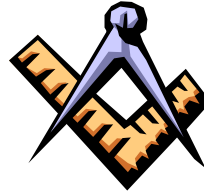


Math & Science



Study Guide



405 Perry Road
Bangor, ME 04401
207-990-3600
www.colemuseum.org

*Open May 1 thru November 11
Seven Days A Week
9:00 am to 5:00 pm*

A Word About Math Problems

There are three types of problem-solving experiences provided in this unit: one-step problems, multiple-step problems, and process problems. The process problems cannot be solved by merely adding, subtracting, multiplying or dividing. They are solved by using one or more of these strategies:

1. Guess and Check
2. Make an Organized List
3. Draw a picture
4. Make a Table
5. Work Backwards
6. Look for a pattern

Read the problem aloud to students. Encourage students to verbalize their thought processes as they choose strategies and find solutions. Concentrate on students' efforts rather than correct answers. Calculators may be helpful. The goal is to teach students techniques with which to tackle problems.

Enjoy!

(Resource: *The Problem Solver*, available in grade levels 1-8, by Creative publications)

Math

Easy

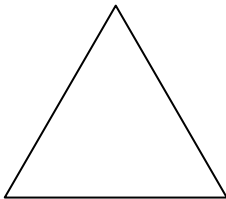
1. Estimate: (Hint: a good estimate is based on finding a pattern)
 - How many transportation vehicles are in the museum?
 - About how many cobblestones are in the museum?
 - About how much land is located under the museum?
2. Joseph wants to go to Boston from Hampden. He can ride a mule or a horse to Bangor. From Bangor he can take a boat, the train, or a wagon to Boston. What are the different ways Joseph can get to Boston from Hampden? (Hint: Draw a picture)
3. 49 adults and children are sitting on the Union Station benches. There are 13 fewer children than adults. How many adults and how many children are there? (Hint: Guess and check)
4. In the early 1900's, four pairs of horses would be used to pull the snow roller over the main streets of Bangor. It could not move as fast as a person could walk: it averaged about 2 miles per hour. How many miles of snow would it have rolled before it changed horses at noon if it started at 7:00am?
5. In Aroostook County growing potatoes was the main industry. A potato wagon hauled the barrels of potatoes out of the fields. A barrel would hold approximately 65 pounds of potatoes. If a person picked 6 full barrels, how many pounds of potatoes would he have picked?

If they paid me \$.25 a barrel, how much money did I make?
6. The Cole Museum has many categories of land transportation with different amounts of equipment in each category. It includes 30 pieces of recreation equipment, 9 pieces of snow removal equipment, 2 blacksmith shops with tools, 10 buggies and sleighs, 10 fire trucks, 6 wagons and carts, 6 automobiles, 6 farm tractors, 12 Cole freight vehicles, 2 logging trucks, 2 horses, 2 military vehicles, and 16 miscellaneous items. Graph and label this information.
7. Years ago instead of moving the snow from the road, huge rollers were used to pack snow down. Rollers pulled by 6 horses traveled about 2 miles per hour. How far could these rollers travel in 14 hours?
8. The Veazie Railroad was the first railroad in New England and is one of the oldest railroads in the United States. This train traveled at 12 miles per hour. Non-stop how long would it take to get to Old Town from Bangor?
9. The Cole Museum has automobiles and motorcycles. Mr. Cole said he could not remember how many of each he had, but he knew he had 8 vehicles with a total of 8 wheels. How many autos and how many motorcycles does Cole's Museum have? (Hint: Guess and Check)
10. In 1933 the model 80 Cletrac plow used 4 gallons of gas per mile and could hold 100 gallons of gas. How many miles could it go before it had to refuel?

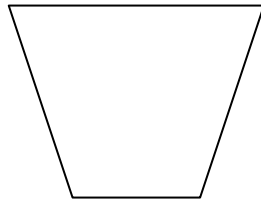
Today, many cars get 30 miles to a gallon. How many miles could a new car get with 100 gallons of gas?

The Cletrac could not plow as fast as someone could walk. In fact, it probably averaged 2 miles per hour. If the driver only works an 8-hour day, will he use a whole tank of gas?

