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ABSTRACT

This booklet, one of a series developed by the Frederick County Board of Education, Frederick, Maryland, provides an instruction module for an individualized or flexible approach to 7th, 8th, and 9th grade science teaching. Subjects and activities in this series of booklets are designed to supplement a basic curriculum or to form a total curriculum, and relate to practical process oriented science instruction rather than theory or module building. Included in each booklet is a student section with an introduction, performance objectives, and science activities which can be performed individually or as a class, and a teacher section containing notes on the science activities, resource lists, and references. This booklet introduces the student to the scientific, mathematical, and physical notions of motion. The estimated time for completing the activities in this module is three weeks. (SL)

AIDS TO INDIVIDUALIZE THE TEACHING OF SCIENCE

ED130913

MINI-COURSE UNITS

BOARD OF EDUCATION OF FREDERICK COUNTY

1973

SE 021 655

Frederick County Board of Education

Mini Courses for

Life, Earth, and Physical Sciences

Grades 7, 8, and 9

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Frederick, Maryland

1973

Frederick County Board of Education
Frederick, Maryland

FOREWORD

The contents represented in these modules of instruction, called mini rses, is an indication of our sincere desire to provide a more individualized flexible approach to the teaching of science.

Data was accumulated during the school year relative to topics in life, earth, and physical science that were felt to be of greatest benefit to students. The final selection of topics for the development of these courses during the workshop was made from this information.

It is my hope that these short courses will be a vital aid in providing a more interesting and relevant science program for all middle and junior high school students.

Dr. Alfred Thackston, Jr.
Assistant Superintendent for Instruction

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NOTIONS ON MOTIONS

Prepared by

Kenneth Howard

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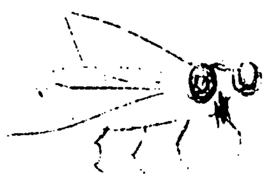
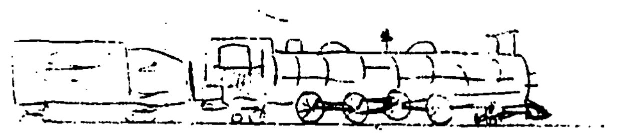
Estimated Teaching Time

3 weeks

NOTIONS ON MOTIONS



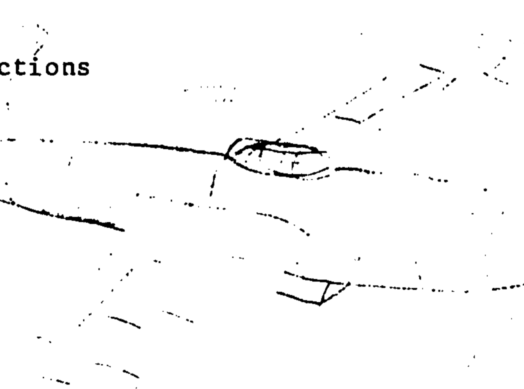


INTRODUCTION:

Movement is all around us. The buzzing fly and the racing car both move. The stars in the sky and the molecules of our body move. There seems to be many kinds of motion, and yet if we examine moving things carefully, we find their motions have many things in common. What is the same about the motion of a star and the motion of a fly? What causes a leaf to fall and a racing car to go? In this unit we shall attempt to answer these questions and develop an understanding of motion in general.

IDEA TOPICS:

1. How far, how fast? - Measuring motion
2. The Bigger, the better? - How does mass affect motion?
3. Sitting still? - Forces that do no work
4. In which direction will I go? - Forces and directions
5. The smoother, the better? - Forces and friction
6. Get the lead out? - Motion which changes



IDEA ONE - How far, how fast? - Measuring motion

A. Objectives:

When you are finished, you should be able to

1. given distance and time, calculate speed.
2. make a graph using distance and time.
3. measure speed using a graph of distance and time.

B. Activities:

1. Do this lab exercise.

Materials and equipment:
- graph paper
- meter stick
- yard stick
- timing device - metronome, or stopwatch, etc.

Using a distance of between 50 and 500 feet (the hall, the sidewalk, or the school ground) measure a distance to be traveled in meters. Find how long it takes several students in your group to

a. walk the distance slowly
b. walk the distance rapidly
c. run the distance

Record the distance and times.

