Physics Fun:

The Study of Mechanics, Energy, Force & Motion

Fun on the Bus

The science of force and motion is all around us. Begin your discoveries as you travel on the bus to Lake Compounce.

1. Make some predictions. If a ball were attached to a string suspended from the ceiling of the bus, **predict** its motion:

    a. when the bus starts up and is accelerating forward

    b. while the bus is moving at a constant speed

    c. when the bus is coming to a stop at a traffic light or stop sign

    d. when the bus is making a left hand turn

    e. when the bus is making a right hand turn

2. Using either yourself as the experiment or a suspended ball, record the **actual** motion that you observe in each of the cases above:

    a.

    b.

    c.

    d.

    e.

3. Explain the motion that your observations reveal. Consider the following

as you answer.

a. At **start up**

1) Does it seem like you are thrown forward or backward?

2) Why would a person watching from the outside not see you move backward if you felt that movement?

3) When sitting in the bus, do you think of the seats as moving?

b. At a **constant speed**

1) Do you feel as if you are moving when traveling on a smooth road?

2) Are there forces acting on you when you are moving in a straight line? Are any of the forces unbalanced?

3) Describe the following:

   a) your motion relative to the person sitting next to you

   b) your motion relative to a person on the side of the road

   c) the motion of a person on the side of the road relative to you

4) Draw the forces acting on you as you sit on the bus while it is moving at a constant speed.

c. **Coming to a stop:** Does it seem like you remain still, or are you thrown forward or back? Why?

d. **Turns and curves:** As the bus is starting to turn or travel around a curve, focus on an object (such as a tree or building) which is in your straight line of vision.

1) Are you aware of the force that causes you and the bus to travel around the curve or turn?

2) How do you think the force is supplied?

3) Does this change when the curve is not as wide or if the bus is traveling at a higher speed?

4. With the help of a person in the front of the bus, time how long it takes to go from 0 to 25 mph (miles per hour). time __________ sec

   a. Convert 25 mph to meters per second (1 mph = .447 m / s).

   b. Calculate the acceleration of the bus in m/s^2

   c. Calculate the distance traveled as the bus reaches 25 mph.

5. Determine the mass of the bus. (2.2 lbs = 1 kg)

   a. Data:

      surface area of one tire in contact with the road ______ sq. inches

      number of people on the bus ______

      average weight of one person ______ pounds

      tire pressure as read from sidewall of tire ______ PSI

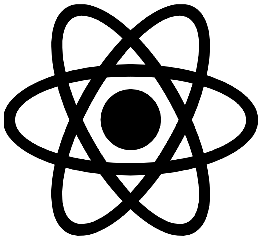
   b. Calculate the weight of the bus with passengers if pressure = force/area.

   c. Actual weight of bus as found from bus driver.

   d. From the known mass of the bus and passengers, calculate the force needed to accelerate the bus to 25 mph.

6. Draw a vector diagram of the bus ride from school to Lake Compounce. Determine the approximate resultant displacement, in both magnitude and direction. Be sure to include the scale used to create the diagram.

The Science of Force & Motion Vocabulary



acceleration
centrifugal force
centripetal force
circumference
diameter
force
frame of reference
friction
G force
gravity
horsepower
inertia
joule
kilogram
kinetic energy
mass
meter
momentum
newton
parabola
potential energy
pound
power
projectile
protractor
radius
watt
weight
weightlessness
work

Vocabulary

acceleration	The rate at which velocity changes. This occurs if there is change in speed or direction.
centrifugal force	A reaction force to centripetal force, which you feel in a moving frame. This is a fictitious force. When your body responds to an acceleration you think there is a force pushing you back.
centripetal force	A force acting toward the center which makes objects turn.
circumference	The distant around a circular object.
diameter	The distance across a circle through the center.
force	A push or pull.
frame or reference	Where you are when you make an observation. (eg. Earth frame or moving frame)
friction	A force which opposes motion between objects in contact.
g force	A multiplication factor which compares a force to a person's weight. (eg. 2 g's is twice your weight)
gravity	A force of attraction between objects.
horsepower	A unit established for comparison to the power of a horse. (1 hp = 746 watts)
inertia	A property of matter which resists a change in its current state of motion.
joule	A unit of work and / or energy in the metric system
kilogram	A unit of mass in the metric system. (1000 grams)
kinetic energy	The energy of motion. The energy an object has due to its velocity. $KE = 1/2mv^2$
mass	The amount of matter an object contains. Mass is unaffected by a change in gravity.
meter	The basic unit of length in the metric system.
momentum	A measure of how lard it is to stop a moving object. (mass x velocity)
newton	A unit of force in the metric system.
parabola	A curved path of an object moving at right angles to a gravitational field.
potential energy	Stored energy. The energy an object has due to its position. Gravitational potential energy = weight x height
pound	A unit of force in the English system. (1pound = 4.45 newtons)
power	The rate of doing work. (P = work / time)
projectile	An object which has been given kinetic energy and is moving with no self propulsion.
protractor	A measuring device which indicates angles in degrees.
radius	The distance from the center of a circle out to the edge.
watt	The unit of power in the metric system. 1 watt = 1 joule / sec.
weight	The force with which an object is pulled toward the Earth; measurement of force of gravity
weightlessness	A condition in which you feel no forces acting on you.
work	When a force acts on an object causing it to move through a distance. The amount of energy gained by an object that's moved is equal to the work needed to move it (no friction). Work = Force x distance

Systems of Measurement

System	*length*	*mass*	*time*	*area*	*volume*	*force*	*velocity*	*acceleration*	*work*	*energy*	*power*
Metric (MKS)	meter (m)	kg	sec (s)	m^2	m^3	newton (N)	m / s	m / s / s	joule (J)	joule (J)	watt (W)
Metric (CGS)	cm	gram (g)	sec (s)	cm^2	cm^3	dyne (dyn)	cm / s	cm / s / s	erg	erg	dyne-cm/ sec
English (FPS)	ft	slug (sl)	sec (s)	ft^2	ft^3	pound (lb)	ft / s	ft / s / s	ft-lb	ft-lb	ft-lb / sec

1 newton = 1 kg • m/ s^2
1 joule = newton • meter
1 watt = Newton • meter / s

Conversions

Energy: 1 erg = 10^{-7} joules
1 BTU = 1055 joules
1 Kilowatt • Hour = 3.6×10^{6} joules
1 calorie = 4.186 joules

Force: 1 dyne = 10^{-5} newtons
1 dyne = 2.247×10^{-6} lb
1 pound = 4.44 newtons

Volume: 1 liter = 10^{-3} m^{3}

Speed: 1 mph = .447 m / s

Mass: 1 atomic mass unit = 1.7×10^{-27} kg
1 kg = .0685 slug
1 slug = 14.59 kg

Power: 1 hp = 746 W
1 hp = 550 ft-lbs / sec

Angle: 1 degree = 1.745×10^{-2} rad

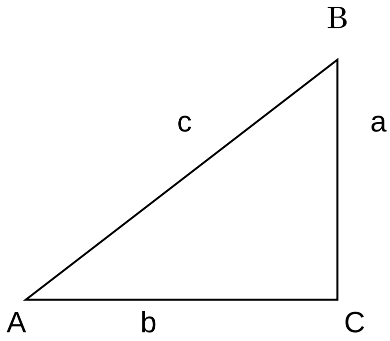
Length: 1 fermi = 10^{-15} meters
1 Angstrom = 10^{-10} m
1 inch = .0254 meters
1 foot = .3048
1 mile = 1609.3 meters

More Useful Science Stuff

Unit Prefixes for Powers of 10			
	Prefix	Symbol	Multiple
Greek	tera	T	12
	giga	G	9
	mega	M	6
	kilo	k	3
Latin	deci	d	-1
	centi	c	-2
	milli	m	-3
	micro	:	-6
	nano	n	-9
	pico	p	-12

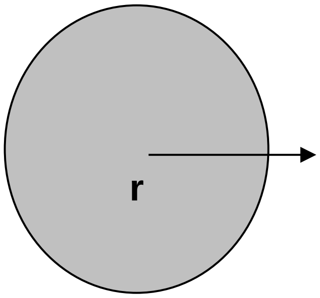
Math Help:

Right Triangle:



$c^2 = a^2 + b^2$
sin A = a/c
cos A = b/c
tan A = a/b

Circle:

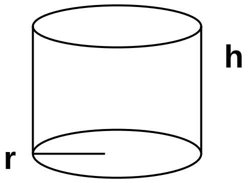


Area of a Circle = πr^2
Circumference of a circle = $2 \pi r = \pi d$
Where r is the radius of the circle,

d is the diameter of the circle, and
π is approximately 3.14

Cylinders: Volume of a Cylinder = $\pi r^2 h$

Sphere: Volume of a sphere = ${}^4/_3 \pi r^3$



Science Word Search.

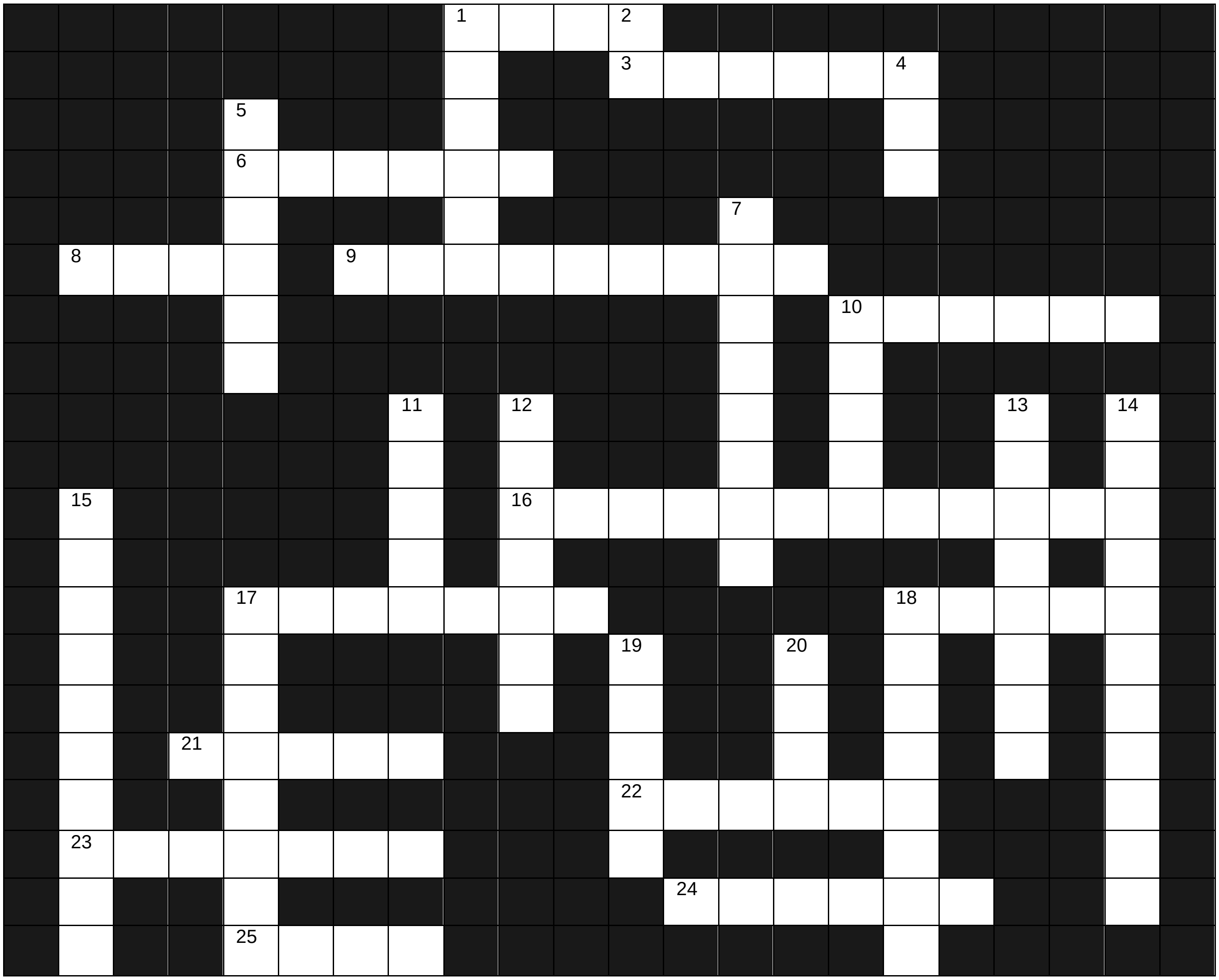
T	R	E	P	R	O	J	E	C	T	I	L	E	D	I	N	M	O	S	A	U	R	S	R	O	A	M	D	P	A
L	A	K	E	C	O	M	P	E	O	U	N	C	E	I	S	E	A	B	E	A	U	T	I	D	S	W	O	X	C
H	U	H	M	O	R	S	V	N	S	T	U	I	E	S	A	T	X	M	R	I	O	P	S	E	T	W	O	P	C
J	O	K	E	S	H	A	V	T	E	T	H	B	E	S	F	E	S	S	A	M	P	A	C	T	E	U	V	C	E
P	S	T	E	E	O	L	Y	R	D	A	N	A	N	D	T	R	I	N	A	T	O	R	C	R	T	R	N	E	L
R	C	H	R	I	R	S	T	I	N	E	R	T	I	A	B	E	L	L	S	A	N	F	W	H	I	S	T	L	E
O	S	C	A	R	S	A	N	F	E	M	M	Y	D	N	U	O	P	A	R	A	B	O	L	A	T	C	O	M	R
T	O	M	O	M	E	N	T	U	M	I	T	K	E	E	P	S	O	Y	O	U	G	R	O	I	N	E	G	S	A
R	E	G	I	S	P	T	E	G	R	O	F	Y	O	U	E	R	U	D	N	O	S	C	R	A	A	N	R	A	T
A	N	O	T	G	O	L	A	A	U	N	I	T	E	S	A	W	N	J	E	W	L	E	E	D	O	T	F	R	I
C	O	W	A	N	W	I	L	L	I	A	M	C	A	R	R	I	D	C	A	R	O	T	Z	I	P	R	W	M	O
T	G	H	O	S	E	T	S	F	T	O	E	K	I	N	E	T	I	C	E	N	E	R	G	Y	I	I	P	M	N
O	T	T	E	Z	R	I	W	O	R	K	D	U	I	R	F	I	L	M	N	O	I	R	E	D	V	P	A	G	A
R	O	U	N	D	Q	U	E	R	X	L	O	H	P	O	C	E	W	O	N	D	E	R	F	P	G	E	V	I	J
P	A	R	N	I	G	R	A	C	F	O	O	D	A	N	D	U	B	E	V	E	R	A	G	O	E	T	O	O	D
X	U	I	O	C	O	R	N	E	F	I	E	L	D	A	J	B	M	U	D	R	I	L	E	T	X	A	U	S	T
H	J	K	T	D	U	L	P	C	I	T	U	S	S	M	E	D	E	F	R	F	R	O	G	E	Q	L	U	E	U
A	N	N	W	I	C	E	R	S	A	T	I	S	G	O	L	S	A	D	E	N	T	I	M	N	E	F	S	A	R
F	R	O	E	Z	D	I	A	M	E	T	E	R	H	O	S	P	E	T	A	R	T	A	L	T	I	O	T	Y	E
R	Z	E	N	M	A	T	U	S	E	N	O	P	D	I	A	G	N	O	G	F	E	W	I	I	T	R	Y	X	C
I	A	P	E	R	N	K	I	V	S	M	O	U	N	T	A	I	N	S	K	L	M	N	E	A	C	C	O	W	R
C	E	N	J	O	P	O	D	S	I	N	L	E	F	E	L	B	X	R	E	F	D	O	C	L	I	E	P	E	O
T	O	R	N	A	D	U	E	I	U	E	D	N	X	C	I	W	A	T	T	Y	H	N	K	E	L	T	Y	O	F
I	N	T	E	R	N	L	Y	H	N	V	B	E	D	A	N	L	P	E	R	T	O	P	C	N	X	Z	R	I	G
O	L	I	V	E	T	E	J	T	A	Y	R	A	D	I	U	S	L	O	R	I	C	Z	S	E	L	H	G	U	Q
N	E	V	E	H	K	E	V	I	N	A	S	B	C	Y	T	R	P	L	M	V	E	C	O	R	Z	O	R	O	Y
K	A	E	G	T	G	B	C	I	T	M	A	R	G	O	L	I	K	R	V	A	H	A	L	G	L	O	W	E	M
A	D	I	M	A	R	K	R	O	J	U	O	C	X	Y	K	L	E	A	Y	R	U	D	W	Y	M	U	C	Z	Y
D	E	N	U	O	R	X	Z	O	O	M	E	T	B	V	C	X	E	U	O	G	D	E	S	E	V	T	A	R	B
W	F	R	A	M	E	O	F	R	E	F	E	R	E	N	C	E	M	T	S	D	O	P	K	I	N	E	C	S	R

