



Math & Science Day

To The Teacher

The activities found in the Math & Science Day workbook were written to focus on specific skills by answering interesting questions about the rides and other features found throughout **Six Flags Over Texas**. Our activities incorporate mathematics and science appropriate for the middle grades. We recommend that you look carefully at these activities to determine which ones are appropriate for your students. We believe that students should be given a reasonable set of well-defined lesson goals to accomplish while at the park.

It is suggested that students work in groups of 2 or 4. Students will have a more enjoyable and successful **Math & Science Day at Six Flags Over Texas** if you discuss measurement and data-gathering tools, strategies and concepts with them before they come to the park. Height-Finders, if you plan to use them, should be constructed and used for practice in advance (instructions on how to make a Height-Finder can be found in the workbook). This makes an excellent class project.

We have included information that will allow you and/or your students to develop additional activities or questions if you so desire. To assist in this, data about the rides at **Six Flags Over Texas** can be found at the end of the workbook.

Electronic data collecting devices can be used on any of the activities but have not been included at this point since some schools have not yet acquired the needed technology. If you have been using this technology and feel comfortable with letting students bring it to the park, please feel free to add to the "Equipment Needed" and adjust the activities to accommodate the change in procedure.

We hope you enjoy your day of fun with science, mathematics and discovery at
Six Flags Over Texas!

Six Flags
MATH $A=1/2bh$
AND
SCIENCE
DAY

WORKBOOK

**Mathematics & Science Activities
for Grades 6 – 8**



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LIST OF EQUIPMENT NEEDED

(one of each item per group)

- 1. Watch/Stopwatch** with a second hand
- 2. Height-Finder**
- 3. Measuring tape** with centimeters
- 4. Pencil, Paper** and ***Math & Science Day Workbook***
- 5. Backpack** or fanny pack to hold equipment
- 6. Coin** or one-inch **metal washer**
- 7. Calculator**

TANGENT TABLE

(Attach to the back of the Height-Finder)

Table of Tangents

Angle	Tan.								
1	.02	17	.31	33	.65	49	1.15	65	2.14
2	.03	18	.32	34	.67	50	1.19	66	2.25
3	.05	19	.34	35	.70	51	1.23	67	2.36
4	.07	20	.36	36	.73	52	1.28	68	2.48
5	.09	21	.38	37	.75	53	1.33	69	2.61
6	.11	22	.40	38	.78	54	1.38	70	2.75
7	.12	23	.42	39	.81	55	1.43	71	2.90
8	.14	24	.45	40	.84	56	1.48	72	3.08
9	.16	25	.47	41	.87	57	1.54	73	3.27
10	.18	26	.49	42	.90	58	1.60	74	3.49
11	.19	27	.51	43	.93	59	1.66	75	3.73
12	.21	28	.53	44	.97	60	1.73	76	4.01
13	.23	29	.55	45	1.00	61	1.80	77	4.33
14	.25	30	.58	46	1.04	62	1.88	78	4.70
15	.27	31	.60	47	1.07	63	1.96	79	5.14
16	.29	32	.62	48	1.11	64	2.05	80	5.67

Suggestion: Reproduce this table to fit onto the back of the Height-Finder for easy reference. Again, you can fit four on a page, then cut and paste; or you can copy them onto **card stock**, cut them apart, and tape onto the back of the finished Height-Finder.

If you have access to a **laminating machine**, you might want to laminate the Height-Finder/Tangent Table **BEFORE YOU ATTACH THE STRAW OR THE STRING** so it will hold up better during use.

MAKING MEASUREMENTS

TIME

If you must figure an amount of time in order to work a problem, use a stopwatch, a digital watch with a stopwatch mode, or a watch with a second hand. When measuring the period of a ride that involves circular motion, measure the time for several repetitions of the motion, then divide by the number of repetitions. This will give a better estimate of the period of motion than just measuring one repetition. It is best to measure two or three times and then take an average.

DISTANCE

Since you cannot interfere with the normal operation of the rides, you will not directly be able to measure heights, diameters, etc. Using the following methods, most of the distances can be measured remotely to give you a reasonable estimate. Try to keep consistent units (i.e. meters, centimeters, etc.) to make calculations easier.

- **Pacing:** Determine the length of your stride by walking at your normal rate over a measured distance. Divide the distance by the number of steps to get an average distance per step. Knowing this, you can pace off horizontal distances.
- **Ride Structure:** Distance estimates can be made by noting regularities in the structure of a ride. For example, tracks may have regularly spaced cross bars as shown in *figure a*.

