PBS Mathline®

The Elementary School Math Project

Whirlybirds

Math Grows Up (Statistics)

Objective

Students will be able to measure to the nearest centimeter. Students will predict and determine the frequency of an event.

Overview of the Lesson

Students participate in a simulation of a parachute jump competition by making paper Whirlybirds, and then dropping them towards a target on the floor. They measure the distance from the point where the Whirlybird lands to the target. Distances are categorized into 10 centimeter intervals and tallied. Students analyze the data to determine the frequency of a parachutist hitting a target area.

Materials

Teacher:

- One Whirlybird
- Scissors

Each Student:

- Activity Sheet: Making a Whirlybird
- Scissors
- Ruler
- 2 sheets of unlined paper

Each Pair of Students:

- Small block or cube
- Measuring tape (centimeters)

Procedure

Motivate students by telling them that they are going to take part in a parachute jump competition. Have students recall experiences where they have seen a parachutist try to land on a target area. Explain to the class that since they cannot perform the actual jumps, they will have to simulate the event.

Show the class a Whirlybird made from Activity Sheet: Whirlybirds. Tell the class that they are going to drop the Whirlybird and try to hit the target. They are going to measure the distance from the target to where the Whirlybird lands to the nearest centimeter.

Divide the class into groups of four. Have the groups brainstorm to determine the measurement intervals they should use to tally the distance from the target. Allow about three to five minutes for discussion and then have the class come to a consensus on the intervals that will be used. Using intervals of ten centimeters works nicely: Hit: 0 Miss: 1-10, 11-20, 21-30, 31-40, 41-50, greater than 50. There are other ways of determining the interval. Remind students that a 0 should be used to designate a direct hit. Using rulers and unlined paper, have students design and make a tally or data sheet for the parachute jumps. They will need to determine the headings for the tally sheet. The headings or columns should include "distance", "tallies", and "frequency". Give scissors and a copy of the Activity Sheet: Whirlybirds to each student. Demonstrate the step-by-step construction of the Whirlybird and then have each student construct one.

Divide the groups of four students into pairs. Give each pair of students a measuring tape and a small block which will serve as the target. Tell the class to drop the Whirlybird from shoulder height and measure the distance from the tip of the whirlybird to the target. After measuring the distance from the target, students will place a tally mark in the designated interval on the data sheet. Each student will make 25 jumps.

Have students meet in their cooperative groups of four again. The four students will combine their data and record it on a new chart. They will now be looking at data for 100 simulated parachute jumps. Students will see that it is hard to get a direct hit and within 10 cm of the target should be considered a good jump! Redefine "hit" as a parachute that lands anywhere from 0 through 10 centimeters from the target. Students will have to add the number of direct hits (0) and the 1 - 10 interval. On this new chart, students will make three vertical columns with the headings, Distance, Frequency, and Fraction.

Have all of the groups share their fractions for the "Hits" (0-10 cm). Write these fractions on the board. Ask students to order the fractions from least to greatest. Analyze the fractions to see if there are any clusters. Determine the typical amount of jumps that landed in the 0-10 range. To assess student understanding, ask the students to use their class data to predict the frequency for landing 0-10 centimeters from the target for 12 jumps. If the fraction in the 0 - 10 interval is 25/100, it is easy for the students to take 1/4 of 12 mentally. A fraction calculator could be used for difficult fractions. Continue the same procedure to analyze the data from other intervals.

Mathematically Speaking. . .

When students are trying to predict the distance the typical Whirlybird lands from the target, they actually need to analyze the data set to find a measure of center. In this lesson, the students ordered the data from least to greatest and looked to see where the data clustered. There are several measures of center that can be utilized. When the data is ordered from least to greatest, the median is the measurement that lies in the middle of the data. If there are two measurements in the middle, the median is the midpoint between the two. Mode is another measure of center. The mode is the measurement that occurs most often in the data set. The mean, still another measure of center, is the arithmetic average of a set of measurements, computed by adding all the measurements, then dividing that sum by the total number of measurements. The mean is not useful as a measure of center when there are outlines or extreme values that are markedly higher or lower than most of the other measurements.

Extensions & Connections

Using a fraction calculator, have the students compute the mean and compare it to the median. Have students evaluate using the median or the mean as a measure of center for their data.

Discuss the variables that could affect the accuracy of the jumps. When the Whirlybirds were dropped from shoulder height, was that the same distance for every member of the class? Were there any air currents in parts of the classroom that could have had an effect on the data? Did everyone measure accurately? A discussion of a "fair" experiment might be helpful where variables are controlled.

Resources

Elementary Quantitative Literacy: Book 2. (To be published) Dale Seymour Publications. Palo Alto, California.

Addenda Series: Making Sense of Data. (1993) National Council of Teachers of Mathematics. Reston, Virginia.

The Sky's the Limit: Activities to Integrate Mathematics and Science (AIMS). (1987) Fresno, California.