Using the data.

a. Calculate how many meters each student goes in one second (or time interval) by (a) walking slowly, (b) walking rapidly, (c) running.

b. Find the average distance traveled in meters per second for each of the 3 groups. Does this represent the exact distance traveled by any one individual in the group? Why or why not?

c. Make a graph for each of the averages calculated in b. above placing time in the vertical axis and total distance traveled on the horizontal axis. How does the slope of each of the graphs compare? Which group had the greatest speed? Which graph had the greatest slope? How are speed and slope of graph related?

d. Use the same data that you did in part a. but this time measure it in feet. Find the speed of the students in feet per second.

e. From the data below, make a graph of distance versus time.

Time in minutes	Distance in miles
0	0
10	5
20	10
30	15
40	20
50	25

From the graph you just completed, answer the following questions.

Did the car change speed during the trip?
How far did the car travel in 12 minutes?
What was the speed of the car?

2. Obtain from your teacher a copy of the text Interaction of Matter and Energy. Turn to pp. 144-145 (second edition, pp. 184-185) and do the investigation as it appears there. Answer the section labeled interpretations.

IDEA TWO - The bigger, the better? - How does mass affect motion?

A. Objectives:

When you are finished you should be able to

1. calculate speed using data and graph.
2. state the relationship between mass and speed.

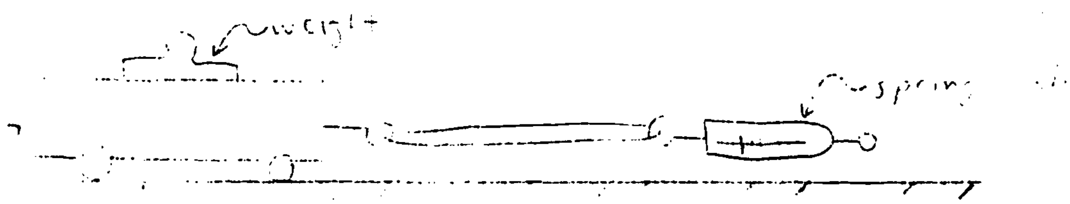
B. Activities:

1. Do this lab exercise.

Materials and equipment:
- timing device (metronome, stopwatch or tape timer)
- small cart (skate, PSSC cart or Halls carriage)
- heavy thread
- spring scale
- 5 equal weights
- metric ruler
- graph paper

Collecting data:

Place the cart on the floor or a long table, attach a thread to it, and hook the spring scale to the end of the thread. Place one weight in the cart and practice pulling the cart along so that you can keep the scale reading the same.



Mark off a 200 cm course on the floor (don't mark on the floor with pen). Pull level to the floor so that the spring scale reads 200 grams of force throughout the trip. Record the time it takes the cart to cover the 200 cm course. Repeat this several times and average your results. Repeat this, adding one weight each time.

Number of weights	Distance	Time Trial 1	2	3	Average	Speed
1	200 cm					
2	200 cm					
3	200 cm					
4	200 cm					
5	200 cm					

Using the data:

a. Calculate the speed of the cart in centimeters per second for each weight. As the number of weights was increased, was the speed increased or decreased? Why? For each trial run you made, was the speed of the cart the same at the beginning of the course as at the end? If not, what does this mean about the speed you calculated - was it exact or average?

b. Make a graph for each of the five weights placing the distance on the horizontal axis and time for the trial on the vertical axis. Place all 5 graphs on one sheet of paper. Which graph has the greatest slope? Which has the least? From your graph, calculate the average speed for each weight. What is the relationship between number of weights and the average speed of the cart?

2. Obtain from your teacher a copy of the pamphlet, Force and Motion, from the Cambridge series and do problem 5-2 on pages 134-136.

3. If you want more information and more examples, obtain from your teacher a copy of the text, Energy, Matter and Change by Ron Townsend and read pp. 253-259. There is an experiment shown on page 259 you might want to try.

IDEA THREE - Sitting still? - Forces that do no work

A. Objectives:

When you are finished, you should be able to

1. measure forces acting on objects.
2. recognize that forces acting on objects do not always cause motion.

B. Activities:

1. This is a lab exercise.

Obtain from your teacher a copy of the unit, Pushes, Pulls & Moving Things, and do Lab Sheet 5 - The Cart and the Rubberband - as it appears there (pp.9-11).

2. Obtain from your teacher a copy of the pamphlet, Force and Motion, from the Cambridge series and do problem 5-6 - Newton's Third Law - on pages 150-151. Also read reference sheet 5-3 on pages 152-153. This sheet will help you in answering the questions by giving examples.