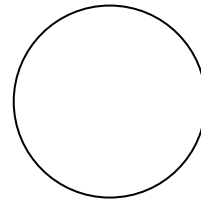
11. The museum has a collection of early license plates. One 1935 plate has the number 625. If each plate has to have 3 digits and you can only use each digit in the above plate once, how many different combinations could be made? (Hint: Make an Organized List)
12. The snow blower could travel $\frac{1}{2}$ mile with one gallon of gasoline. If the snow blower traveled 12 miles, how many gallons of gasoline would it use?
13. The first Maine license plate was issued in 1905. The first time the word "Vacationland" appeared was 1936. How many years later was this?
14. If the potato wagon can carry 21 barrels per trip, how many trips must be made to carry 63 barrels of potatoes?
15. If the GMC potato truck can hold 40 barrels of potatoes and the potato wagon can carry only 21 barrels, how many more barrels can the truck haul than the wagon?
16. Can you find something in the museum whose number has a 5 in the hundreds place, a five in the tens place, and a 7 in the ones place?
17. If the head cook earned \$4.00 per day and the cook's helper earned only \$2.50 per day in a logging camp, how much more does the head cook earn each day?
18. Trolley cars in the Bangor area stopped running in 1946. How many years ago was that?
19. The Model T tractor conversion kit was purchased in 1930 from Sears for \$99.50. After paying \$9.00 down, how much remains to be paid?
20. Give an example of each geometric figure by drawing a picture of the vehicle in which the figure is located.



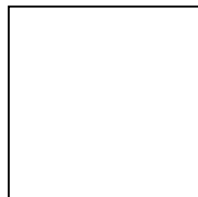
(Triangle)



(Trapezoid)



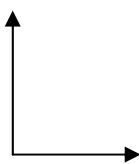
(Circle)



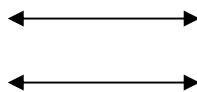
(Square)



(Rectangle)



(Angle)



(Parallel Lines)



(Perpendicular Lines)

Medium

21. The first roads were dirt and mud. Then there were gravel roads. Eventually larger towns and cities used cobblestones. Cole Museum decided to lay some cobblestones as display areas. On the first day workers laid 100 stones, on the second day they laid 200, and on the third day 400. At this rate on which day will all 35,000 stones be laid? (Hint: Make a Table)

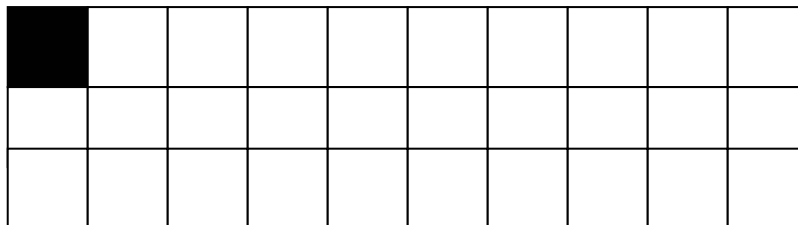
Cole Museum has 35,000 cobblestones, which is 10% of what was in the Bangor railroad yard. How many cobblestones were in the railroad yard?

22. Meredith got on the train and paid the conductor \$.45 for her trip to Lincoln from Bangor. How many different groups of coins could Meredith have used to pay her train fare? (Hint: Make an Organized List)
23. The bench seats as you enter Cole Museum are from the Bangor Union Station. Each bench is 18 feet long. If each student needs 9 inches of space to sit, how many students could sit on one bench?

There are 4 benches in the museum. How many students could sit on all the benches?

24. Pleasant Hill Dairy delivered milk to homes for 38 years. They delivered milk in quarts, pints, and half-pints. A metal carrying case could carry 8 containers. How many different combinations could fill a carrying case?
25. Cole Museum has the largest collection of one company's trucks from horse drawn to 18-wheelers in the United States. One of those trucks is the Diamond Reo. The Diamond Reo tractor "retired" with over a million miles driven on it. How much is a million miles? Explain it in such a way that a young child could understand.