There are 29 words here. Can you find them?

acceleration
centrifugal force
centripetal force
circumference
diameter
force
frame of reference
friction
G force
gravity
horsepower
inertia
joule
kilogram
kinetic energy
mass
meter
momentum
newton
parabola
potential energy
pound
power
projectile
protractor
radius
watt
weightlessness
work

May the Lake Compounce Force Be With You!!

Take the Crossword Challenge:



Putting the Force in Motion:

Across

1. A force acting on an abject through a distance
3. A multiplication factor which compares a force to a person's weight
6. The ability to do work
8. Unit of length in the English system
9. Energy due to position; stored energy
10. An interval of time for completion of a single cycle
16. The rate at which velocity changes
17. Energy of motion
18. Standard SI unit of length
21. A push or pull
22. SI unit of force
23. Property of matter which opposes any change in its state of motion
24. Distance from the center of a circle out to its circumference
25. The amount of matter in a body

Down

1. The force of attraction of the earth on an object
2. Abbreviation for kilogram
4. Metric unit of work or energy
5. Sir Isaac who proposed three laws of motion in 1678
7. Curved path where any point on the curve is equidistant from a fixed point and from a fixed straight line
10. The rate of doing work
11. SI unit of work or energy
12. A force of attraction between objects
13. Force opposing motion between objects in contact
14. Force that causes an object to move in a circle
15. An object which is thrown or shot
17. SI unit of mass
18. Mass of an object multiplied by its velocity; measure of how hard it is to stop a moving object.
19. Unit of force in the English system
20. SI unit of power

REV THOSE CRANIAL ENGINES!

Amusement Parks conjure up visions of chills and thrills and moments of magic and excitement – breathtaking speed, hanging upside down, plunging to earth, or facing the heavens. **Who masterminds such marvels?** Would the answer surprise you? Architect, engineers, designers, planners, surveyors, geologists, carpenters, electricians, plumbers, sound technicians, mechanics, construction crews, landscapers, artists, marketers, accountants, personnel directors, and yes, even educators --- all of the inventive, creative, problem solving men and women who rely on science and math (the queen of all sciences) for their inspiration and know-how are the brains and brawn behind creating and operating a wonderful park. Now, will you ever again ask your teacher "what is math good for anyway?" Not if amusement park fun is your cup of tea! Consider using math and science to help strengthen your mental muscle.

Want something different to help you get started? Put on your thinking cap, rev those cranial engines, and warm up YOUR problem solving skills with these mental barbells.

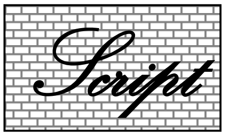
Warning! Decode at your own risk. May promote serious synaptic activity, including but not limited to inventive outbursts, spontaneous creative combustion, and feigned mental anguish characterized by murmurs of "oh brother, geez, yeah sure, I'm working on it, leave me alone, oh no, haha, aha, and I knew that."

Hi GOOD ***!***

You've had your Twink
Twink
Twink
Twink ***, now it's time to*** **T
E
G O** ***.***

No more ZZZ
JOB ***. This*** **THING** US
US ***. Math and science***

are involved in every aspect of life as we know it.



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Studying and exploring math and science could be somet
bi ***.***

Build your brain power little by little, and soon you'll see the

TUNNEL › ***. Reach for the*** **STπKY** ***, and surely you'll***

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U
CROWD

HEAD SHOULDERS
ARMS BODY LEGS
ANKLES FEET TOES

BE BUSH AT

and be . Now let's not . If you want to experience math and science in action, make BBBBBBBB ***for Lake Compounce. It's***  ***. The Zoomerang will put you*** track ***to discovering why the shape of the curve for a looping coaster is not a circle. Take a crash course in how not to drive on the*** **Kidde Bumper Cars**, ***where Newton's Law of Motion will seem like*** spuds ***by the time you're done. Put*** TOTOO ***and decipher the*** **Pirate***'s pendulum action.*

Millions of years of geologic processes will flash before your eyes as you ride the upthrown face of a normal fault and literally be TOUCH EARTH ***.*** KJUSTK ***water is your passion, check out force and motion on the*** **Saw Mill Plunge** ***or on the*** **Thunder Rapids Raft** *ride.* ***But*** K S T C I ***, there's more. The absolute*** I SING ANGEL FOOD ***will be*** **Boulder Dash**, ***the longest wooden roller coaster in the East and, from*** COAST COAST COAST ***, the only one ever built into the side of a mountain.*** KNOWITNO ***, this unique terrain coaster will garner a huge*** clapclap ***as it races between boulders and swishes through trees in its boundary***

line hopping journey from Bristol to Southington and back again.

L~~E~~AST *, we can even offer you*

L U N
N C
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to keep you in gear for all of this excitement. Shhh! **YOU JUST ME** *, there's an awful lot of fun to be had exploring math and science!*

HALLELUJ AH favor favor favor favor

! Benefits? on *! We'll try to* H A P P I N E S S *as we "round" out your hands-on educational experience, bring you*

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in your studies, help bridge the

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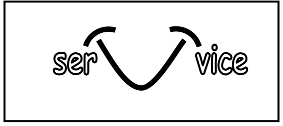
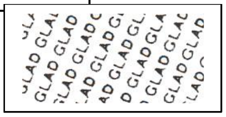
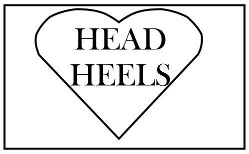
as students and teachers begin **C i ii** *and reach a* **MINDMI ND** *, provide*



and generally encourage you to feel



. **EFFEC TS** *? You'll be*



with The Lake and with learning. Are you still with me bright eyes? If you're

__READING_

about now, you're QUITE *.*

OLD X SAKE
OLD X SAKE
OLD X SAKE
OLD X SAKE

and for new times sake, we love our park and think you'll give it

BMUHT BMUHT

too. It's an

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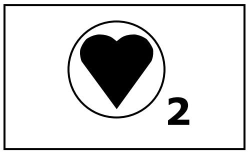
ONCE **ALL ALL ALL ALL**

stands for excellent. , get that science and math

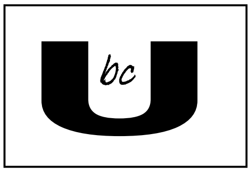
thing going. There's NOXQQIVIT ***. Put your*** **DO12″OR** ***.***

T
LIVE

. Face the music. Take your medicine. And wipe that grin into your face!! Okay, Okay, now that our

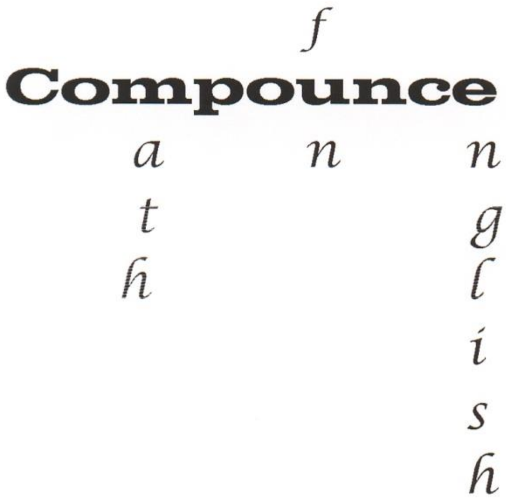


fest is over and you're pleading cranial overload, I'll sign off with a WISH ☆ ***to***



in all the old and young familiar places at Lake Compounce. Farewell…au revoir…auf wiedersehen…adios…arrivederci…zaijian… Roger ☐ ***!***

Agent M alias 00 3.14



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Compounce Island Survivor

Welcome to Compounce Island. You are about to embark on an unforgettable journey, where the thrills and chills are not for the faint of heart, where brains count as much as brawn, and where the fun may raise your laugh quotient to astronomical proportions. Your mission will be to survive the series of challenges that await your thoughts and actions. Will intelligence, cunning, boldness, observation, clear thinking, research or just sheer endurance be the survivor's claim to fame? Only time will tell. Only you and you alone hold the answer! Good Luck!

The Tribal Council

Note: Challenge components vary in degree of difficulty. Your master leader is to determine whether you will attempt to meet any or all of the challenges as a team or individually, whether time restraints will be required, or whether other limitations will be imposed. Please proceed according to her/his directions. This most excellent teacher is authorized by the Tribal Council to make all decisions concerning the challenges and to determine who is the ultimate survivor.

Challenge 1: Fractured Powerlines

Id the types of energy using the clues. Beware of high voltage!
(Hint: Fractions are reduced to lowest terms)
Example: 1/2 of a soft drink (soda) + 3/5 of spacious (large) Answer: solar

A. 5/7 of the central part of an atom + 2/7 of ancient ____________________________

B. 1 relative + 1/3 of manners + 1/3 of a vehicle ________________________________

C. 3/4 of a negatively charges atomic particle + 2/3 of frozen water + 1/4 of the height of a thing _________________________

D. 3/5 of molten rock + 1/4 of the opposite of positive + 1 spasmodic muscle contraction ______________________

E. 3/5 of gladness + 3/7 of a minute organism + 1/5 of loyalty ____________________

F. 1/3 of to think deeply + 3/7 of stress on a material + 3/5 of a woman’s headdress + 1/2 of an interjection (!) for see _______________

G. 3/7 of a proposition that can be proved + 1/4 of scarce + 3/ 7 of a common wild duck ____________________________

H. 1/3 of a measurement of light intensity + 1/3 of a large ox from Tibet + 2/7 of a brother or sister + 3/7 of the unit of energy produced by a food substance ______________

I. 2/7 of to wander + 4/7 of a waterway + 2/5 of frosting + 2/9 of a large lizard ________

How many of these types of energy do you think are found at The Park? Where?