3. There are some interesting examples of this idea about which you can read. Obtain from your teacher a copy of the text, Energy, Matter and Change by Ron Townsend and read pp. 263-266. Try the Test Yourself section on page 266.

IDEA FOUR - In which direction will I go? - Forces and direction

A. Objectives:

When you are finished, you should be able to

1. recognize that the direction of a force is important.
2. given 2 or 3 forces acting on a body, show the motion a body will have.

B. Activities:

Optional - Choose 1 or 2.

1. Obtain from your teacher a copy of the unit, Pushes, Pulls & Moving Things, and do Lab Sheet 6, Force Diagrams, on pp.13-16.

2. Optional - If you did not do Activity 1, then do this one.

   Obtain a copy of Pathways in Science - Physics 2 and the corresponding lab manual. Read pages 57-61 of the text and answer the questions on page 62. Do the lab exercise in Problem 4 on pages 17-20 in the lab manual.

3. Obtain a copy of the text, Energy, Matter and Change by Ron Townsend and read "Forces at an Angle" on pp. 263-270. There is a lab activity on page 270 you may try if you wish.

IDEA FIVE - The smoother, the better? - Forces and friction

A. Objectives:

When you are finished, you should be able to

1. relate friction to force.
2. observe some factors which affect frictional forces.

B. Activities:

1. Obtain from your teacher a copy of the unit, Pushes, Pulls & Moving Things, and do Lab Sheets 2 & 3 - The Rubber Band & Block, and The Rubber Band, Block & Chalkdust on pp. 3-6.

2. Optional - If you want to get some more ideas on factors which affect frictional forces, then do this activity.

   Obtain a copy of the text, Interaction of Matter and Energy and do the Investigation on friction on pp. 149-153 (second edition, pp. 191-199).

IDEA SIX - Get the lead out? - Motion which changes

Introduction: If you are traveling down the road in a car with a steady speed of 40 miles per hour, you are traveling with uniform motion, which we investigated in idea one. If you want to pass a car ahead and you speed up to 60 miles per hour, while you are speeding up, you are traveling with accelerated motion. In accelerated motion as you go faster and faster, you cover more and more distance for each second you move.

For example: During acceleration, for one second an object travels 1 foot. For two seconds, the object covers 4 feet. For three seconds, it will cover 9 feet. For four seconds, it will cover 16 feet.

A. Objectives:

When you are finished, you will be able to

1. recognize that a net force on an object causes acceleration.
2. classify motion due to gravity as acceleration motion.
3. identify gravity as a force which can cause things to accelerate.

B. Activities:

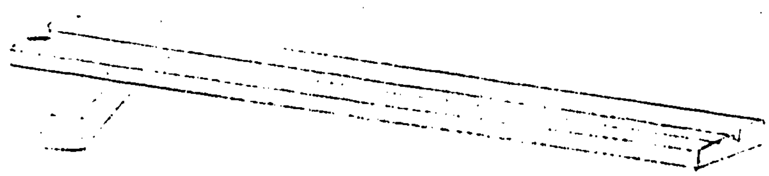
Do this lab exercise.

Materials:

grooved board to be used as track & small wood block
masking tape (to be placed next to the groove)
steel ball or marble
timer (stopwatch or metronome)
metric ruler
graph paper

Collecting data:

a. Set up the track as shown in the figure so that one end is raised about 5 cm.



b. Attach masking tape horizontally along the board next to the groove. This will be used to mark on.

c. Have a member of your team hold the ball in place at the top of the track with a pencil. As he practices releasing the ball, you observe the motion of the ball as it rolls down the track.

d. When you decide you are ready to take data, start the timer and release the ball the instant the timer clicks.

e. Have another member of your team place a pencil mark where the ball is on the track at the instant the timer clicks a second time. The time between the first and second clicks is the first time interval. Repeat this at least 5 times and find the average position of the ball at the end of the first time interval. Record the average position on your data table.

f. Repeat the procedure in e. but let the timer click twice. Record the average position of the ball at the end of the two time intervals.

g. Repeat for as many intervals as you can.

Table 1

Position of Ball	End of Time Interval
cm	
0	0
	1
	2
	3
	4
	5

h. Make a graph of your results placing time intervals on the vertical axis and position on the horizontal axis.