The Museum has 35,000 cobblestones. This is only about 1/30 of one million, or the shaded part of this figure.



How many more cobblestones does the museum need to make 1,000,000?

26. In 1920 gas sold for 6 9/10 cents per gallon. How much would it cost to fill a 10-gallon tank in a Model T auto?

If gas sells for 1.21 9/10 per gallon. How much would it cost to fill a Model T gas tank?

Many of today's cars have a 16-gallon tank. If the tank is 3/4 empty, how much will it cost to fill it?

27. The Model T tractor attachment in 1930 sold for \$99.50 in the Sears catalog for "\$9 down and low monthly installments." How much would monthly payments be if you wished to have it paid in 12 equal monthly payments? (Round to the nearest cent)

Estimated Freight Charges per 100 lbs. of Tractor attachments	
150 Miles	→ \$0.51
300 Miles	→ \$0.64
500 Miles	→ \$1.01
750 Miles	→ \$1.33

Using the above chart, about what would it cost to ship 300 pounds of tractor equipment from Boston to Bangor.

Today, Sears would charge you 18% interest per year to borrow money. What would your payments on the tractor have been with 18% interest? (Round to the nearest cent)

Hard

28. Jeffrey was working his first day at the railroad blacksmith shop. Metal parts were made here. Jeffrey's boss asked him for a special size tong, but Jeffrey had no idea of the names of the tools. He quickly reached for something and hoped it was the correct tool. If there were 40 different tongs, 50 different hammers, and 10 different molds, what was the probability that Jeffrey grabbed any tong?

What was the probability that Jeffrey grabbed the correct size tong?

29. Larry was helping to harvest potatoes and was carrying potatoes in a basket. First, he tripped and spilled one third of them. Then he gave one half of what was left in the basket to his friend Mary. When Larry started out again, he didn't notice he had a hole in his basket and he lost two thirds of what was left in the basket. When Larry arrived at the truck he had 6 potatoes left. How many potatoes did Larry start with? (Hint: Work Backwards)

30. Corduroy roads were made of lengths of alder trees laid side by side over muddy and swampy areas. Alders were plentiful and easy to cut because of their slenderness. Roads were constructed quickly and vehicles would not get stuck in the mud. One day Annie and Marge were up at sunrise. At 6:00am they started laying alder logs. In the first half hour they laid 10 logs. In the second half hour they laid 11 logs, and in the third half hour they laid 8 logs. In the fourth half hour they laid 9, and 6 in the fifth half hour.

Annie and Marge were tired but they decided to keep working until they had no more logs. At the rate they were going, how long will they have worked? (Hint: Make a Table/Find a Pattern)

31. The watering trough outside of Cole Museum was used to water horses when they were the usual form of transportation. There appears to be two parts to this trough. The first rectangular shape measures 62" long, 36" wide, and 24" deep. The base measures 67" x 42" x 13". What is the volume of each? _____ What is the total volume? _____

Solutions To Problems

1. Over 200
35,000 acre
2. 6 ways
Mule, horse, boat, train, wagon
3. 31 adults, 18 children
4. 10 miles
5. $165 \times 6 = 990\text{lbs}$
 $\$.25 \times 6 = \1.50
6. Bar graph should have title
7. 28 miles
8. It is about 12 miles to Old Town from Bangor, so it would take about one hour.
9. 6 autos
2 motorcycles
10. 25 miles
3,000 miles
No, as 2 times 8 is 16
11. 625 has 6 combinations

6 2 5
6 5 2
2 5 6
2 6 5
5 2 6
5 6 2

7236 has 24 combinations

7 2 3 6	6 ways with one digit at beginning
7 2 6 3	
7 6 3 2	
7 6 2 3	
7 3 6 2	
7 3 2 6	
6 2 3 7	4 digits in all $6 \times 4 = 24$
6 2 7 3	
12. 24 gallons
13. 31 years
14. 3 trips
15. 19 barrels
16. Fire engine number
17. \$1.50
18. 45 years
19. \$90.50
20. Many answers