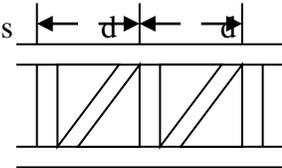


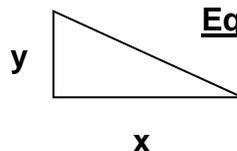
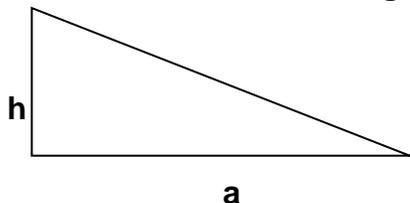
figure a

- **Using a Height Finder:** This is known as Triangulation (see next page)

FINDING THE HEIGHT OF AN OBJECT

Using Ratio and Proportion

Method I:



Equation to solve (solve for h):

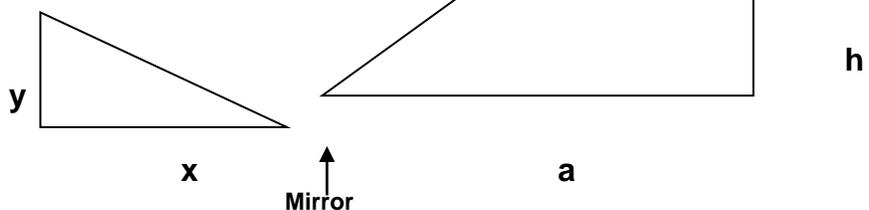
$$\frac{h}{a} = \frac{y}{x}$$

Legend:

- h** = height of the object
- a** = length of shadow of the object
- y** = height of the observer
- x** = length of shadow of the observer

Method II:

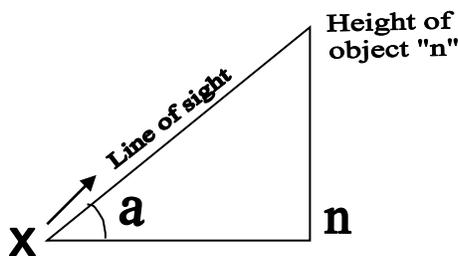
Place the mirror so that you can see the top of the object being observed



USING A HEIGHT FINDER

(Triangulation)

When you want to determine the height of an object that you cannot physically measure, apply a little geometry. Imagine that you are at the bottom **point x** of the diagonal side (hypotenuse) of a right triangle and looking up at the top along the hypotenuse where the top of the **object n** you are measuring is located. The **angle a** created between your view up the hypotenuse and a horizontal line from your eyes to the **object n** can be measured with the Height-Finder. When an object is sighted through the Height-Finder, the number of degrees in **angle a** can be read from the pointer. Find the appropriate **tangent** from the Tangent Table provided.



Distance from viewer to object being measured (baseline)

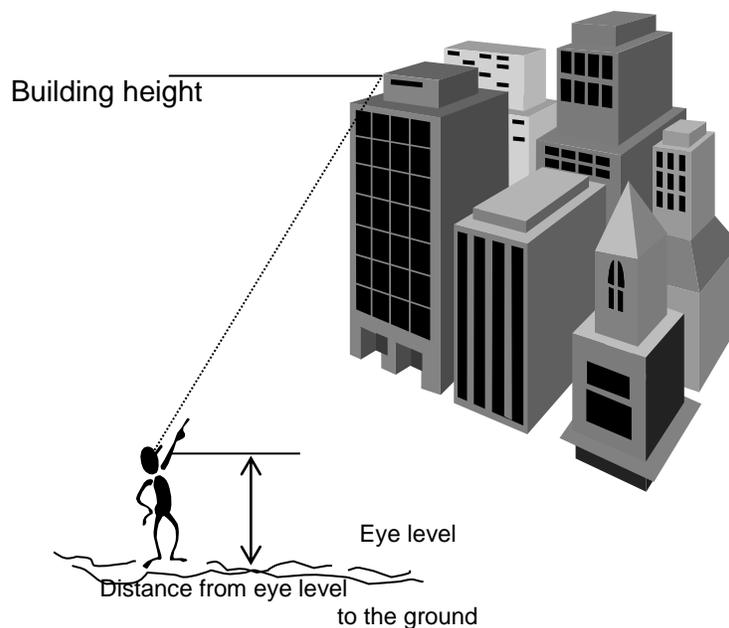
FORMULA:

