you feel the 2 strongest forces ?

   a) _____ b) _____

Explain why you think this was
a)
b)

Teacher Guidelines for DOUBLESHOT- Physics Day Santa Cruz Boardwalk

This ride is ideal for data collection with accelerometer probes - Vernier, Pasco or others.
Exact details depend on equipment but would include the following steps

1. Obtain a data vest (as sold by Vernier) or other means to hold equipment safety during the ride – MUST be pre-approved by park safety officers.

2. At the park
   a) Preprogram device to collect data for about 20 secs
   b) Load device into vest – align with ride !
   c) Press start after getting onto ride but before it moves
   d) Ride
   e) Return to teacher and download your files onto a laptop computer
   f) View acceleration graph and repeat if graph does not look OK
3. Back at school
   a) View acceleration graph (if necessary re-zero!)
   b) Record times of highest accelerations
   c) Integrate acceleration to get velocity
   d) Find highest velocities and compare the acceleration
   e) Integrate velocity to get distance
   f) View all 3 graphs together

At this point you will be able to see clearly where the greatest positive and negative accelerations happened and which parts of the ride they corresponded to.

Note
Using the older spring type accelerometers might not be approved of by the Boardwalk Safety Officers and it would probably be very difficult to get useful data