Challenge 2: Scienceologies

How do your island relationships stack up?
(Hint: Relationships take many forms. Don’t make snap judgments.)

e.g. Fire is to hot as ice is to cold.
Ice is to cold as fire is to hot.
Hot is to cold as fire is to ice.
Fire is to ice as hot is to cold.
Hot is to fire as cold is to ice.
Cold is to ice as hot is to fire.
Cold is to hot as ice is to fire.
Ice is to fire as cold is to hot.

Bonus: Try the first analogy above with numbers that make the statement true.
Let fire be 2, hot be 4, ice be 3 and cold be 6. Does 2/4 = 3/6?
Try each of the other analogies using the same substitutions. Discovery?

A. Long strings are to short strings as lower frequency of vibration is to __________________ frequency of vibration.

B. One meter is to 2.5 meters as 39.37 inches is to _______________________ inches.

C. Similarly charged is to oppositely charged as repel is to __________________________.

D. Negatively charged particles are to positively charged particles are electrons are to ____________________________.

E. Potential is to rest as kinetic is to _________________________.

F. Positive is to negative as anode is to ______________________.

G. Pulley and wheel & axle are to lever as wedge and screw are to ___________________.

H. Change of liquid to gas is to change of gas to liquid as evaporation is to ________________.

I. Absorbing energy is to liberating energy as endothermic is to _____________________.

J. Divergent parallel light rays are to convergent parallel light rays as concave is to _________________________.

K. Light excluded shadow part is to partially illuminated shadow part as umbra is to ___________________.

Challenge 3: **Crocodile Gulch**

Knowledge can be golden. Do YOU know what you don’t see and hear on the island? Scientific laws describe natural events that are and integral part of our lives, and of course, The Park is no exception.

Cycle de Crocodile claims he has thermodynamics locked up and Sir Garfield of the Cat Persuasion promulgates his own version of electrostatics. (Ouch! His pizza gnaw is worse than his bellow.) And, Knight Odie of the Water Bowl says he’s on the verge of being permanently changed and has reached his elastic limit. Now, whatcha gonna do when they come for you!!!

Triple challenge: Can you identify which person lent his name to the following laws, when he lived, and his country of origin?

Bonus: To whom are the three island musketeers beholden for their favorite laws?

First List	*Second List*	*Third List*
I. Robert Boyle	__________	___________
II. Jacques Charles	__________	___________
III. Rudolf Clausius	__________	___________
IV. Charles Augustin de Coulomb	__________	___________
V. Robert Hooke	__________	__________
VI. James Prescott Joule	__________	___________
VII. Gustav Robert Kirchhoff	__________	___________
VIII. Heinrich Lenz	__________	___________
IX. Sir Isaac Newton	__________	__________
X. Georg Simon Ohm	__________	__________

Second List

A. The volume of a dry gas is directly proportional to its Kelvin temperature, providing the pressure is constant.

B. The algebraic sum of the currents at a circuit junction is equal to zero.

C. Unless a net force acts on an object, the motion of an object (or lack of it) does not change.

D. The volume of a dry gas varies inversely with the pressure exerted upon it, provided the temperature is constant.

E. Below the elastic limit, strain is directly proportional to stress.

F. It is not possible to construct an engine whose sole effect is the extraction of heat from a heat source at a single temperature and the conversion of this heat completely into mechanical work.

Third List

G. An induced current is in such direction that its magnetic property opposes the change by which the current is induced.

H. The ratio of the emf applied to a closed circuit to the current in the circuit is a constant. (emf: the energy per unit charge supplied by a source of electric current.)

I. The heat developed in a conductor is directly proportional to the resistance of the conductor, the square of the current, and the time that current is maintained.

J. The force between two point charges is directly proportional to the product of their magnitudes and inversely proportional to the square of the distance between them.

1. English mathematician and scientist (1642-1727)
2. German physicist (1818-1889)
3. English physicist (1818-1889)
4. French scientist (1746-1823)
5. English philosopher and scientist (1635-1703)
6. German physicist (1789-1854)
7. German physicist (1824-1887)
8. English scientist (1627-1691)
9. German physicist (1804-1865)
10. French physicist (1736-1806)

Challenge 4: **Let's Get Technical**

Find me if you can. Match each attraction with its description.

A. Maximum ride speed nineteen and two tenths kilometers per hour; four cylinder engine; 1863 replica; twenty-four inch gauge track; air brakes on all wheels.

B. Twenty-seven meters high; kaleidoscopic light show if looking at the right time.

C. Ride speed eleven and nine tenths meters per second; sixty-five degree maximum swing angle from center.

D. Two hundred eighty-six meters of track; reaches seventy-five kilometers per hour before the action really begins; one cable hydraulic lift, one chair hydraulic lift.

E. Parallel channels branch at station entrance and merge again at exit; conveyor belts driven by an electric motor through air activated clutch/brake assembly and gearbox.

F. Main functions controlled by hydraulic valves for brake, climb, basket, and tower rotation; normal rotation speed between nine and eleven revolutions per minute.

H. Forty-five hundred feet filled with laterals, speed, air time (ejector, floater, bunny hops, and sideways jogs), one hundred eighty degree turnaround.

I. Approximately one thousand thirty-eight feet long, including lift conveyor.

J. Tunneled waterslide combined with a 10 ft. wide flume designed for 6.5 ft. inflatable.

K. After rotation reaches 10 rpm, entire ride lifts 7.5 ft and tilts at 20 degrees; inverter drive smoothes ride stop; air brakes smooth each car stop.

Pirate Ship ________
Zoomerang ________
Boulder Dash ________
Ferris Wheel ________
Mammoth Falls ________
Compounce Railway ________

Twister ________
Wave Swinger _______
Saw Mill Plunge ________
Thunder Rapids Raft ________

Challenge 5: **Tame the Wild Things**

Be forewarned. This is not a walk in The Park! It requires physical stamina, cunning, and a spirit of adventure. (Hint: Enjoy!)

Completed (X)

A. Navigate the Saw Mill Plunge *without* getting soaked. _______

B. Spin on the Revolution *without* tossing your cookies or developing a green facial hue. _______

C. Bravely race through and between the dense vegetation and rugged rock facings on Boulder Dash *without* screaming or laughing raucously. _______

D. Travel up, up, up, and yet farther up the famous hillside (where the spirits of compowne, atumtuckoo, or patuchoos squaw may call your name) *without* trembling, closing your eyes, or begging to come down. _______

Note: If you *really (really), truly, actually* were able to tame the wild things as suggested, you didn't follow the hint. Go back and do it the right way!!!

Motion

There are two basic types of motion. Motion that is **uniform** and **accelerated** motion.

For an object moving with **uniform motion**, the velocity remains in the same direction and has constant magnitude (size). For uniform motion, forces are balanced. There are no net or resulting forces. Under these conditions calculating the velocity is straightforward.

$$\text{velocity} = \frac{\text{distance traveled}}{\text{time of travel}} = \frac{s}{t}$$

This velocity is an average for the trip.

As soon as forces that do not cancel each other out act on an object, uniform motion no longer takes place. Whenever an unbalanced force acts on an object an **acceleration** is produced. Newton's second law of motion expresses the relationship among force, mass, and acceleration as $F = ma$.

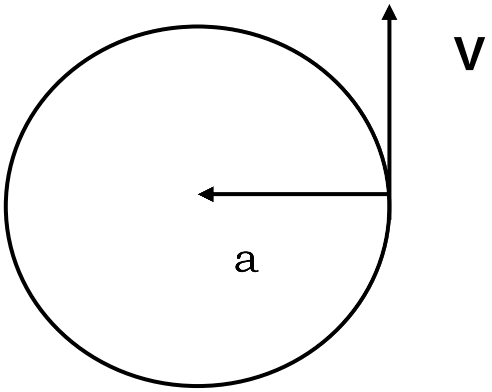
$$\text{Force} = \text{mass x acceleration} \qquad \text{or} \qquad \text{acceleration} = \frac{\text{Force}}{\text{mass}}$$

The acceleration of an object increases as the amount of force causing the acceleration increases. The larger the mass of the object, the larger the force needed to produce acceleration.

Acceleration is the change in velocity over a period of time. (How fast something is going faster.) This change can be in the speed (whether increasing or decreasing), in the direction of the motion, or in both.

Acceleration = velocity / time $a = v / t$

Acceleration occurs anytime there is a change in velocity. For objects moving in a curved path, velocity is changing even though speed may be constant. Velocity is a vector and therefore must have speed and direction. When traveling in a circle. if your direction is changing, then there is acceleration toward the center of the circle. This acceleration is called **centripetal acceleration.**



centripetal acceleration = (velocity)^2 / divided by the radius

$a_c = v^2 / r$

a_c = centripetal acceleration
v = velocity
r = radius of the circle

In the case of an object spinning in a circle, the size of the velocity (speed) is calculated by measuring the time for one complete spin and dividing this into circumference of the circle.

$$v = \text{Circumference} / \text{time}$$

If there is an acceleration, there must be an unbalanced force producing it. The force causing the circular motion is called **centripetal force** (F_c). This force causes the object to change direction, thereby creating the acceleration in the same direction (toward the center).

As stated previously;

$$F = ma$$

Newton's Second Law of Motion must also apply to circular motion.

Therefore: $F_c = ma_c$

$$a_c = \frac{V^2}{r}$$

Note the calculation for a_c

If we substitute (v^2 / r) in for (a_c), we find the equation needed to calculate centripetal force.

$$F_c = mv^2 / r$$

This force is easy to see and understand if you swing a rubber stopper on the end of a string. You can see your hand is producing the force which is transferred through the string to make the stopper follow the circular path. So your hand produces the force, which causes the centripetal acceleration.

Likewise, if you were in an automobile at rest and the driver pushes the accelerator to the floor, you feel like you are being pushed back in the seat. In reality, the seat is accelerating you forward. This "force" you feel back against the seat does not really exist. It's your inertia trying to keep you at rest. The only force is the seat accelerating you. So the force you feel out against you, called **centrifugal force**, is a fictitious force. You are reacting to the seat pushing on you!

Generally speaking, you might think of centripetal force as an action force and centrifugal force as a reaction force. Remember, centrifugal force is considered to be fictitious. It can only be observed in the accelerated frame of reference.

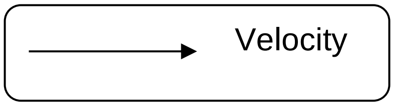
These forces are also found on many other rides at Lake Compounce! Any ride which moves in a circular or curved path will produce centripetal and centrifugal forces.

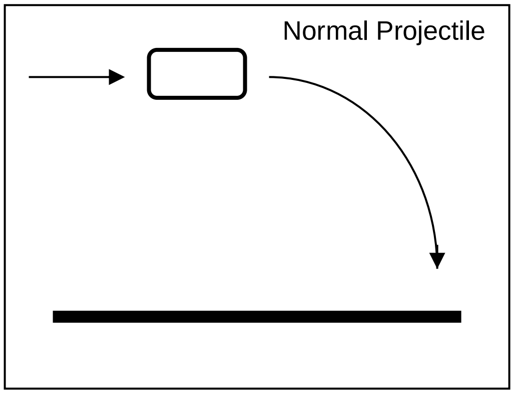
Gravity and G - Forces

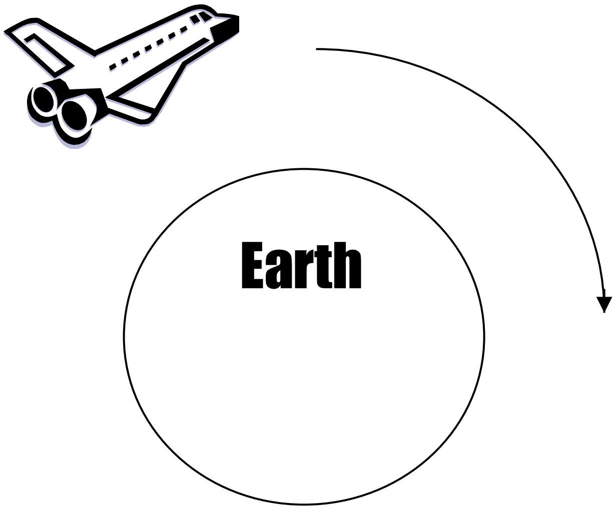
Gravity refers to the force of attraction between objects. All objects exert a gravitational force. Any two objects with mass attract each other, and the strength of this force depends on the mass of the objects and the distance between them. The larger or more massive the object, the greater the force.

Some forces can act from a distance without actual contact between the two objects. We are accustomed to the gravity of Earth. When you are standing still the force exerted on you by the Earth produces your weight. This is also referred to as one “g”. Gravity causes free-falling objects on the Earth to change their speeds at the rate of 9.8 m/s each second. That is a change in speed of 32 ft/s in each consecutive second. Therefore, a “g” is a unit of acceleration equal to the acceleration caused by gravity. When you feel heavier than normal you are experiencing a force greater then 1 g. When you feel lighter than normal you are experiences a force less than 1 g. You are weightless when you feel no forces (free fall).

