low. The teacher pointed out the strategic locations of the three mints in the eastern, central, and western regions of the United States and asked students to consider the effects on coin circulation of a highly mobile population.

The following materials were used in conducting the investigation: A large collection of nickels (500); magnifying glasses; and two pieces of string, each piece approximately three feet long.

First Round

Questions

- How many of the sample coins are minted in Denver? In Philadelphia? In San Francisco?
- Do coins remain in the region where they are minted? What do you think?

The class used a coin collection that belonged to one of the authors. They concentrated on Jefferson nickels, having over 500 of them available, but similar results may be obtained using other coins. On Jefferson nickels minted after 1968, the mint mark, if present, is on the head side of the coin just below Thomas Jefferson's ponytail. For pre-1968 coins, the mint mark, if present, is on the tails side of the coin. A "P" indicates Philadelphia; a "D," Denver; and an "S," San Francisco.

The teacher first distributed some coins containing a mint mark for students to identify. A magnifying glass was used for reading some mint marks, since it was difficult to distinguish a P from a D. After examining these coins, students examined their loose change for mint marks, and the teacher passed around a few coins without mint marks, remarking that such coins might present a problem in the investigation. The class decided to keep track of four types of coins—D, P, S, and N (for none).

Data

The class investigated this collection of more than 500 coins, minted over about twenty-five years, starting with 1968. To simplify data collection, the teacher had eliminated all nickels minted prior to 1968, which have their mint marks on the tails side. Omitting these older coins had no effect on the final results. For the initial data collection, groups of students classified each coin according to its mint location—D, P, S, N—and formed four such sets without counting the number in each set.

Analysis

Students began examining the data by labeling the four corners of a classroom table as D, P, S, and N. They then placed the coins from each mint location in the appropriate corner. **Figure 2** shows the results. Students next guessed what fraction of the total was represented by each group. Clearly, for this particular collection of coins, the number of S coins was insignificant relative to the total of over 500 coins. After some debate, students decided that removing the S coins at this stage of the investigation would have little effect on the overall results. Without the S coins, it appeared that roughly one-half were P coins, one-fourth were D coins, and one-fourth were N coins.

On the same table, students then constructed a physical model of a pie chart using the remaining coins and two pieces of string. Since the class's initial guess was that about half the coins were marked P, they used one string to separate the P coins from the others. The initial guess for D and N coins was about
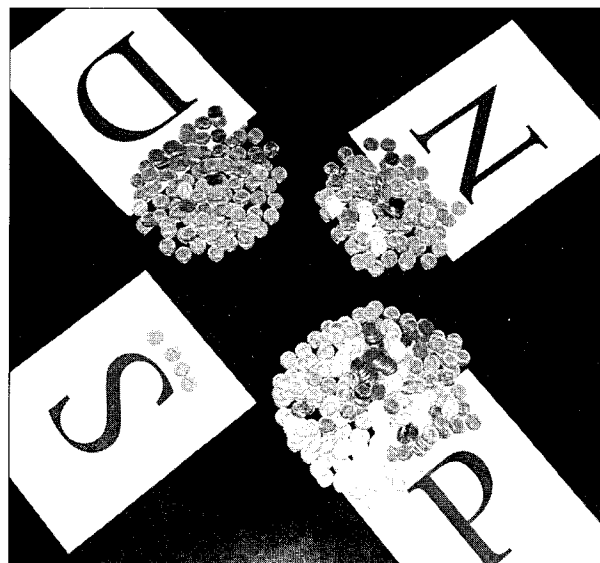

Fig. 2 Where coins are minted—the initial analysis of data

one-fourth each, so the students used the other string to separate these two groups (see **fig. 3**). The students spread out the coins to form a circular region in which no coins were stacked on top of one another. They kept the coins as close together as possible and adjusted the strings as needed to keep the coins from different mints separated (see **fig. 4**). The students then reconsidered their estimates for the fraction of coins in each group. Finally, they were asked to agree on estimates of the size of the center angles of the model for each group of nickels in the model, and each student constructed a pie chart on paper with these angles. This pie chart was useful later in the investigation (see **fig. 5**).