Tangent of **angle a** (in degrees) _____
times the baseline distance (___ meters)
plus your eye level height
equals the height of the object
-OR-

$$[\tan a^\circ] \times [\text{baseline}] + \text{eyelevel} = \text{height}$$

Example:

If **angle a = 36°** it would have a tangent of **.73**. If the distance of the baseline from you to the object was 120 ft (or **1,440 inches**) and your eyelevel height was **43 inches**, then the equation to find the height of "**n**" would be as follows:
[.73 x 1440 in.] + 43 in. = 1094.2 in.
(91.18 ft.)



BEFORE GOING TO SIX FLAGS

Introduction: Before going anywhere, it is important to plan a budget. In order to have a successful field trip to *Six Flags Over Texas*, think about any money you will want to take.

Mission: Problem-solving with decimals (Math TEKS 6.2B, 7.2B)

If on your field trip you plan to eat lunch, play 2 boardwalk games, buy a souvenir, and buy an additional drink during the day, what is a reasonable amount of money to take with you? Justify your answer.

Activity or item	Price Range
Boardwalk games	\$3.00 – 5.00
Meals	\$10.00 – 13.00
Souvenirs	\$5.00 – 30.00
Drinks	\$5.00 – 6.00
Refillable Souvenir Bottle with Soda	\$14.00 -16.00
Soda Refill in Souvenir Bottle	\$1.50 – 2.50

(Prices are approximate and subject to change)

Introduction: There are examples all around us of natural and man-made things breaking down or deteriorating because of their exposure to various conditions in the atmosphere. This is called “weathering.”

Mission: Recognizing and identifying examples of weathering
(Science TEKS: 6.2B, 7.2B, 7.7A, 7.14B, 8.2B)

Before you go to the park, make a list of some types of chemical and physical weathering that you might observe. When you go to the park, look for as many examples of both chemical and physical weathering as you can find. Write down where you saw them (be specific -- on buildings, rocks, rides?) Describe what the weathering looked like.

THROUGHOUT THE PARK

Introduction: When you think of a system as “anything that has parts,” you can apply it to almost anything. Have you ever thought of all of the systems in a park such as *Six Flags Over Texas*?

Mission: Identifying systems (Science TEKS: 6.2C, 6.5A & B, 7.2C)

- a. Pick two things from anywhere in the park that would come from different systems (one very large and one very small). Describe each one and identify all of the parts that make it a system.
- b. Pick two systems that interact (from anywhere in the park). Describe each system and tell how they interact and influence each other.

Introduction: Parks like *Six Flags Over Texas* are designed to anticipate the number of people that can safely be in the park at one time. Engineers estimate the number of people who can fit in line for a ride and the number of people who can ride at one time for safety reasons.

Mission: Estimating and communicating
(Math TEKS 6.10; Science TEKS 6.4B)

- a. Choose three rides and estimate the number of people that can ride each at one time.
- b. Describe your answers in terms of median and range.

Introduction: Have you ever noticed that your heart seems to beat faster when you get excited? What effect does riding a ride have on you?

Mission: Looking for differences in pulse rates
(Science TEKS: 6.2B, 6.4A, 6.12B, 7.2B, 7.4A, 7.9B, 7.11B, 8.2B, 8.4A, 8.6B)

Find a pulse point on your body – your wrist, neck, or temple [be sure to use your pointer finger and not your thumb to count the number of beats]. Using the second hand on a watch or a stopwatch, count the number of pulses in 15 seconds and multiply by 4. **Take your pulse rate before riding and again after riding**. Is there a difference? Why is this so? Collect this data before and after several rides.

STAR MALL

Location: Silver Star Carousel

Introduction: Did you know that this carousel ride is a replica of the ornate, hand-carved rides commonly found in Germany in the early 1900's? Ride back in time as you learn what makes a carousel special.

Mission #1: Determining the rate of motion (Science TEKS 6.2B, 6.4A, 7.2B, 7.4A, 8.2B, 8.4A)

- Each member of the group should choose a different moving animal to observe. Count the number of times the animal goes up and down in one minute. Record and compare results for each of the animals observed.
- Determine the time it takes for one complete rotation of the carousel. To do this, choose one animal and time how long it takes to complete an entire rotation. Record your results. Repeat this procedure to check for accuracy.