On the roller coaster, when you go down a steep hill, you will get that “light stomach feeling” and will notice yourself lifting off the seat. You have just experienced weightlessness. Imagine the shuttle astronauts having this same feeling continually for several days. This may give you an idea of why many astronauts have what is known as **space** or **motion sickness**. While the shuttle is in orbit, it is falling. With its tremendous horizontal velocity, as it falls the Earth curves away from it. So it never hits the Earth, it falls in an orbit.







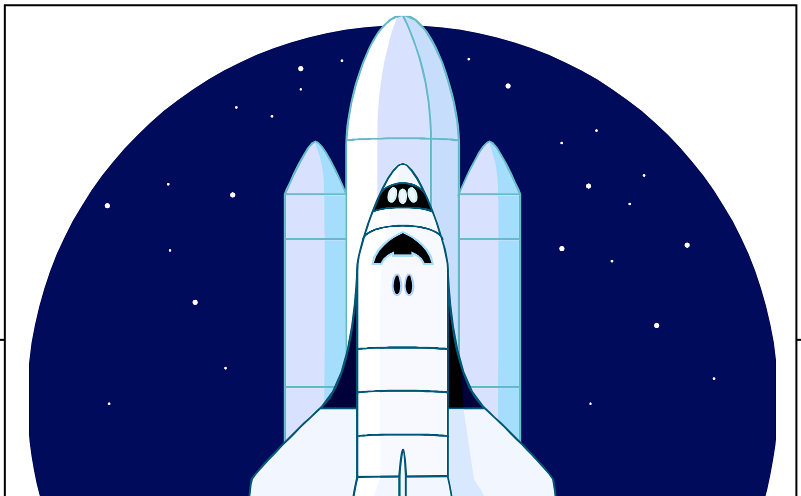
G – Force Information:

<u>Definition</u>: The ratio produced when the force felt by an object is divided by the force that the object would feel while motionless on the Earth's surface.

$$\boxed{g - \text{force} = \frac{\text{Force}}{\text{weight}}}$$

Examples of g- forces:

Shuttle in Orbit	0	g's
The Moon	.165	g's
Mars	.38	g's
Shuttle Lift Off	3.0	g's
Sun	28	g's



Energy Transformations

There are many energy transformations that occur at Lake Compounce.
The main energies used to make calculations involve gravitational potential energy and kinetic energy. **Potential energy** is energy that is stored. **Kinetic energy** is energy of motion.

When an object is lifted from the ground or rest position it acquires potential energy. The amount of energy can be expressed as:

$E_p = mgh$

where: m = mass (kg)
g = acceleration due to gravity (m/s^2)
h = height above starting position (m)

Energy is measured in units called JOULES.

When the object drops, the potential energy that it has is changed to kinetic energy as the object falls. At the bottom of its fall, the object is moving at its fastest velocity which indicates it has its maximum kinetic energy. This kinetic energy can be expressed as:

$E_k = \frac{1}{2} mv^2$

where: m = mass (kg)
v = velocity (m/s)

Conversion of energy requires that the total potential at the top must be equal to the total kinetic at the bottom. If you calculate the potential energy at the top and set it equal to (1/2 mv^2), the maximum velocity at the bottom can be calculated.

$$mgh = \frac{1}{2}mv^2$$

v = velocity (m/s)

$$\frac{2\,mgh}{m} = v^2$$

g = acceleration due to gravity (9.8 m/s/s)

$$\sqrt{2gh} = v$$

h = height (m)

Work & Power

Work is produced by a force acting on an object moving through a distance.

Work = Force x distance

$W = Fd$ where:

W = work (joules)
F = Force (newtons)
d = distance (meters)

Notice the unit for work (joules) is the same as the units of energy. Energy is the ability to do work. If work is done to lift an object, that work reappears as potential energy.

Power is the rate of doing work, or how fast work is done.

$$Power = \frac{work}{time} = \frac{W}{t} = \frac{Fd}{t}$$

Where;

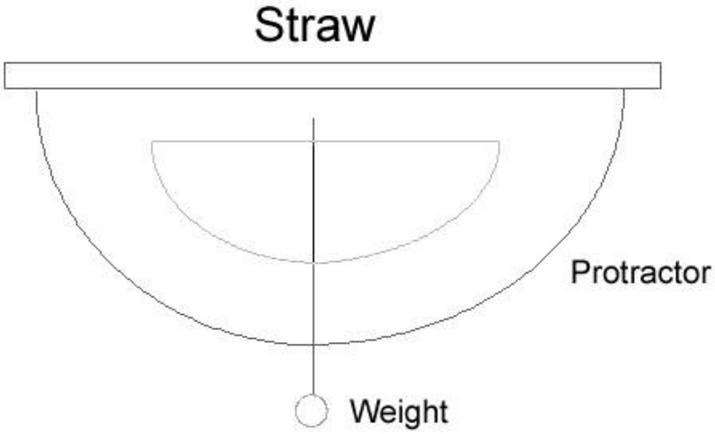
P = power (watts)
W = work (joules)
t = time (seconds)

Power in watts can be converted to horsepower using the following conversion:

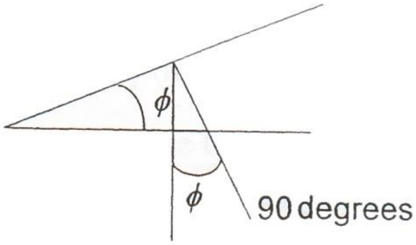
1 hp = 746 watts

An Angle on Distance

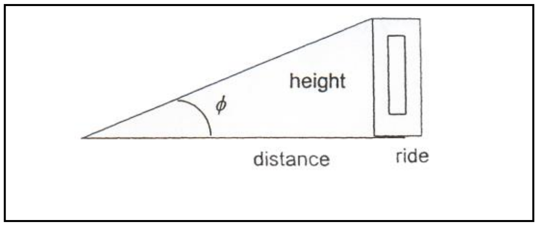
To determine the height of a ride use a simple “protractor” elevation finder.



Have one student sight through the straw at the top of the ride. Another student reads the angle on the protractor. **The angle read is then subtracted from 90 degrees.**



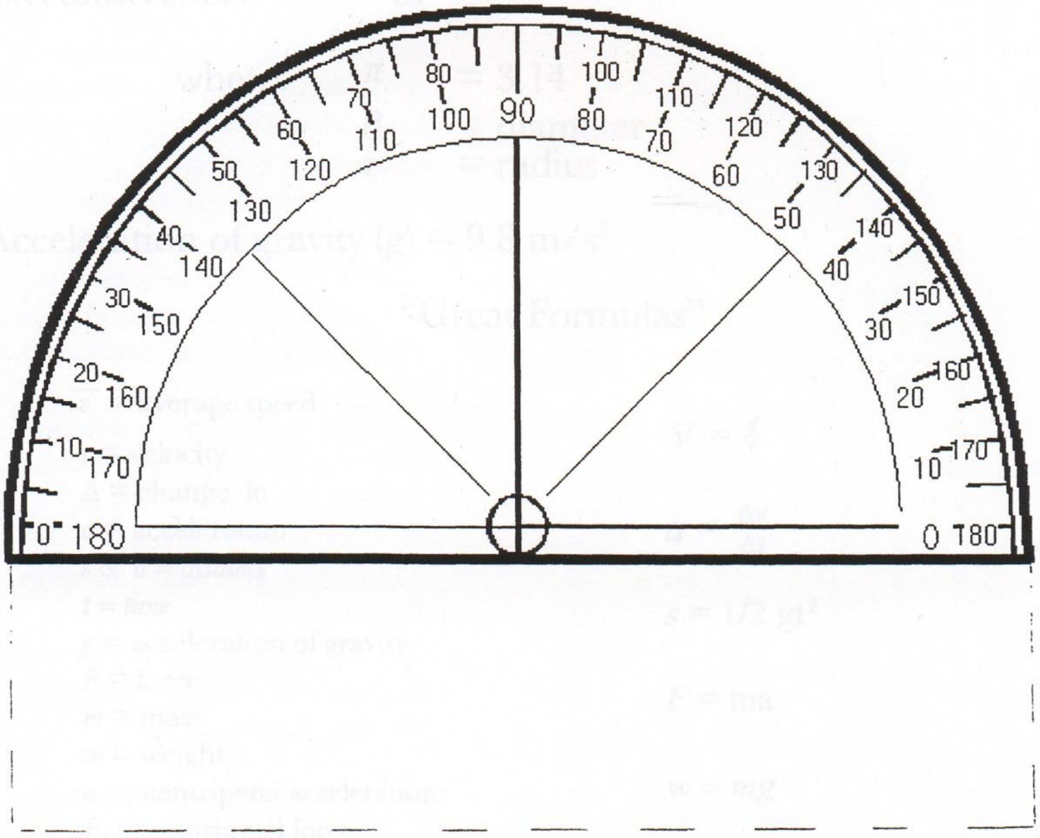
To calculate the height of the ride you will also need the distance between the student and the ride.



$$\tan \Phi = \frac{height}{distance}$$

$$h = d\,(\tan\Phi)$$

(Remember to add the height of your eye to the ground.)



1. Cut out the protractor including the dashed line section.

2. Trace the protractor part only on a piece of cardboard, such as the back of a tablet.

3. Glue or staple the cardboard to the back of the paper protractor.

4. Roll the top section around a straw and tape.

5. Punch a hole and tie a 9 inch string of heavy black thread through the hole. On the other end tie a metal nut, washer, or fish sinker.

6. Follow the directions on the page titled "An Angle on Distance."

Reference Sheet:

Equations:

$\bar{v} = s/t$

$a = \frac{\Delta v}{\Delta t}$

$s = \frac{1}{2} gt^2$

$F = ma$

$w = mg$

$a_c = v^2/r$

$F_c = mv^2/r$

$W = Fd$

$P = W/t = Fd/t = F_v$

$s = v_i\Delta t + \frac{1}{2} at^2$

$v^2 = 2as$

$\bar{v}$ = **average speed**

v = velocity

Δ = change in

s & d = distance

t = time

a = acceleration

v_m = **minimum velocity**

F = force

w = weight

g = acceleration due to gravity

r = radius of curvature

a_c = **centripetal acceleration**

F_c = **centripetal force**

m = mass

$v_m = \sqrt{gr}$

$\mu = F_f / F_n$

$F\Delta t = \Delta mv$
$m_1v_1 = m_2v_2$
$T = 1 / f$
$E_p = mgh$
$E_k = ½\ mv^2$

$T = 2\pi\sqrt{l/g}$

T = period

f = frequency
W = work
E_k = kinetic energy
E_p = potential energy
P = power
h = height
$F\Delta t$ = impulse
Δmv = change in momentum

l = length
F_f = force of friction
F_n = force normal to the surface

TABLE OF TRIGONOMETRIC RATIOS

Angle	Sine	Cosine	Tangent	Angle	Sine	Cosine	Tangent

Significant Digits

The **precision** of a measurement in a calculation is indicated by the number of **significant digits**. Every digit in a measurement is significant except for zeros used only to space the decimal point.

For example:
4.028 has **four** significant digits. (No zeros are used to space the decimal point.)
0.072 has **two** significant digits. (The two zeros are spacers.)
650.05 has **five** significant digits. (No zeros used to space the decimal point.)
7000 has **one** significant digit. (The three zeros are spacers.)
53.600 has **five** significant digits. (The last two zeros are not spacers.)
0.005700 has **four** significant digits. (The first three zeros are spacers, but the last two are not.)