Using the data:

Does this graph look like the graph from Idea One, Activity A? If it does not, can you suggest why? By calculation, find the distance traveled for each time interval and record in data table below.

Table 2

Distance Traveled	Interval
cm	
	1
	2
	3
	4
	5

What supplied the force to make the ball travel down the track?

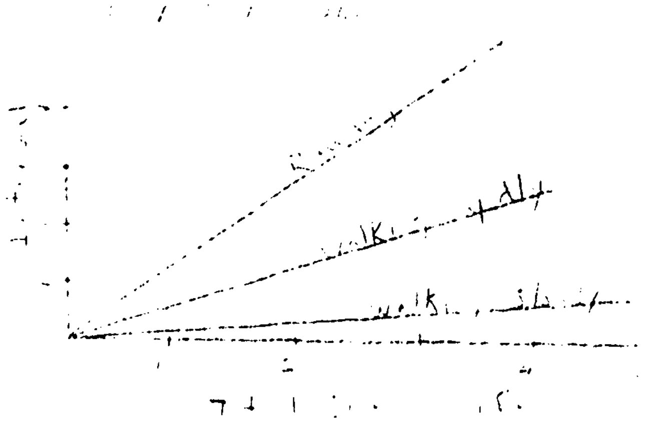
Examine carefully the data in table 1 and see if it follows the law of accelerated motion - that is, that traveling for two time intervals, an object covers 4 times the distance for the first time interval, etc.

Notes to Teacher:

Idea One

Activity 1

In making the graph in the section using the data in part c, students will have actually calculated the speed in part b. and should be directed to plot the total distance covered during a time interval using the average speed so that they get a graph of average distance covered.



Idea Four

The option of doing part 1 or 2 is presented because it is felt that both are good, and the student will be able to accomplish the objectives by completing either one; however, slower students might find the reading in Activity 2 easier.

Idea Six

It is not a requirement for the students to measure the acceleration, but to identify qualitatively the differences between uniform motion and uniformly accelerated motion. More motivated students might wish to actually measure acceleration.

References:

Lab Inquiry Text, Cambridge Series, Force and Motion, Eisler & Stock, Cambridge Book Company, 1972

Interaction of Matter and Energy, second edition, Abraham, et al, Rand McNally & Company, 1973

Energy, Matter and Change, Ron Townsend, Scott, Foresman, 1973

Lab Manual for General Physical Science, Unit One - Pushes, Pulls & Moving Things, Baltimore County Public Schools, 1966

Lab material can be readily made.

Pathways in Science, Physics, Volume 2 - Matter and Energy, Joseph Oxenhorn, Globe Book Company, 1969

Pathways in Science, Lab Work Book, Physics, Volume 2 - Matter and Energy, Joseph Oxenhorn, Globe Book Company, 1971

No audio-visual material is listed because there seems to be very little available at the required level.

Evaluation Form for Teachers

1. Name of the mini course ______________________________

2. Was this unit appropriate to the level of your students?

3. Explain how this mini course was used with your students. (Individual, small group, or total class)

4. Identify the plus factors for this course.

5. List the changes that you would recommend for improvement.

7. Did you use any other valuable resources in teaching this unit? If so, please list.

PLEASE RETURN TO SCIENCE SUPERVISOR'S OFFICE AS SOON AS YOU COMPLETE THE COURSE.

ADDITIONAL SCIENCE MINI-COURSES

LIFE SCIENCE	Prepared by
A Study for the Birds	Terrence Best
Creepy Critters (Snakes)	Terrence Best
How's Your Plumbing?	Paul Cook
Guess Who's Been Here for Dinner	Paul Cook
Plants - The "Other" Living Things	Sharon Sheffield
Let's Look at You - The Human Organism	Sharon Sheffield
Classification: Why is There a Need?	Melvin Whitfield
Protist: The "Unseen" Kingdom	Melvin Whitfield

EARTH SCIENCE	
Coastline Development	Nelson Ford
Ocean Currents	John Fradiska
Features of the Ocean Floor (Ocean Floor Topography)	John Fradiska
Space and Its Problems	John Geist
Invertebrate Fossils: Clues to the Distant Past	John Geist
An Attempt towards Independent Study in Astronomy	John Geist

PHYSICAL SCIENCE	
Household Chemistry	Ross Foltz
Notions on Motions	Kenneth Howard
Environmental Chemistry	Fred Meyers