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An Alternative to a Project Physics Film Loop

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AN ALTERNATIVE TO A PROJECT PHYSICS FILM LOOP

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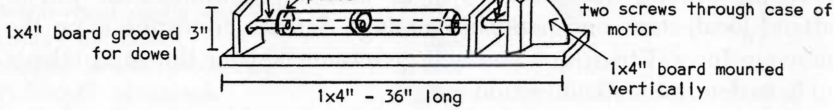
The apparatus used for this experiment was described at a Summer Institute at Knox College. It is very adaptable to the experimental procedure of the film loop *Vector-Addition-Velocity of a Boat* and deserves more widespread awareness.

The equipment is fairly easy to build and is quite inexpensive. It consists of a charcoal grill motor mounted on a board with a 36″ dowel inserted in the motor. Newsprint paper is secured to the dowel with masking tape. This apparatus serves as an alternative to the river in the film loop, as the paper will roll up when the motor is plugged in. The speed of the paper can be increased by securing drilled tinker-toy spools or equivalent to the dowel and gluing a 30″ Christmas wrap cardboard tube to the spools. The paper is then taped to the cardboard tube instead of to the dowel.

The boat of the film loop can be replaced by a slow moving battery operated toy. This must be a very slow moving toy such a walking dog, walking robot, or caterpillar tractor (the Project Physics tractor from Holt moves too fast). A suitable motorized car can be built using another grill motor and wheels from an inexpensive plastic toy. (Surplus grill motors are generally available at a Salvation Army store or similar thrift stores. Newsprint roll ends are often provided free from local newspaper printing establishments, as these must be removed from the presses before they are completely used. These still contain several hundred feet of newsprint.)

Figure 1 is a sketch of the apparatus:

FIGURE 1



The toy can be directed "upstream, downstream, directly across, etc." as is done in the film loop. Data can be obtained in basically the same manner as with the film loop, with the following subscripts substituted for the boat and the water of the film loop:

V_{te} = Velocity of toy relative to earth;

V_{tp} = Velocity of toy relative to paper;

V_{pe} = Velocity of paper relative to earth.

Then $V_{te} = V_{tp} + V_{pe}$.

For each heading of the toy, a vector diagram can be constructed with the vectors drawn to scale. Three vertical objects such as pencils inserted in the holes of rubber stoppers should be placed beside the paper to serve as markers from which the velocities relative to earth can be measured. Two of these should be 50 cm apart on one side of the paper and the third should be directly across the paper from one of the markers.

The data collection part of the experiment is as follows:

Part 1

Determine the speed of the paper relative to the earth. Place a mark on the paper and determine the time it takes to travel the 50 cm between markers. Calculate V_{pe}.

Part 2

Head the toy up-paper (upstream). With both the paper and the toy in motion, determine the time for the toy to travel the 50 cm between markers. Calculate V_{te}, then find V_{tp} using a vector diagram. Remember that $V_{te} = V_{tp} + V_{pe}$.

Part 3

Head the toy down-paper. In a manner similar to Part 2, measure V_{te} and use a vector diagram to find V_{tp}.

Part 4

Head the toy directly across the paper. Measure the speed and direction of the toy relative to the earth. To find V_{te} hold a meter stick above the toy as it moves and in the direction of the toy's motion relative to the earth. Measure an appropriate distance on the meter stick and the time to travel this distance. Again construct a vector diagram to find V_{tp}.

Part 5

Head the toy up-paper at an angle such that it moves directly across the paper. Record the angle and determine V_{te}. Again construct a vector diagram and find V_{tp}.

Questions

(1) Compare the values you obtained for V_{tp}. Determine an average value for V_{tp}.

(2) List some sources of error for the experiment.

Part 6

Determine the actual speed of the toy. Compare this value to the average value you found in question 1.

COMMENT: REMEMBER THE HUMANITY IN SCIENCE INSTRUCTION

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There go the "alphabet sciences" and here come the "pace sciences." PACE, Personalized Adventures in Chemistry Education; PABE, Personalized Adventures in Biological Education; PAPE, Personalized Adventures in Physics Education; PAESE, Personalized Adventures in Earth Science Education. Independent learning centers, modular instruction, programmed instruction, packet projects, single concept film loops, single concept bioplastic kits, computer programs, pencil and paper sciences, *all,* yes, all individualized or whatever it is called. Though millions have been spent on some of the individualized programs, they do not represent "cure-alls." They do not hold a candle to personal instruction, though they may be supplements. Don't hesitate for fear the "pace sciences" will replace you—they can't. These "things" may be supplements—but often students and schools get devoured in the paper and pencil of them. Some appear to allow the student to waste time for the "fun" of "messing around." Basic understanding decreases in such situations. Individualized instruction is student-instructor oriented, and these individualized learning "things" are student-paper oriented. Remember the "humanity' 'in science instruction? They are called students—and instructors.