Note: **Calculations from measurements** cannot be more precise than the least precise measurement. Keep the following in mind when using measurements in calculations:

a. A **count of objects** (seven apples, for example) does not have significant digits. Do not round off answers based on the numbers of digits in a count.

b. When **adding, subtracting**

1°	.0175	.9998	.0175	46°	.7193	06947	1.0355
2°	.0349	.9994	.0349	47°	.7314	.6820	1.0724
3°	.0523	.9986	.0524	48°	.7431	.6691	1.1106
4°	.0698	.9976	.0699	49°	.7547	.6561	1.1504
5°	.0872	.9962	.0875	50°	.7660	.6428	1.1918
6°	.1045	.9945	.1051	51°	.7771	.6293	1.2349
7°	.1219	.9925	.1228	52°	.7880	.6157	1.2799
8°	.1392	.9903	.1405	53°	.7986	.6018	1.3270
9°	.1564	.9877	.1584	54°	.8090	.5878	1.3764
10°	.1736	.9848	.1763	55°	.8192	.5736	1.4281
11°	.1908	.9816	.1944	56°	.8290	.5592	1.4826
12°	.2079	.9781	.2126	57°	.8387	.5446	1.5399
13°	.2250	.9744	.2306	58°	.8480	.5299	1.6003
14°	.2419	.9703	.2493	59°	.8572	.5150	1.6643
15°	.2588	.9659	.2679	60°	.8660	.5000	1.7321
16°	.2756	.9613	.2867	61°	.8746	.4848	1.8040
17°	.2924	.9563	.3057	62°	.8829	.4695	1.8807
18°	.3090	.9511	.3249	63°	.8910	.4540	1.9626
19°	.3256	.9455	.3443	64°	.8988	.4384	2.0503
20°	.3420	.9397	.3640	65°	.9063	.4226	2.1445
21°	.3584	.9336	.3839	66°	.9135	.4067	2.2460
22°	.3746	.9272	.4040	67°	.9205	.3907	2.3559
23°	.3907	.9205	.4245	68°	.9272	.3746	2.4751
24°	.4067	.9135	.4452	69°	.9336	.3584	2.6051
25°	.4226	.9063	.4663	70°	.9397	.3420	2.7475
26°	.4384	.8988	.4877	71°	.9455	.3256	2.9042
27°	.4540	.8910	.5095	72°	.9511	.3090	3.0777
28°	.4695	.8829	.5317	73°	.9563	.2924	3.2709
29°	.4848	.8746	.5543	74°	.9613	.2756	3.4874
30°	.5000	.8660	.5774	75°	.9659	.2588	3.7321
31°	.5150	.8572	.6009	76°	.9703	.2419	4.0108
32°	.5299	.8480	.6249	77°	.9744	.2250	4.3315
33°	.5446	.8387	.6494	78°	.9781	.2079	4.7046
34°	.5592	.8290	.6745	79°	.9816	.1908	5.1446
35°	.5736	.8192	.7002	80°	.9848	.1736	5.6713
36°	.5878	.8090	.7265	81°	.9877	.1564	6.3138
37°	.6018	.7986	.7536	82°	.9903	.1392	7.1154
38°	.6157	.7880	.7813	83°	.9925	.1219	8.1443
39°	.6293	.7771	.8098	84°	.9945	.1045	9.5144
40°	.6428	.7660	.8391	85°	.9962	0872	11.4301
41°	.6561	.7547	.8693	86°	.9976	.0698	14.3007
42°	.6691	.7431	.9004	87°	.9986	.0523	19.0811
43°	.6820	.7314	.9325	88°	.9994	.0349	28.6363
44°	.6947	.7193	.9657	89°	.9998	.0175	57.2300
45°	.7071	.7071	1.0000				

Locator

North End	Midway
Zoomerang	Wildcat
Zoomer’s Gas N’ Go	Wave Swinger
Pirate Ship	Revolution

Twister

Ghost Hunt

Anchor Bay

Saw Mill Plunge

Thunder N’ Lightning

Ferris Wheel

Splash Harbor

Clipper Cove

Mammoth Falls

Compounce Railway

Circus World/Kiddieland

American Flyers

Back Midway

Carousel

Wildcat Entrance

DownTime

Boulder Dash

South End

Thunder Rapids

Catering Pavilions

Investigations:

Your visit to Lake Compounce is an opportunity not only to have fun, but also to learn about science and the use of technology throughout the park.

Use our education program and our exciting rides to broaden your appreciation of Science.

Investigation #1: Zoomerang Coaster

Mass of each car = 1500 pounds or 680 kg
Number of cars = 7
Maximum Height = 36.91 meters Lift 1
35.5 meters Lift 2
Top of Loop = 19.325 meters
Total distance traveled = 286 meters (1 way)
Diameter of loop = ____________________

Ride the Zoomerang or watch from the upper midway. Match the statement with the letter from the photo above. Letters may be used more than once and there may be more than one answer for each statement. Keep in mind that the Coaster zooms both frontward and backwards.

_____ 1. Where do you have the greatest potential energy?
_____ 2. Where do you have the greatest kinetic energy?
_____ 3. This location is where you have the greatest velocity.
_____ 4. This location is where you have the slowest velocity.
_____ 5. This is where you feel almost weightless.
_____ 6. This is where you feel very heavy.
_____ 7. Where is work being done?
_____ 8. Where do you feel the greatest deceleration?
_____ 9. Where so you experience the greatest G-Force on you?
_____10. This is where the greatest friction is produced.

Observations and Calculations:

1. How many riders are on the Zoomerang? Find the average number per ride from 3 runs of the coaster.

1st trip number	
2nd trip number	
3rd trip number	
average number / trip	

2. Use your watch or stopwatch to determine how long the ride lasts from loading people to unloading people.

time = ________ seconds = ________ minutes = _______ hours.

3. Based on the time for one ride, calculate how many rides could be run in an 8 hour day.

__________ rides

4. Using the average number of people per trip and the number of rides per day, how many people could ride the Zoomerang in:

One Day ? _______ One Season (85 days)? _________

5. Work is the force causing something to be displaced. W = Fd

   a. Calculate the work needed to lift the Zoomerang to the top of the first lift hill. Note: For vertical work here, the force is the weight of the train and the riders and the distance is the height Therefore, W = mgh. Use the max number of riders at 63.5 kg each.

   b. Power is the rate of doing work. Calculate the power needed to lift the train to the top of the first hill.

   Power = _________ Watts = __________ horsepower

6. Explain qualitatively the energy transformation in one complete trip. Specifically, consider the energy change from the loading area to the first peak and then the change from this point to the end of the ride.

7. What measurements must be made to evaluate the maximum potential energy of the Zoomerang?

   a.

   b. Carefully make these measurements and record the results here.

c. Calculate the maximum potential energy of the Zoomerang (include riders). Where is the Zoomerang located when it has potential energy? What is the speed at this point? (Label and explain your steps).

d. What is the Zoomerang’s maximum kinetic energy? Where is it located at this time? What is its speed at this point? (Show work)

e. Compare the speed calculation obtained in (d) above with the speed calculation obtained in the next problem. Comment on any correlation.

It is said that the speed of a roller coaster as it travels through a loop depends on the height of the hill from which the coaster has just descended. The equation $s = 8\sqrt{h - 2r}$ gives the speed s in feet per second, where h is the height of the hill and r is the radius of the loop. Using the data assembled at the start of the lab, determine how fast the Zoomerang travels through its initial “loop.”

8. a. What force or forces do you feel at the top of the loop?

b. Draw a free body diagram representing the forces acting on you at:

Top of the Loop

Bottom of the Loop

9. What is the minimum speed you can have **when upside down** and not fall out? (assuming no restraints). *Show your work!*

Investigation #2: The Pirate

Weight of Pirate Empty = 14300 lbs or 6490 kg

Ride capacity (number of Riders)	
Approximate weight (full)	
Maximum height of the Pirate	
Radius of Swing	

1. Explain the energy transformation which occurs when the Pirate is in operational mode.

2. Calculate the maximum velocity of the Pirate and show where this

occurs. (Show your work).

Answer ________

3. Measure the **period** of the Pirate (Use a stop watch and time several oscillations).

Period =

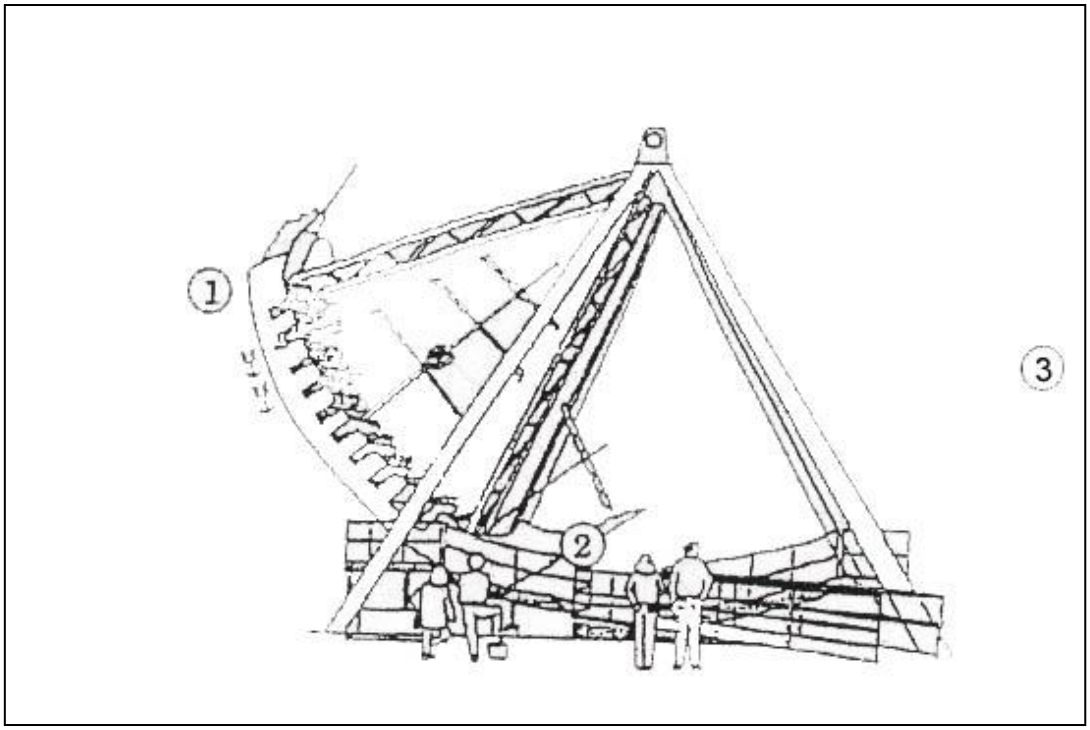
Calculate the **frequency** of the Pirate. (Show all work).

4. Draw a free body diagram of the forces acting on you when (a) you are at the bottom of the swing and (b) at the top of the swing.

Bottom	Top

5. Using the Pirate as a pendulum, and the information from above, calculate the acceleration due to gravity at this park. (Show your work).

g =



Investigation #3: The Carousel

Note: Answer the questions based on your position on the Carousel. Use two different distances from the center.

Data:

	Trial #1	Trial #2
1. Your distance from center		
2. Your period of rotation		
3. Your velocity		
4. Centripetal force acting on you		

Show your work here:

1. What effect on the centripetal force did changing your location produce?

2. If you are near the center of the Carousel, explain what strategy you would use to throw a ball to a partner on the outside edge.

3. If the output of the engine is 25 hp. Calculate the work required to turn the Carousel once.

   (Note: 1 hp = 550 ft-lbs/sec or 746 watts).

   Work ________________

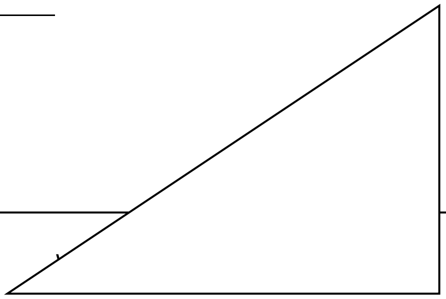
Investigation #4: The Wildcat

Data:

Your mass: _____________________ kg
Angle of the first hill: _______________ °
Time for train to travel up the first hill: __________________ sec.
Elevation of first hill = 73’7” from grade level (__________ meters)

1. Calculate your average speed going up the first hill.

Distance = _____________



73’7”

Ø =

Velocity Calculation Here

Distance Calculation Here

2. What is your potential energy at the top of the first hill? (Show work)

3. How much work was needed to get you to the first hill? (Show work)

4. What force was used to get you to the top of the hill? (Show work)

5. The Wildcat track at the bottom of the first hill is at an elevation of 5’ 2” from grade level or ______________ meters. (Show all work)
   a. How much potential energy is remaining at the bottom of the first drop?
   b. How much kinetic energy do you have at the bottom of the first drop?
   c. Calculate your velocity at the bottom of the first drop.

First Turn: Radius of curvature = ________ feet (_______ meters)
Elevation = 57’ 9” or (________ meters)

6. What is your velocity in this turn? (Show your work)

7. Calculate the centripetal force on you in this turn. (Show your work)

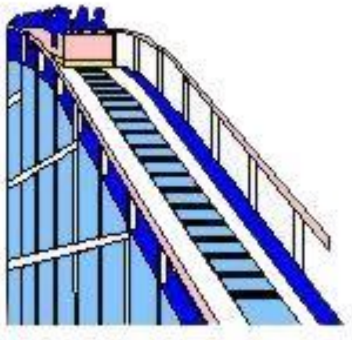
8. Why is the track banked in the curve?

9. What is the g force on you in the turn? (Show your work)

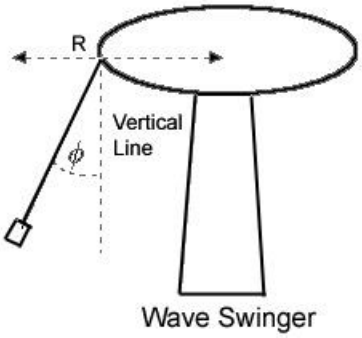
End of Ride: Time to stop: _______________
Braking point elevation = 21’ 1” (________ meters)
Braking distance = 250 feet (________ meters)

10. What is your velocity at the braking point? (Show your work)

11. What is your deceleration? (Show your work)



Investigation #5A: Wave Swinger



1. Estimate the radius of the circle traveled by a chair in the outer ring as the ride operates

2. Using the above value, calculate the distance (circumference) traveled by the chair in one revolution.

3. Calculate the linear speed of the moving chair.

4. Estimate the mass of the chair and the average rider.

5. What is the centripetal force needed to keep the chair with rider moving in a circle? (Assume the swing chair has a mass of 9 kg.)