Mission #2: Calculating percentages (Math TEKS: 7.3A, 8.3B, 8.7A)

- Imagine a bird's eye view of the ride. Draw a diagram to show where the animals are in relation to the center of the ride. Be sure to include an accurate count of the total number of animals.
- Count the number of stationary animals. Determine the percentage of stationary animals to the total number of animals. Determine the percentage of animals that ended in the up position, in the down position, and in the middle position.

Mission #3: Observing the path of moving objects (Science TEKS 6.6A,B, 7.6B, 8.7A)

- Predict what would happen if a coin is dropped from the outer edge of the carousel while the carousel is moving. What path would it take? Why do you think it would travel that path?
- Get on the carousel and drop a coin (or metal washer) from the edge. Record your results. Have each member of your group do the same procedure (dropping the object from the same height each time). Record each person's results and describe any similarities or differences.
- When you return to school, investigate how your results correlate to Sir Isaac Newton's First Law of Motion.

TEXAS SECTION

Location: New Texas Giant (Hybrid Roller Coaster)

Introduction: This world-class hybrid roller coaster (wood and steel) is known for its rapid descents, fast aggressive corners, high speed, and sudden direction changes. Have you ever wondered who rides roller coasters and why people love to ride them? Let us investigate!

Mission #1: Collecting, graphing and interpreting data (Science TEKS: 6.2B, 6.4B, 7.2 B, 8.2B, Math TEKS 6.10D)

Observe the ride at least once as a group. What things did you notice about the ride? Gather data by selecting at least one of the following:

- Does the time vary from ride to ride? Time the ride from beginning to end five times. Do the times vary? Why or why not? Graph your results.
- Tally the number of males vs. females during three ride cycles. Are there more males than females? Why or why not?
- Tally the approximate age of the riders for two ride cycles (classifications should include child, young adult, adult and older adult). What age group is most represented? Give possible reasons for your results.
- Who rides in the front and in the back of the ride? Do more males or females ride the front and/or back of the coaster? Why or why not?
- Investigate a question of your own that can be answered by collecting data.

Mission #2: Finding the height of the highest point of the ride (Math TEKS 6.8)

- Using your Height-Finder, sight through the straw toward the highest point of the ride. What is the distance from where you are to the base of the New Texas Giant?
[Notice and record the angle of the pointer (this is **angle a**)].
- Use the following formula to determine the height of this ride:

[Tangent of **angle a** (in degrees)] X [baseline distance (in meters)] + your eye level height = height of the object

(NOTE: Another way to do this is by using a graphing calculator with trigonometric functions)

TOWER SECTION

Location: Roaring Rapids (River Rapids Ride)

Introduction: Be ready to get wet on a wild, twisting, turning, whitewater river ride complete with drenching waterfalls and long, winding river embankments.

Mission: Determining rates of travel (Science TEKS 6.6A, 7.6B)

- a. Determine the rate of travel in your boat.
- b. How could you increase your rate of travel?
- c. The length traveled is a distance of 1800 ft. Time and record your ride from beginning to end. Calculate the speed by using the following formula:

$$\text{[Distance traveled]} \div \text{[time it took to travel the entire distance]} = \text{speed}$$

USA SECTION

Location: Gotham Games (Skill Games)

Mission: Determining the probability (Math TEKS: 6.9B)

Pick a midway game and describe the probability of winning in one round (consider the number of participants and the number of chances).

BOOMTOWN

Location: Gunslinger (Swings)

Introduction: Have you ever wondered what it would feel like to ride aboard a spinning top? Riders on the Gunslinger are seated in individual seats that swing from a rotating top. It's a swinging time!

Mission: Calculating the speed of a ride (Math TEKS: 7.2D)

- a. Time the ride from the moment it begins to the moment it ends and count the number of rotations completed in that time.
- b. Compute the average number of rotations per minute.

Introduction: Have you and a friend or pen pal ever written to each other in a secret code? Here is a mathematical secret code. See if you can figure it out!

Mission: Using problem-solving techniques (Math TEKS: 6.1E)

Maria's pen pal asked her to meet him at the swing ride. He gave her the following clues to determine who he was:

- a. Number the swings #1 - 48.
- b. Omit every other swing starting with #2 (the even numbered swings) until only one person is left.
 - (1) In which seat is her pen pal sitting?
 - (2) What is the pattern for predicting which is the correct swing for any number of swings?