Ideas for Online Discussion

(*Some ideas may apply to more than one standard of the* ***NCTM Professional Standards for Teaching Mathematics.)***

Standard 1: Worthwhile Mathematical Tasks

- In this lesson students designed and made their own data sheet for the simulation rather than using one made by the teacher. Do you feel this was a worthwhile task and a good use of time? When making the chart what other mathematical skills were being reinforced?
- In this data analysis lesson, what significant mathematical concepts are being presented?
- What measurement skills are being reinforced in this lesson?
- Discussing the intervals to be used and having students set up the data sheets are very time consuming parts to this lesson. Would you invest the time in these elements of the lesson?

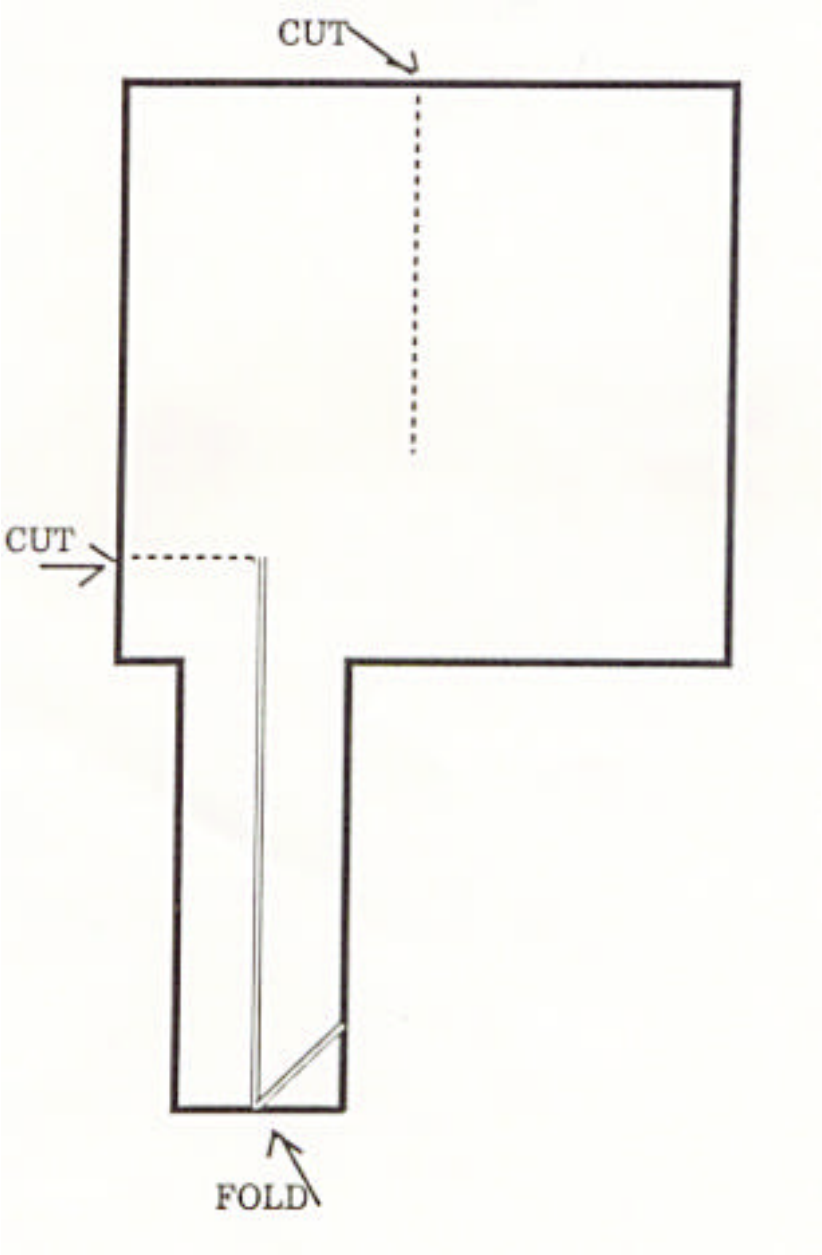
Standard 2: Teacher's Discourse

- The original definition of a "hit" was "0" - or landing directly on the target. Later, the class redefined a hit as 0 - 10 cm. Was this a good idea in your opinion?
- What opportunities are provided for student discussion in this lesson?
- What new mathematical vocabulary or notation was introduced/reinforced in this lesson? How do you present new vocabulary?

Standard 5: Learning Environment

- How does the teacher use teams of students to work collaboratively on collecting data? How does the collaboration of 4 student teams facilitate the mathematics of the lesson?

MAKING A WHIRLYBIRD



1. Cut out along the heavy lines
2. Cut the dashed lines.
3. Fold the wings down in opposite directions, as shown.
4. Fold the body in half at the double lines and fold again at the base to form a point.