6. Measure or estimate the angle between the chair chains and the vertical.

7. What is the tension needed in the chain to supply the centripetal force in Question #5?

8. Diagram the ride at the following times:

   a. at rest
   b. when it is moving, but not tilted
   c. when it is moving and tilted.

   Is there any difference in the radius? Please explain.

9. Determine the length of the entire chain.

10. What causes the swings to move out as the wheel turns?

11. Where does “down” appear to the riders?

12. Describe the reasons for the different sensations on the ride at the following points:

    a. when moving, but not tilted.
    b. going down when tilted.
    c. going up when tilted.

13. Measure the period of a swing when:

a. moving and not tilted.
b. moving and tilted.

14. How does the angle of an empty swing compare with the angle of an occupied one at the same radius? Does the mass of the rider seem to make any difference?

15. Although the hub is rotating at a constant rate, it does not seem that way when the ride is tilted. Indeed, your tangential velocity is NOT constant. Why?

16. Determine the tangential speed at which the outer swing is moving when the hub is moving and tilted. Give the answer for both the bottom and top of the orbit.

17. Determine the tangential acceleration of the outer swing when the hub is moving and tilted. Give the answer for both the bottom and top of the orbit.

18. Find the centripetal force of an empty swing when the hub is moving and tilted. Give the answer for both the bottom and top of the orbit.

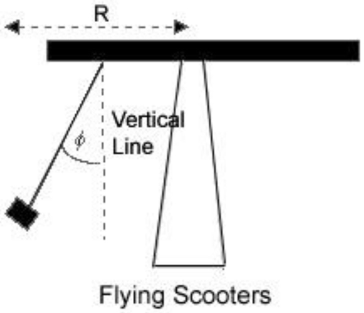
19. The swing angle is the difference of the vector combination of the gravitational and centripetal forces. Calculate the theoretical angle the swing should have (when the ride is not tilted), and compare it with the measured value.

20. Calculate the gravitational, centripetal, and tensional forces acting on the swing when you are in it. Do this for the following four cases:

a. at rest
b. moving, but not tilted
c. moving, tilted, and at the top of the orbit.
d. moving, tilted, and at the bottom of the orbit.

How do these compare with the same quantities when the swing is empty?

Investigation #5B: The American Flyers



The American Flyers
are similar to the Wave Swinger in that the cars swing out away from the axis of rotation during the ride. The American Flyers are different because the rider controls the amount of the swing by positioning the "sail" on the front of the vehicle.

1. Estimate the mass of the car and passenger.

2. Estimate or find the period of rotation.

3. Estimate the radius of the circle traveled by the "flying car" when the passengers do not touch or move the "sail."

4. Estimate the amount of centripetal force needed to keep the vehicle flying in the circle described in Question #3. Explain.

5. Estimate the amount of centripetal force needed to make the vehicle fly as far as possible from the ride's axis.

6. Estimate the amount of centripetal force needed to make the vehicle fly as close as possible to the ride's axis.

7. What is the approximate outward force that can be provided by the "sail." How did you get this answer?

8. What is the approximate inward force that can be provided by the "sail"? How did you get this answer?

Investigation #6: Saw Mill Plunge

(A Water Roller Coaster)

Reminder: Use the information provided by your teacher concerning the bench marks for hard-to-measure locations.

Data and Measurement:

Length of boat: 9 ft = ______ meters

Mass of boat: 350 lb = ______ kg

Vertical drop of hill: ______ meters

Angle of down hill: ______

Time for whole boat to pass any given point before going up to top of hill: __________ seconds t_1

Time for boat to come down hill: __________ seconds t_2

Time duration of the splash at the bottom of the hill: __________ seconds t_3

Time for whole boat to pass any given point after splashing at bottom of hill: __________ seconds t_4

Observations:

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

2. If there is a great deal of mass in the front of the boat, is the splash larger or smaller than if there is a smaller mass in the front? If so, explain.

3. Is there an observable splash-time difference with greater mass in the front than if the greater mass is in the rear? If so, explain.

4. Is there any place on the ride where riders “lunge” forward involuntarily? Where does this occur? Explain why.

Calculations:

1. Determine the average velocity of the log **before** going up the hill.

2. Calculate the length of the hill.

3. Determine the average speed of the log **down** the hill.

4. Assuming the speed of the log at the top of the hill is the same as the speed before the hill, calculate the speed of the log at the **bottom** of the hill just prior to splashing.

5. Calculate the average acceleration of the log going down the hill.

6. Calculate your momentum at the **bottom** of the hill before splashing.

7. Calculate your momentum **after** splashing is complete.

8. Using the time of splash, calculate the average force you experience during the splash.

9. List several purposes of having water as part of this ride.

10. Compare this ride to a roller coaster. What are the similarities?

Investigation #7: Compounce Mt. Skyride

1. Determine the length of the Skyride in meters. Describe the method you used to determine the total distance (round trip) that a single chair travels during its circuit.

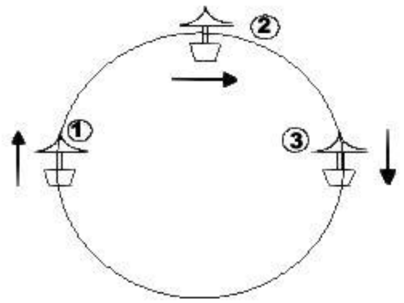
2. Observe the ride for one full circuit (or ride the ride yourself). How long does is take for the ride to reach the top of the mountain?

3. How many chairs are on the Skyride? Each chair can carry up to 4 adults. Using information from your answers to the above questions, what is the average number of people that can ride the chairlift in an 8 hour day if all chairs are used?

4. What is the distance between chairs? Explain how you arrived at your answer.

5. The Skyride is a continuously moving attraction. If you are on the chair at the base of the mountain heading upward, is this potential energy or kinetic energy?

Investigation #8: Ferris Wheel



1. If you were sitting on a bathroom scale, where on the above diagram would you see a greater weight than normal?

2. At which position in the above diagram would you see a smaller weight?

3. Estimate the maximum speed of the ride in rpms (revolutions per minute).

4. Does the size of the Wheel affect your perception of its speed? Why or why not?

5. How many gondolas are there on the Ferris Wheel?

6. What are the maximum numbers of passengers that the wheel can carry with a capacity of 6 adults or of 8 children per gondola?

_________ adults ________ children

7. Estimate / calculate the full height of the wheel from its base.

_______ meters

8. Estimate / calculate the radius of the wheel. _______ meters

9. Calculate the circumference of the wheel.

_______ meters

10. If light bulbs are to be placed 6 centimeters apart around the front edge of the perimeter (circumference) of the wheel, give a close approximation of how many bulbs would be needed.

____

11. Compute the mechanical advantage if the radius of the Ferris Wheel is 12.2 meters and the diameter of the axle is 12.0 inches.

____

12. Time 1 complete period (use a particular chair as your starting point). Find the height for each angle (use triangulation). Make a data table of angles, times, and heights from starting point. Label time in seconds and height in meters. Plot 1 period of a time vs. height graph.

Angle	time	height
0		
π 4		
π /2		
3 π /4		
π		
5π /4		
6π /4		
7π /4		
2 π		

13. Write a sine equation for your graph.

14. At what height will the chair used as the starting point be after 15 seconds? Use your equation to answer.

Investigation #10: The Kiddie Bumper Cars

Participate in this investigation with a partner.

1. What happens in a collision to each car when:
    a. one bumper car is not moving?
    b. a rear-end collision occurs?
    c. a head-on collision occurs? (speculate)
    d. there is a collision with a stationary object (the side rail)?
    e. cars sideswipe?

2. Describe how you feel when any type of collision occurs. Are you a well-packaged passenger? Please explain your answer.

3. How is electrical energy supplied to the bumper cars? Describe the complete circuit for one of the cars.

4. Why do the cars have rubber bumpers?

5. Mass of the bumper car: 385 lbs ___________ kg
Mass of rider (you) ___________ lbs ___________ kg
Mass of car and rider ___________ lbs ___________ kg
Total mass of your partner and his/her car __________ kg

6. During collisions, is kinetic energy always conserved? Please explain your answer.

7. Is the mechanical energy (kinetic + potential) of the bumper cars conserved? Please explain your answer.

8. Estimate the average speed of a bumper car in motion.

9. Estimate the stopping distance of a bumper car in an average collision. Try to observe the approximate amount of "give" of a bumper car in a number of different collisions where the car comes close to stopping after the collision.

10. Find an average negative acceleration of a bumper car in an "average" collision. How many g's is this? (Show your work)

11. Assume that you are traveling at 2 m/s.

    a. Calculate the momentum of you and your car.

    b. You collide with a wall and rebound at a speed of 1 m/s. Calculate the momentum of you and your car after the collision with the wall bumper. (Keep in mind that momentum is a vector quantity!)

    c. Calculate the change in momentum of you and your car.

    d. Assume that you are moving at 2 m/s. You strike a wall bumper and come to a rest in 0.5 seconds. Calculate the impulse acting on you and your car during the collision.

    e. Calculate the force that caused the change in momentum.

Investigation #11: Thunder Rapids Raft Ride

Data and Measurements:

Mass of raft: 681.8 kg

Radius of raft: ________ meters

Vertical length of lift conveyor: _________ meters

Time for whole raft to pass any given point before going up to top of hill: ________ seconds

Time for raft to cycle the route: ________ seconds

Time duration of the raft in the load / unload station: ________ seconds

Time for whole raft to pass any given point after entering the station until it drops off the conveyor ________ seconds

Observations:

1. Why is there water on the slide or hill and not just at the bottom of the slide?
2. If there is a great deal of mass on one side of the raft, is the splash larger or smaller than if there is a smaller mass on a side? If so, explain.
3. Is there an observable splash-time difference with the greater mass of a fully loaded raft than if the greater mass is on one side? If so, explain.
4. Is there any place on the ride where the riders “lunge” forward involuntarily? Where does this occur? Explain why.

Calculations:

1. Determine the average velocity of the raft **before** going up hill.

2. Calculate the length of the conveyor hill.

3. Determine the average speed of the raft up the hill.

4. Assuming the speed of the raft at the top of the hill is the same as the speed before the hill, calculate the speed of the raft at the **end** of the trough just prior to entering the load / unload station.

5. Calculate the average acceleration of the raft as it leaves the conveyor.

6. Calculate your momentum at the **bottom** of the trough before entering the load / unload station.

7. What happens to your momentum as water splashes down on you at Lover's Rock.

8. List several purposes of having water as part of this ride.

9. Compare this ride to a roller coaster. What are the similarities?

10. What would happen to the time length of the ride if the inflatable tubes were to be over inflated? Under inflated?

_ _ _ ((((. . . = = = **Boulder Dash**

This mountain coaster is a marvel of engineering. It is the longest wooden roller coaster on the east coast and the only one of its kind built on a 750 ft. mountain, which forms the western boundary of Lake Compounce Park. The course is determined by the mountain topography and designed to disturb as little of the natural setting as possible, including the trees, bushes, ledges, and boulders.

The coaster ride begins in the north end of the Park near the Ferris Wheel (located in Bristol) travels to the south end of the Park near the Skyride (located in Southington) and back again over 4500 plus ft. of track. For a breathtaking two minutes, guests race through dense woods, past rugged rock facing, and between large boulders at up to 60 miles per hour.

The unusual design tries to keep the coaster a hill hugger and very fast. The speed doesn't change greatly during the ride as with most roller coasters. Heavily dependent on gravity from the top of the first initial drop on, it maintains a high range speed throughout the ride. For true coaster lovers (as well as everyone who dares to ride), a deluxe assortment of other specialties complete the unparalleled ride. In amusement park lingo, your experience might include sideways jogs, bunny hops, ejector or floater airtime, laterals, and a feisty 180-degree turnaround.

In short, Boulder Dash may be one of the coolest psychologically thrilling rides in the world. Because you are actually riding on a real intact mountain, many unexpected "blind" surprises may have your hair standing on end.

Now, that you know the scoop, give it a try!

Data:

One train: Mass of each car: 1134 kg
Number of cars: 6
Capacity of one train: ____________

Your Mass: _____________ kg
Total distance traveled: 4672 ft. = ________meters
Total time of ride: ________ seconds
Time from loading to unloading: ________ seconds

Estimate height of first hill: _______ ft = _______meters
Estimate angle of first hill: _______
Time to climb first hill: ___________ seconds

Estimate height of largest drop hill: ______ ft =_____meters
Time to descend largest drop hill: ________ seconds

1. Calculate the distance up the first hill.

2. Calculate your average speed going up the first hill.

3. What is your potential energy at the top of the first hill?
   (Show your work.)

4. How much work was needed to get you to the first hill?

5. What force was used to get you to the top of the hill?

6. From observation: Does relatively the same speed appear to be maintained throughout the ride ? How about as the rider?

7. Did the speed appear to be faster because of the boulders and trees?

8. Were there any backward leaning zones?
   Any forward leaning zones?

9. What percentage of your ride appeared to be airtime?
   Compare your estimate with those of your classmates.

10. Compare your adventure on Boulder Dash to that of the Wildcat and/or the Zoomerang.

    a. On which coaster did you experience less sideward g forces?

    b. On which coaster did you have more airtime?

    c. Did you experience differences in speed?