Interpretation

From the pie chart, the class could see that slightly more than half the coins were minted in Philadelphia and that the remaining coins were roughly divided equally between coins minted in Denver and coins with no mint mark. These coins belonged to someone who had always lived on the east coast, so it was not surprising to students that P coins were dominant. Some students suggested that possibly more coins are minted in Philadelphia than in the other locations. At this point in the investigation, the teacher moderated a whole-class discussion of the following questions:

- What does the pie chart tell us about where the coins were minted? Which location is most common? Give some possible reasons why this location is the most common.
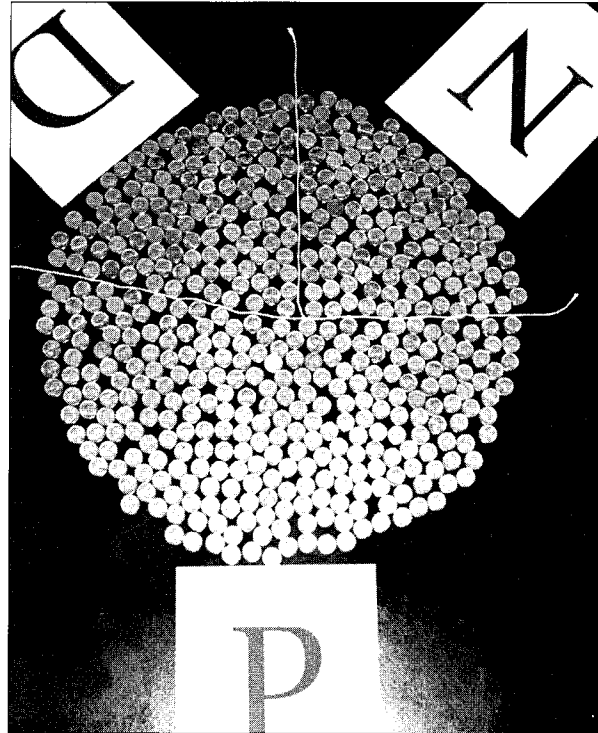- Do you think someone living in the central or

Fig. 4 The finished pie chart

western United States would have similar results? Why?
- Approximately what fraction of coins is in each of the other two groups?
- Where were coins with no mint location minted? Assuming that these coins were minted in Philadelphia, Denver, or San Francisco, where do you think they were minted? Why?

Some typical responses were these:

Most of the coins in the collections were made in Philadelphia because it's closer to where we are.
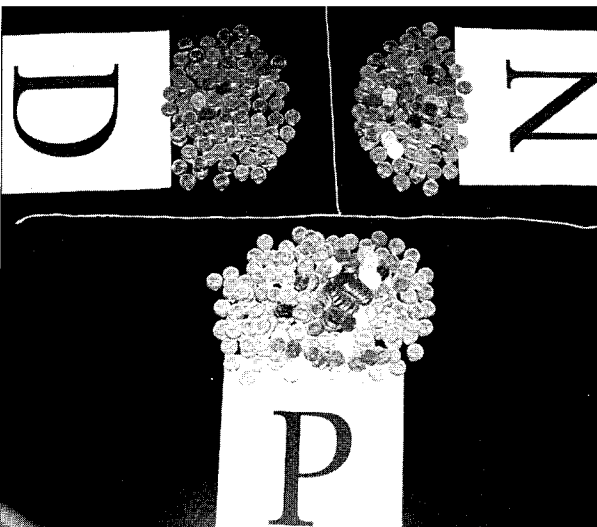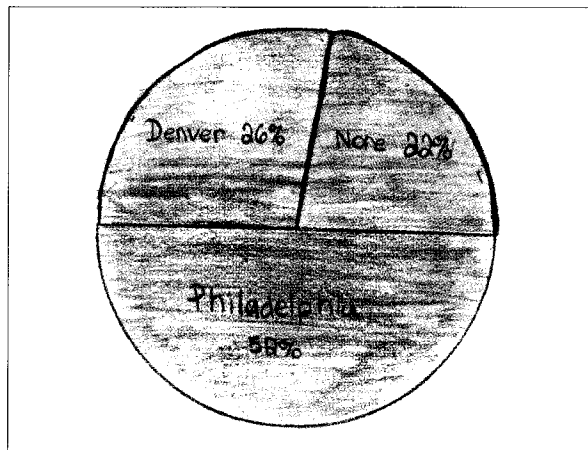

Fig. 3 The first step in creating a pie chart of coins

Fig. 5 A student's pie chart