21. On the 9th day

Day	One	Two	Three	Four	Five	Six	Seven	Eight	Nine
Stones	100	200	400	800	1600	3200	6400	12800	25600
Total	100	300	700	1500	3100	6300	12700	25500	51100

22. 39 combinations

.25	.10	.05	.01	.25	.10	.05	.01	.25	.10	.05
1	2	0	0	0	4	1	0	0	2	0
1	1	2	0	0	4	0	5	0	1	7
1	1	1	5	0	3	3	0	0	1	6
1	1	0	10	0	3	2	5	0	1	5
1	0	4	0	0	3	1	10	0	1	4
1	0	3	5	0	3	0	15	0	1	3
1	0	2	10	0	2	5	0	0	1	2
1	0	1	15	0	2	4	5	0	1	1
1	0	0	20	0	2	3	10	0	1	0
				0	2	2	15	0	0	8
				0	2	1	20	0	0	8
								0	0	7
								0	0	6
								0	0	5
								0	0	4
								0	0	3
								0	0	2
								0	0	1
								0	0	0

23. 24 students on one bench
96 students on 4 benches

24. 45 combinations

Quarts	Pints	Half Pints
8	0	0
7	1	0
7	0	1
6	2	0
6	1	1
6	0	2
5	3	0
5	2	1
5	1	2
5	0	3
4	4	0

25. Cole's Museum needs 965,000 more stones.

26. \$1.69
\$12.19
\$14.63
27. \$7.55 per month
About 240 miles from Boston. Estimate price at 300 miles on the chart for a shipping rate of \$1.92
\$8.90 per month
28. 40 out of 100 or 4 out of 10 or 2 out of 5
29. 4 potatoes
($6 * \frac{3}{4} = 9$
 $9 * \frac{2}{1} = 18$
 $18 * \frac{3}{1} = 54$)
30. $5 \frac{1}{2}$ hours

Hours	.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5
Half Hour	1	2	3	4	5	6	7	8	9	10	11
# of Logs	10	11	8	9	6	7	4	5	2	3	0

31. $54,432 \text{ in}^3$
 $+36,582 \text{ in}^3$

 $91,014 \text{ in}^3$ Total

Science

1. The museum ice cutter was used to take ice from Birch Stream, a pond on the Bishop Maplewood Farm in LaGrange, ME, and shipped all over Maine and to places as far away as Bermuda. Before the invention of refrigeration, ice was packed in sawdust to keep it from melting. Do the following experiment to see if this was an efficient method.

Procedure

1. Use 3 ice cubes
 2. Leave one without covering
 3. Pack one in sawdust
 4. Pack one in some other material such as newspaper or Styrofoam
 5. Measure the mass of the ice in 5 minute intervals
 6. Record your data and write your conclusions.
2. The sprayer is a farm machine that spreads chemicals on the potatoes to protect the crops from blight, diseases, insects, and also to kill the potato tops. Research the chemicals that are used and report what effect, if any, these chemicals have on the environment. Have any of these chemicals been changed or eliminated over the years?
 3. The Cole Land Transportation Museum has many land transportation vehicles. Classify as many as you can remember in each category.

Manual	Horse-Drawn Sleigh	Motorized

4. Cole's tank cars were used to carry fuel north to Aroostook Country and to bring a load of potatoes and/or paper on a southbound trip. How did this invention help the economy? Design another vehicle that could be used for a dual purpose.
5. Potatoes were transported in Maine by sled, wagon, truck, and train. The potato planter and digger were two important machines used on the potato farms. Plant several seed potatoes.

Simple Machines

A. Wheel and Axle

Materials

- 2 boxes of the same size, one with wheels
- Sand
- Spring Scale

Procedure

1. Place the sand in the box without wheels
2. Attach the scale to one end of the box
3. Holding the other end of the scale, drag the box a distance of one yard
4. Record the number of ounces indicated on the scale while the dragging was in progress
5. Repeat the procedure with the box with wheels

Thought Questions

1. Why is it important to use grease and oil in connection with the wheel and axle?
2. What example of this experiment was used in the Cole Museum?