Congratulations! You are now officially a bold, brave, bona fide Boulder Dasher!

DOWNTIME!!!

A heart pumping, adrenaline flowing, white knuckled, and literally hair raising experience, DownTime is a vertical drop tower with *attitude* and turbo action.

After the guests are seated, the cart is raised slightly and weighed. Then it is steadily lifted to the top of the tower where it is locked in brakes. Stationary for a few seconds, the cart is then abruptly launched toward the ground with chilling negative g-force acceleration. The ride softens with a bungee like bounce before reaching the bottom of the tower and rebounds for a few soft bounces before descending slowly back to the ground. Air pressure, power cylinders, pistons, and air powered brakes work in harmony with each other to provide guests with some exciting ups and downs.

Whether you're a watcher or a rider, DownTime is an interesting phenomenon to investigate.

1. How many guests can the ride accommodate?

2. Why do you think the cart needs to be weighed?

3. Measure the overall cycle time of the ride from start to finish to gain perspective about the ride. You'll need a watch with a second hand or one with a stopwatch mode.

4. Measure the time it takes for the cart to be lifted to the top of the tower. Start measuring at the end of the weigh sequence.

5. Measure the time of the cart's turbo descent Start immediately after release of the braking mechanism. Hint: Don't look away or you'll miss it! Stop just as the cart is ready to bounce.

6. Calculate the height of the DownTime tower (including the flagpole) using triangulation. The distance from the center DownTime tower panel to the right front corner of the retail building (facing building) is 83.79 feet = ______ meters. (Reminder: The height of the ride = height from sighting + height of your eye.)

7. Calculate the height of the DownTime tower (excluding the flagpole).

DownTime is **185 feet tall** (without the flagpole). The **dynamic distance is 165 feet** (the distance through which all the action occurs.) The **first bounce** occurs about **40 feet up** the tower (from height without flagpole).The empty cart weighs approximately 2000 lbs.

185 ft = _______m 165 ft = _______m 40 ft = _______m 2000 lbs = _______kg

8. Calculate the average speed of the cart moving up the tower (begin end of weigh sequence).

9. Calculate the average speed of the cart moving back down toward the ground (begin release to just as cart is entering first bounce).

10. Calculate the momentum of cart filled with riders (140 lb average), as it is entering first bounce.

11. Consider the following overview of the DownTime ride cycle, filling in the blanks as you proceed.

A. Load/unload passengers: Cart is at tower bottom. Air pressure in all components except the air supply tank is at ambient.

B. With the cart lifted slightly and held at constant height, the weight is established. The ride control system determines the _______________________ required to accomplish the desired ride action.

C. The cart is dispatched and moves from bottom to top of tower. The “up-valve” admits air into the power _________ to accomplish this. The air admitted into the cylinders acts on the top side of the ________ and drives them downward. The passenger cable system lifts the cart in proportion to ____________ movement. Air is exhausted from the “dump-valve and exhaust” located on the bottom of each cylinder.

D. The cart is latched in the air-powered _______________ at the top of the tower. As the cart is held, the air In the upper portion of the cylinders and main valve is vented to atmosphere through the port valve filters, and calculated _________________ is introduced into the bottom side of power cylinders and the turbo tank.

E. Cart launch: The brakes release the cart and air pressure accelerates the cart downward with an initial acceleration of approximately ______ g. The power cylinders top side begins to build pressure. The power cylinders bottom side begins to dissipate pressure.

F. The cart reaches the bottom of the first bounce about 40 ft up the tower as air is compressed by the pistons. Passenger cart acceleration loading attains its _________vertical acceleration of approximately _____ g. The air pressure in the upper portion of the power cylinders and the main valve reaches its ___________. This pressure depends on the ________________.

G. The cart bounces softly several times and descends slowly back to the ground.

12. Review the following partial set of pressure readings (**in psig**) (pressure per square inch) taken from a random ride cycle on DownTime, and choose only the appropriate reading(s) to complete the chart below.

psig: 22 (before cart enters brakes), 0 (cart enters brakes), 20, 44, 3, 26, 5, 17, 8, 20

Corresponding times in seconds:

20 through 22, 25 through 30, 33, 36, 39, 42.5, 44.5, 47.5, 49, 51 seconds
.

Component	Cart at bottom of tower	Cart at launch	Cart bottom of 1st bounce
Turbo tank	0 psig	P = 20 psig	P = < 5 psig
Main valve	____ psig	P = ____ psig	P = ____ psig
Cylinders	____ psig	P = ____ psig top P = ____ psig bottom	P = ____ psig top P = ____ psig bottom
Pistons	____ psig top ____ psig bottom	P = ____ psig top P = ____ psig bottom	P = _____ psig top P = _____ psig bottom

13. Graph the pressure readings from question 10 and describe what is taking place at the various readings. Label the vertical axis **Pressure (psig)** using increments of 10 psig, beginning at 0 psig. Label the horizontal axis **Time (sec)** using increments of five seconds, beginning at 20 seconds. Project how the graph might continue (with dotted line).

14. If DownTime was a free fall drop tower rather than a turbo drop tower, what differences would you expect to find in the ascent and descent? Consider time, speed, and g forces.

You're done?! Had fun?! Then you've earned some Down Time!

THUNDER N' LIGHTNING

Center of Axle to Ground: 57' 2" = ______m

Length of Arm: 43' = _________m

Ride Capacity: ________

Radius of swing: _______

1. Explain the energy transformation which occurs when Thunder N' Lightning is in

operational mode.

2. Draw a free body diagram of the forces acting on you when (a) you are at the bottom of the swing and (b) at the top of the swing.

3. Calculate the maximum velocity of Thunder N' Lightning and show where this occurs.

4. Measure the period of the ride

5. Calculate the frequency of the ride.

6. Explain why and how Thunder N' Lightning functions as a pendulum

7. Determine the direction of travel pendulum arc. _________ degrees of rotation

8. Using Thunder N' Lightning as a pendulum, calculate the acceleration due to gravity at the park.

9. As a pneumatically powered swing, discuss how the push/pull action of the piston/cylinder assembly causes the swing to move back and forth.

Zoomer's Gas N' Go

Though the power they're supplyin' is electrifyin' and your chills are multiplyin'
You won't be losin' control on the Zoomers – the cool new ride of the season.

Ten 1956 style Corvettes are greased up and ready to go and will keep guests on track for a spin down memory lane. The guide unit and steering are designed to allow guests to maneuver the car around the course, but still prevent driving off the roadway. The steering system utilizes a specially manufactured rack and pinion unit acting through steering springs.

Equipped with a sound system, these replicas of the famed car which came into its own in the 1950's, take guests back in time with sights and sounds that will revive memories, as well as create new ones. And it's sure to be a very pleasant reminder that the 50's still impact us today.

So, what's up with the Corvette?

The famed Chevrolet Corvette was the first all American open top sports car built by an American car manufacturer. The very first Corvette rolled off of the production line in Flint, Michigan on June 30, 1953 and cost $3490. The outer body was constructed with fiberglass, which was a unique new material at the time. It reportedly had a 6 cylinder truck engine, a two speed transmission, drum brakes, and a triple carburetor intake.

To improve efficiency, the car was changed as the decade went on. The new 1955 Corvette had V8 power. In 1956 the Corvette had a standard 210 hp engine with single carburetor. By 1957 the new fuel injected Corvette could go from 0 to 60 mph in 5.7 seconds. And once 1958 rolled around, the redesigned Corvette was not only a sales success but also a music and movie star.

From 1953 to the present, the Corvette has been a sought after, sporty, and all over cool car with special appeal. For example, movie legend John Wayne owned a Corvette made on October 1, 1953. And, the oldest surviving Corvette, which was the third one off the assembly line in 1953, was sold in Scottsdale, Arizona for one million dollars on January 12, 2006.

What was happening in the 50s?

Techno, Entertainment, Tidbits, Gas Prices, and Average Income

1950: 12 inch black and white tvs; Saturday afternoon Cinema matinees; doorstep milk delivery; credit card invented in US; films "Cinderella" and "Father of the Bride;" gallon of gas 18 cents; Average income $3210 per year.

1951: luxury cars with powerful engines and two-tone paint (turn signals extra); broadcast of color tv test pictures from the Empire State Building; "I Love Lucy" on tv; gal. of gas 19 cents; $3510 per year.

1952: more cars with automatic gearboxes; world's first passenger jet made in the

UK signals faster, cheaper travel; gal. of gas 20 cents; $3850 per year.

1953: transistor radios invented in US; first color televisions for $1175; "buy now, pay later" marketing for cars; gal of gas 20 cents; $4000 per yr.

1954: robot and solar cells invented in US; larger, more powerful car engines; "Do It Yourself" trend for home repairs and car maintenance; "Father Knows Best" on tv, Marlin Brando in the movies, Elvis Presley's first commercial record, and "Rock Around The Clock" from Bill Haley and the Comets; gas 22 cents.

1955: 7.9 million cars sold in the United States, seatbelts are required by law; first McDonalds opens; tv dinners and Coca Cola in cans; Chuck Berry and The Platters join the Rock and Roll music stars; minimum wage is raised to $1 per hour; gal. of gas 23 cents; $4130 per year.

1956: disposable diapers and tefal non stick pans; video recorder and tape invented in US; "The Price is Right" on tv; Elvis on the Ed Sullivan variety show and hits the charts with "Heartbreak Hotel;" gal. of gas 22 cents; $4450 per year.

1957: larger tail fins and lights on cars, more powerful engines; 67% of cars purchased on credit; first space satellite "Sputnik 1" launched by Soviet Union; "Perry Mason" and "Maverick" on tv; Little Richard joins the R 'n' R artists; Slinkys and Hula Hoops; gal. of gas 24 cents; $4550 per year.

1958: cars larger and heavier, bigger engines; first satellite launched from Cape Canaveral; Microchip developed by Intel in US; computer modem invented in US; Alaska becomes 49th state; gal. of gas 25 cents; $4600 per year.

1959: Boeing 707 airliner put in service; "Bonanza" and "The Twilight Zone" on tv; Hawaii becomes the 50th state; Barbie Dolls; gal.of gas 25 cents; $5010 yr.

The Staples and Then Some:

1951: loaf of bread 16 cents; lb of bacon 52 cents; dozen of eggs 24 cents; lb of hamburger 50 cents

1952: lb of hamburger 53 cents

1956: lb of ground coffee 85 cents

1957: dozen of eggs 28 cents; lb of bacon 60 cents

1959: loaf of bread 20 cents

On the Average: Cars and Houses

1950: Car $1510 House $ 8450

1951:	Car	$1500	House	$ 9000
1952:	Car	$1700	House	$ 9050
1953:	Car	$1650	House	$ 9550
1954:	Car	$1700	House	$10250
1955:	Car	$1900	House	$10950
1956:	Car	$2050	House	$11700
1957:	Car	$2749	House	$12220
1958:	Car	$2550	House	$12750
1959:	Car	$2200	House	$12400

We're All Shook Up

1. Approximately how old is the oldest surviving Corvette?

2. A Chevrolet Corvette cost $3631 in 1958. What is the percent of increase of the Corvette over the average price of a car for that year?

3. Compare the selling price of the oldest surviving Corvette in 1953 with the its selling price in 2006. Taking only sell prices into consideration, what was the gross percent of profit?

4. How much would a typical 2006 breakfast consisting of two eggs over easy, 2 pieces of toast, and 2 pieces of bacon (12 slices to a lb) cost in 1951?

5. If you need 2 ounces of ground coffee to make a carafe of coffee that holds 6 cups, what would it cost to serve one cup of coffee in 1956?

6. A report, which wishes to give an overview of inflation, compares the value of $100 US dollars for 1950 and 2005. It determines that the conversion of $100 from 1950 to 2005 would be equivalent to $835.41. Determine what the 1950 average cost of a car, a gallon of gas, a house, and income would be equivalent to in 2005 money.

7. Calculate and compare the percent of increase or decrease in the cost of a new house for each year, beginning in 1951, as compared to 1950. Graph your results.

8. Calculate and compare the percent of increase or decrease in the cost of a new car for each year, beginning in 1951, as compared to 1950. Graph your results.

9. Calculate and compare the percent of increase or decrease in the cost of gas for each year, beginning in 1951, as compared to 1950. Graph your results.

10. Calculate and compare the percent of increase or decrease in average income for each year, beginning in 1951, as compared to 1950. Graph your results.

11. Calculate and compare the percent of increase or decrease in the cost of a new car, a new house, gas, and average income for the decade as a whole using 1950 and 1959 information.

12. Compare your calculations and graphs for monetary changes for houses, cars, gas, and average income from 1950 to 1959. What comments would you make regarding trends and/or inflation?

“Rock and Roll is here to stay… it’ll go down in history…”

The music of the 50’s lives on in its own right and as the catalyst for the music that followed throughout the decades up to the present. Whether in the theater, in movies, on television shows, on the radio, or in the myriad of ways we get our music, there’s no doubt that it’s alive and well and continues to be influential.

