**Dice, Histograms & Probability**

**Teacher Notes**

**Description**

Students roll provided dice (> 1 die per roll) and record the resulting individual values as well as the sum of the values. They create histograms of the data to gain experience with histograms as a way of organizing and interpreting data.

Students can extend the activity by:

* Making a histogram of the class data for individual values and for sums.
* Using a spreadsheet to simulate the pseudo-random numbers they would obtain with dice rolls.

Teachers can extend the activity further by provided loaded dice; sufficiently large numbers of rolls with these can create a “bump” in the histogram.

**Standards Addressed**

*Next Generation Science Standards*

 Science and Engineering Practices

 4. Analyzing and interpreting data

 5. Using mathematics and computational thinking

 7. Engaging in arguments from evidence

 Crosscutting Concepts

 1. Patterns

*Common Core Literacy Standards*

 Reading

 9-12.7 Translate quantitative or technical information . . .

*Common Core Mathematics Standards*

 MP5. Use appropriate tools strategically.

 MP6. Attend to precision.

**Enduring Understanding**

Data of a probabilistic nature must be treated statistically. Histograms are an important tool in statistical treatment of data.

**Learning Objectives**

Students will know and be able to:

* Precisely record simple observations.
* Describe how degrees of freedom (variability) show possible variation in values.
* Create and interpret a histogram

**Prior Knowledge**

Students must be able to keep careful records of observations and sum integers.

**Background Material**A fair die has an equal probability of producing any of the available numbers. Histograms of the individual rolls shouldn’t show any features at all—they should be flat. This tendency is seen clearly only with a large number of rolls.

Students will see a peak in the histogram of sums of the rolled dice, (e.g., 3 d6s). The location of the peak depends two things: how many rolls you combine, and the number of sides on the rolled dice. There are three ways to roll a 10 when rolling two d6: 6+4, 4+6, and 5+5. There are 27 ways to roll a 10 when rolling *three* d6! *The peak of the histogram appears at the sum that can be most easily created.* Again, this is seen more clearly with a large number of rolls.

**Implementation**

We do not provide a student handout with this activity. If students complete charts before developing their histograms, they should see that data could be analyzed more effectively when properly organized.

Provide students with sets of similar dice. All groups should have the same number and type of dice if you want to pool individual or group data into a larger, shared set. Ask the students to record their dice rolls in a chart before drawing a histogram of their data. Students should have the chance to compare their results and to combine them in whole-class histograms.

Many spreadsheets have a facility for creating random numbers. You might consider asking your students to do this assignment on a spreadsheet.

You can provide copies of the class histogram or the spreadsheet simulation for the Student Reports.

It is also possible to keep this activity short with student histograms only and a discussion rather than a report.

**Assessment**

Have students display their histograms around the room. Ask them to note similarities and differences in the histograms. Ask them

* what number appears most often. Discuss the reasons for this.
* to predict what would happen to the histogram if there were twice as many dice rolls recorded?
* to predict what would happen if there were twice as many dice?

Have them write their predictions, try it out, then write why their prediction was correct/not correct. Encourage them to include ‘degrees of freedom’ and/or ‘variability’ in their explanations.

For summative assessment, either have students fill out the Student Report or write a general statement that covers the report’s main points. If you do not use the report form, be sure to ask students to explain the link between organizing and interpreting data—the advantages of organizing the data in histograms. This is an important real world connection.

See report.