B. Lever

Materials

- Heavy object
- Yardstick
- Hammer
- Nutcracker
- Scissors
- Tweezers

Procedure

1. Identify the three important points of every lever; fulcrum, force, weight.
2. Encourage the student to try to do some hand work which can be made easier by using a lever such as: crack a nut by hand, pull a nail with fingers, and lift a heavy object.

Thought Question

1. What levers did you see being used in the Cole Museum?

C. Pulley

Materials

- Bucket
- Two or more single wheel pulleys
- Weight
- Cord
- Spring Scales

Procedure

1. Lift up weight by cord and spring scales
2. Record Weight
3. Put a small rope cord over the pulley and tie one handle of the rope to the handle of the bucket.
4. Attach the spring scale to the other end of the rope. Pull down until the bucket is raised. Record the reading

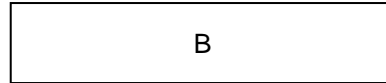
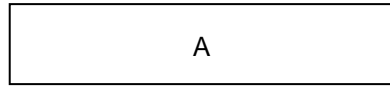
Thought Question

1. Where did you see pulleys used in the Cole Museum?

8. Read aloud to the teams:
 1. You will have 15 minutes (running clock; no time outs) to complete this problem. You will be given a warning when you have 2 minutes remaining.
 2. You may talk once time begins.
 3. A clamshell is used to move soil when building roads.

Your challenge is:

- a. Before you is a table marked with areas A and B.



- b. There is a pound of sand in area A.
- c. Your team is to move one pound of sand from area A to area B by building at least 2 or more structures from the material given to you.
- d. No team member may cross the boundary line, nor allow any body part to cross the boundary line.
- e. Your team will receive 5 points for each structure made and 5 points for successfully transferring the sand from area A to area B.
- f. I will read the problem again (Repeat 1, 2, 3, and 4 completely).

For Judges/Teachers only:

1. Divide the students into teams of 4-6
2. Be sure to end exactly at 15 minutes
3. Materials for each team:
 - 1-8 oz paper cup
 - 10" piece of string
 - Two self sticking mailing labels
 - One paper clip
 - One 3" x 5" card
 - Two pieces of paper
 - One pair of scissors

9. In 1844 Samuel F.B. Morse developed a system of sending messages by using a special code. This code consisted of long and short signals and is called the Morse Code. Research to learn the Morse Code. Then using a flashlight, send a Morse Code message to a friend. Ask the friend to write down your message in dots and dashes and then decode it into letters. Read the message. Is it the same one you sent? Evaluate your techniques. How might they be improved to make your messages more accurate?
10. The B and A railroad ran on the ground on two rails, but trains of the future may not. Trains may travel underground through airless tunnels. Because of no wind resistance, the train could float above a single rail on a cushion of air. Japan has been experimenting with such a train that has reached speeds of 310 mph. Think about the apparent emphasis on speed in future transportation. What are the advantages of faster transportation? What are the disadvantages? What do we gain by traveling more and more rapidly? What do we give up? Design a brochure for a futuristic train. Will it go to exotic spots? Have comforts? Food? What are some of the advantages it will have over other forms of transportation?
11. Cole Museum has grouped its equipment into categories: snow removal, fire equipment, autos, farm equipment, and trucks. List at least 5 items in each of these categories.
12. During the 1960's, scientists had to modify everyday conveniences to make them suitable for use by astronauts on a voyage to the moon. Suppose that the modern counterparts of the tools you listed had to be modified for space travel. Choose one and redesign it for use in the vacuum of outer space. Either make a model or draw a picture of the redesigned item.
13. What if a photocopy machine could duplicate anything so that it becomes a real 3-dimensional object? What would be the consequences of mass-producing one type of vehicle? Consider which vehicle you would choose and list advantages and disadvantages. What would happen if too many were produced? Who would it affect and how?
14. Is there an item in the Cole Museum that would have been familiar to people who lived 300 or more years ago? What item in the Cole museum do you feel people 300 years from now will still be readily recognized? Be prepared to discuss and defend your choices. For example, Alvin Lombard in 1901 invented the endless belt designed to navigate heavy equipment in the deep Maine snow. Today it is not only used in all phases of construction but is used by the military worldwide.