SUGGESTION: It may be helpful to draw this out.

Location: Runaway Mine Train (Steel Roller Coaster)

Introduction: All aboard your own runaway mine car, an exciting ride that plunges riders through an abandoned mine.

Mission: Finding the distance (Math TEKS: 8.2, 8.3B)

Time the ride from beginning to end. If the average speed of the train is 35 mph, find the length of the ride by using this formula:

$$\text{rate (speed*)} \times \text{time} = \text{distance}$$

BACK AT SCHOOL

Introduction:

Have you ever thought of a ride that you think would be fun but doesn't exist? What would you have to know to design such a thing?

Mission: Designing a ride (Science TEKS: 8.5A)

Design a new ride that you have never seen before. Draw it and describe what it would be made of and how it would work. Discuss any design problems there might be in making such a ride and propose how you might solve those problems.

DATA FROM ROLLER COASTER DATABASE

(www.rcdb.com)

Six Flags Over Texas

BATMAN The Ride: Length 823m; Height 32m; Inversions 5; Speed 80.5kph; Duration 2 min, 15 sec; Capacity 1400 riders/hr

New Texas Giant: Length 1499.6m; Height 43.6m; Drop 41.8m; Inversions 0; Speed 104.6kph; Duration 3 min 25 sec; Steepest Drop 79°

Shock Wave: Length 1097.3m; Height 35.4m; Inversions 2; Speed 96.6 kph; Duration 2 min, 40 sec

MR. Freeze: Reverse Blast: Length 396.2m; Height 66.4 m; Inversions 1; Speed 112.7kph, Duration 1 min, 30 sec

Runaway Mine Train: Length 731.5m; Height 10.7m; Inversions 0; Duration 4 min, 45 sec

SIX FLAGS OVER TEXAS APPROXIMATE DATA

ROLLER COASTERS

<p>BATMAN The Ride</p> <p>Height: 109 ft 6 in Max. Speed: 50 mph Length of Train: 40 ft Weight (empty train): 20000 lbs; 32 seats Height of Loops: 77 ft, 68 ft</p>	<p>New Texas Giant</p> <p>Height: 153 ft Max. Speed: 65 mph Length of Train: 52 ft Weight (empty train): 15000 lbs; 24 seats</p> <ul style="list-style-type: none"> ■ Uses 250hp dc motor at 400 amps at 500 volts, full load
<p>Shock Wave</p> <p>Height: 116 ft Max. Speed: 55 mph Length of Train: 49 ft Weight (empty train): 12000 lbs; 28 seats Loop: 70 ft tall</p>	<p>Runaway Mine Train</p> <p>Height: 35 ft Max. Speed: 35 mph Length of Train: 48 ft Weight (empty train): 9000 lbs; 30 seats Climb up first hill: 4.8ft/sec.</p> <ul style="list-style-type: none"> ■ Accelerates up the first hill
<p>MR. FREEZE: Reverse Blast</p> <p>Height: 236 ft Max. Speed: 70 mph Length of Train: 42 ft Weight (empty train): 11000 lbs; 20 seats</p> <ul style="list-style-type: none"> ■ Accelerates from 0-70 mph in 3.8s ■ Uses Linear Induction Motors (LIM) for launch (44 pairs of LIM motors at 600 volts AC and 4600 amps) 	

WATER RIDES

OTHER RIDES

<p>El Aserradero (Log Ride)</p> <ul style="list-style-type: none"> ■ Conveyor Belt travels at 3ft/sec ■ Main Drop 30 ft ■ 160,000 gallons water <p>Roaring Rapids</p> <ul style="list-style-type: none"> ■ 2 pumps; 400 hp each ■ 2,000,000 gallons water 	<p>The Train</p> <p>Length of Track: 1 mile Average Speed: 7 mph</p>
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Park power comes in at 12500 volts; peak demand 6.5 Megawatts.



SixFlags®

OVER TEXAS



 Kennels and Cooler Storage, & Trolley Stop

 PARKING

Located in Arlington
between Dallas and Fort Worth
 at the intersection of Interstate 30
 and Highway 360

For park information, call (817) 640-8900
 or visit sixflags.com.



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MAP LEGEND

-  First Aid
-  Security/Lost & Found
-  Restrooms
-  Wheelchair Restrooms
-  Baby Care/Lost Parents
-  Guest Relations
-  Public Lockers
-  Kennels