Popular Artists and Groups:

Perry Como, Mario Lanza, Nat King Cole, Tony Bennett, Elvis Presley. The Platters,
Bill Haley and the Comets, Chuck Berry, Jerry Lee Lewis, Johnny Cash,
Ella Fitzgerald, Dean Martin, Doris Day, Connie Francis, Frank Sinatra

From the list above, match the artist with the hit and the year it appeared.

Hit	Artist	Year	(hint: 1954-59)
Three Coins in the Fountain			

Stranger in Paradise ____

Rock Around the Clock ____

Memories Are Made of This ____

All Shook Up ____

Great Balls of Fire ____

Jailhouse Rock ____

Smoke Gets in Your Eyes ____

What songs that represent the 50’s have you heard in the past year?

What musical representing the 50’s continues to be performed on both local and professional stages across the country?

Zoomer ‘s Gas N’ Go Connections:

1. What songs representing the 50’s do you hear on the Zoomer’s car radio?

2. List all of the components of the Zoomer’s ride that relate to the memories and images of the 50’s?

3. The Zoomer’s Gas N’ Go ride consists of 1015 feet of track. Measure the time it takes to navigate the track on your scenic journey. Start from the second you leave the station until the time you return.

4. Calculate the approximate speed of the ride in miles per hour.

5. Estimate the capacity of the station queue building if it contains 960 square feet of space. Assume each person requires his/her own four sq.ft. of standing room and that space for entry, exit, and other function occupies 300 sq. ft.

6. Though the Zoomer's cars travel with the help of a guide system, does the track need to be designed a certain way for the ride to function correctly? Explain your theory.

Now it's time to put on your shades and rock around memory lane again☺ Zoom, zoom!

PLEASE SHARE WITH STUDENTS EARLY ON EDUCATION DAYS

To aid in triangulation measurements, 4 "bench marks" are given for carefully measured distances from hard-to-measure locations, as follows.

1. For those who have used the educational programs in the past: The configuraton of the Zoomerang area has changed with the addition of the Zoomer's Gas N' Go. Previously, there was a yellow marker on the rail of the **fence** in front of the **Zoomerang**, facing the loop. It was exactly **107' 7" from** a point directly under the center of the loop. It was also **185' from** a point under the starting end of the Track (Lift 1). This portion of the fence has been removed, and it is unlikely that you will be able to access the exact reference point in question.

   New reference point: As you walk along the asphalt road, locate the lamp post and the tree in front of the Zoomer's Gas N' Go station. Looking across the width of the pathway, you will find a nail driven into the asphalt. It is **199' from** a point directly under the center of the loop.

2. A **nail** has been driven into the asphalt directly **in front of, and 100' from the Pirate**. It is at the intersection of perpendicular lines from the lamp post

in front of the Pirate and a nearby lamp post in front of the Twister.

3. To gauge the drop height at the **Saw Mill Plunge**, a mark has been placed in the area in front of the water pumps at the lift slope, outside the fence. This point is **75 meters** horizontally **from** a point under the top of the drop hill. The ground at the point is **1 m below** the water level at the bottom of the drop hill.

   Please note that the configuration of the area has changed with the addition of the Thunder N' Lightning ride. If access to the mark is blocked, please share the following information with your students as you see fit.
   Vertical drop of hill: 14.9 meters; Angle of down hill: 40 degrees.

4. Another **nail** has been placed into the asphalt in front of the raised garden in the entrance Plaza. It is aligned with the highest point of the first hill of the Wildcat roller coaster and is **7' 4" from** the garden **wall** when facing and aligned with the flag atop the Wildcat. The nail head is **186' from** a point below the highest elevation of the **Wildcat**.

Fast Break Carnivale

Test your Math Power and Science Savvy.

Jump, skip, hop around… Solve the problems you have found.
Swing the hammer, ring the bell. The strength of brainwaves it will tell.
Test the waters, see spot run. The mind is laughing, learning's fun.

How many questions can you answer correctly in 15 minutes or less?
Where will you score on the science / math-o-meter?

1. Which container will hold more fries, container A which is 2 cm x 5 cm x 5 cm or container B which is 3 cm x 4 cm x 5 cm?

2. Four students are checking their watches at the park so as not to be late for the bus. They find that their watches read as follows: 1:25, 2:45, 12:45 and 2:05 p.m. One of the watches is fast, one is slow, one stopped working, and one shows the correct time. What time is it?

3. Sam likes to visit amusement parks and collect souvenirs at each place. While at The Lake, he first checked out Good Times Gifts where he paid $1.50 each for two Boulder Dash magnets and $2.50 for an Indian pouch. In the Beach Shop he purchased a visor for $3, and at Chuckles

he found a stuffed owl for $6.50 and a Texas style foam hat for $8. His last stop was the Emporium where he bought a Lake Compounce mug for $7 and a t-shirt for $10. If Sam had $10 left at the end of his shopping spree, with how much money did he begin the day?

4. Name the three kinds of simple machines that can be found in a hand held can opener.

5. Find the following difference in Roman and base ten numerals and discover the year Lake Compounce came into existence: MMX-CLVI.

6. Shelly bought one bag of popcorn and two cotton candy for $1.50 each as well as two caramel apples for $2 each. How much change will she receive from a ten dollar bill?

7. List at least four properties of matter that can be measured.

8. If one knock equals two knicks and one knick equals three knacks, how many knacks are in three knocks?

Ba
m

9. Can a two gallon pitcher hold enough soda to give thirty-three students one eight ounce cup each? How many cups short or extra?

10. What is the term for the product of a force and the time interval over which it acts?

11. Denise, who looks young for her age, enjoys visiting the “guessing” booths at amusement parks because she wins a prize 90% of the time. With a bit of bravado, she tells the game attendant that she is thirty years old not counting Saturdays and Sundays and challenges him to guess her age in 20 seconds. Complete the task if you can.

12. Cal and a friend were being hoisted to the top of the Sky Coaster, which is about 183 feet high, when a key dropped from his jacket pockets. If the key took 6 seconds to reach the ground, find the distance in feet that the key fell. Use the formula d= - 1 /2 (9.8) (t) (t) (A negative answer indicates that the final position is lower than the starting position.)

13. A “thin skin” on the surface of water is created by this force of attraction between water molecules.

14. Jill’s last four test scores in science were 89, 81, 80, and 84. Her park lab investigations will count as a test grade. If she wishes to have an average of at least 85, what must she score on her project?

15. Do roller coasters send your heart on a joy ride or a workout? Go figure! Jim discovered that a typical male adult male heart beats about 70 times per minute. With each beat it pumps about 160ml of blood and does approximately 1 joule of work. About how much work does Jim (the Marvelous Human Machine)’s heart do in a day?

16. True or False? Tension is a force produced in a bar, rope, or string when it is stretched.

17. The Director of Park Operations called a meeting of his coaching staff three weeks before the season opened. The ten coaches in attendance were meeting for the first time since the past year and all shook hands with each other and the director. How many handshakes were there in all? ☺ Use the formula p!/ (p-2)! = h

18. Arnie’s class is at the park for Education Days. It’s 1:00 p.m. when he hears that a rainstorm is heading towards the area at a speed of 30 miles per hour. The storm is about 105 miles from Bristol. Will the storm hit before the park closes at 4:00 p.m.? If not, when?

19. A party was held at the Catering pavilions offering the following choices for creating ice cream sundaes: vanilla, chocolate, strawberry, or Compounce crunch ice cream; strawberry, hot fudge, or butterscotch topping; and the option of whipped cream or not. How many different sundaes can be made?

20. What am I? Two toothed wheels that intermesh either directly or through a chain so that one wheel turns to drive the other.

21. Lifeguards train at a competition style swimming pool that is 75 ft long, 72 ft wide, and filled to a 6 ft depth. Find the volume of the water in the pool.

22. The XYZ Container Company books a catered picnic at The Lake to celebrate twenty years in business. They request a long narrow cake shaped and decorated like a flower delivery box. The cake is to be cut into ½ inch wide pieces and is to be large enough to provide 300 slices. How many feet long will this culinary masterpiece be?

23. True or False? One watt is produced when a current of one amp from a source of one volt flows for one minute.

Ouch

24. A ride mechanic assembling the Flying Elephants in Kiddieland for the beginning of the season is using a socket wrench to tighten a bolt on the ride. He needs the next size smaller than the 7/16 inch socket in the wrench. Which size will he use?

25. The accounting office is being prepared for painting. It is 16 feet long, 14 ft wide and 8 ft high and has 3 windows and 2 doors. Each window takes up 15 square feet and each door 21 square ft. If one gallon of paint covers about 350 square ft, how many are needed to give the office one coat of paint?

26. What can Laurie do with the hammer, anvil, and stirrup she has on her person?

27. On May 18th, Rhonda inquires as to the temperature of the water at Lake Compounce beach. She is told that it is 18° Celsius. Rhonda is only familiar with degrees in Fahrenheit, so she asks her friend to make the translation. What is the temperature of the lake water?

28. What am I? The force with which air or water resists the motion of an object, such as a car, boat, or aircraft.

29. A principal wishes to purchase 184 stress relax balls for his students. The retail manager arranges for the order and packs one dozen per box. How many balls will not be in the last partially empty box? Or, depending on your perspective, how many balls will not be in the last partially full box? `R e l a x ……………. Yes!`

The Science / Math – O – Meter

Pow

29	Wizard
26 – 28	Brainiac
23 – 25	Smartie Pants
19 – 22	Sorcerer
15 – 18	Mathlete
11 - 14	SciFi
8 – 10	Artiste

Blam

4 - 7	Thinker
1 - 3	Rising Moon
0	Setting Sun

Part II: Fermi Questions

Enrico Fermi (1901-1954) was an Italian-American physicist and Nobel Laureate. He was known for achieving the first controlled nuclear reaction.

Justify All Answers and Show All Work!

1. Picnic Tables:

   a. Estimate the number of picnic tables at Lake Compounce.
   DO NOT GUESS! JUSTIFY YOUR ANSWER!

   b. If a gallon of paint covers an area of 500 ft^2 (46.38 m^2), how many gallons of paint would be needed to paint all of the picnic tables at Lake Compounce? (Show your work)

2. Zoomerang Coaster:

   a. Estimate the distance traveled by the Zoomerang Coaster in one operating season. Lake Compounce is open 90 days per year and 9 hours per day. (Show your work).

   b. Estimate the length of the cable used to haul the coaster train to the top of Lift Hill #1.

   c. Estimate the amount of weight the cable pulls in an operating season with the train fully loaded.

3. Thunder Rapids Raft Ride:

   a. Estimate the number of gallons of water that evaporate into the air, in one season, from the clothing, shoes, and hair of people that get wet on the Thunder Rapids Raft Ride.

   b. Estimate the total amount of water that is contained in the holding pond and troughs of the ride.

   c. Estimate the amount of water that the twin pumps circulate in one day.

4. Wildcat Coaster: The Wildcat was erected in 1927.

   a. Estimate the total number of passengers that theoretically could ride this ride since it opened.

   b. Estimate the amount of weight that the coaster trains have theoretically carried since 1927.

   c. Estimate the length of the lift hill chain.

   d. Estimate the number of miles the lift hill chain travels in one operating season.

5. Food Service:

   a. What is the approximate number of pepperoni slices used per day at Harborside Pizza?

   b. Estimate the number of pounds of potatoes used at the Potato Patch in one operating season.

   c. Estimate the number of grains of salt that are on all the soft pretzels sold today at the Croc Pot.
   Base your estimates on observations, do not guess.

6. Compounce Mt. Skyride:

   a. Estimate the length of the haul rope (cable).

   b. Estimate the amount of weight of all guests if each chair were fully loaded with average size adults.

c. Estimate the distance that the ride travels in one operating season.

7. Ferris Wheel:

a. Estimate (or calculate) the number of light bulbs on the Ferris Wheel.

b. Estimate the weight in pounds of the wheel empty, and then fully loaded with average adults.

8. Lake Compounce:

a. Estimate the surface area of the Lake's surface.

b. Estimate the volume of water in the Lake.
(Note: deepest water is 19 feet)

9. Compounce Railway:

a. Estimate the number of railroad ties used to support the track.

b. Estimate the length of track.

c. Estimate the total number pounds the train can pull in one day if fully loaded with average size adults.

10. The Carousel:

a. What is the approximate distance traveled by the lead horse on the outside edge of the Carousel in one operating season?

b. Estimate the gross interior volume of the Carousel Building.

11. The Grand Ballroom was transformed into the Starlight Theatre:

a. Estimate the number of shingles that cover the roof on the Theatre. Base your estimates on observations. Do not guess. (Show work)

b. Estimate the total volume of the Theatre. Do not guess.

12. Material World:

a. Estimate the surface area of all the asphalt walkways within the park.

b. Estimate the number of incandescent light bulbs in use at Lake Compounce.

13. Kiddie Bumper Cars:

a. Estimate the distance traveled by ten cars during a single ride cycle.

b. The drivers of the Bumper Cars are not known for their ability to avoid collisions. Estimate the number of collisions that occur during one operating season.

14. Survey each ride and attraction at Lake Compounce and then determine the hourly entertainment capacity of the total facility. (Disregard buildings; concentrate on moving equipment only).