

ABSTRACT

In this activity, students are challenged to determine how much larger the principal's hand is compared to the hand size of the average kindergartner. Students guess or formulate a hypothesis, and then collect data to support their hypothesis. *The Big Hand Challenge* provides an excellent opportunity for student interaction with younger kids and with the principal. Data collection is easy since the flat, adjustable computer screen allows students to use the spreadsheet itself as a measurement tool. Students learn to appreciate the computer as a tool in math and science, but realize that they themselves are the problem solvers.

TIES TO CURRICULUM

The Big Hand Challenge's tasks, such as graphing data and drawing conclusions, integrate different (and often isolated) topics in mathematics and science. This activity addresses many of the math, science, and technology goals of *the National Science Education Standards*, such as totals, averages, percentages, graphs, comparisons, data collection, data analysis, data interpretation, and the use of computer as an appropriate tool. This activity uses these targets in a manner that involves problem solving, critical thinking, and reasoning.

TIME REQUIREMENT

The Big Hand Challenge takes approximately two hours, although there is an additional 30 minutes of teacher preparation prior to the activity.

Task	Time	Location
Introduction	45 minutes	Classroom
Data collection	30 minutes	School
Data analysis	30 minutes	Classroom
Report	15 minutes	School

LEARNING OBJECTIVES

Students learn to

- ◆ use the computer as a tool in the scientific process;
- ◆ collect and analyze data in a problem-solving situation;
- ◆ communicate the reasoning used in problem solving;
- ◆ use a unique computer tool to measure area; and
- ◆ integrate and apply many isolated math and science concepts and procedures such as totals, averages, percentages, bar graphs, pie graphs, and comparisons.

NUMBER OF LAPTOPS AND GROUP SIZE

This activity requires one laptop per group of three students.

MATERIALS

- ◆ Laptop computers
- ◆ Microsoft Excel
- ◆ Floppy disks (one per group)
- ◆ Overhead transparencies (six per group)
- ◆ Transparency/erasable pens (at least one per group)
- ◆ Overhead computer screen projector

LESSON DESCRIPTION

In *The Big Hand Challenge*, students determine the size of the average kindergartner's hand compared to that of the principal. Using Microsoft Excel, students will enter data and create graphs to facilitate the research process.

Teacher Preparation

Prior to the activity, set up an Excel worksheet on your demo computer, and save enough copies on disks for students to work on in groups of three (see Appendix for spreadsheet set-up instructions). Set up the Excel workbook to include nine worksheets labeled in the following order: Principal, Student1, Student2 ... Student5, Data, Average, Conclusions. The first six sheets are designed to display a 22 x 29 grid of squares that will be used as units of measurement for comparing hand size. The Data sheet displays totals of all the students' hands. Students will create and paste two graphs for each kindergartner onto this sheet based on the data. The Average sheet will display the data (numbers and graphs) reflecting the average kindergartner's hand compared to the principal's. On the Conclusions sheet, students state their research findings.

Trace the principal's hand on an overhead transparency and make copies on transparencies for each team.

Introduction

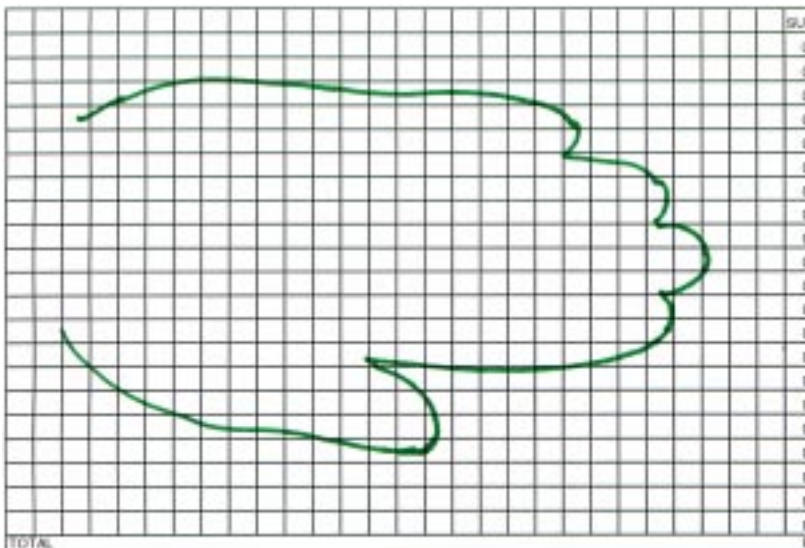
Pose the challenge to class: How much larger is the principal's hand than the average kindergartner? Have students discuss the problem and develop a hypothesis about hand size.

Explain how a spreadsheet works and how it helps organize data. Explain that the class will use a workbook preset with the number of spreadsheets, the sheet size, and the necessary formulas. Divide the class into groups of three students.

Distribute overhead transparencies and overhead pens, and have one student trace the hand of a teammate onto a transparency. Use the first traced hand to demonstrate the data entry procedure on your laptop computer projector, using the following steps.

1. Open the workbook and go to the sheet labeled Student1.
2. Overlay the transparency with the traced hand over the laptop screen. Lay the screen flat so the transparency stays in place.
3. Point out to students that the spreadsheet is visible under the transparency and the grid can be used to measure the area outlined by the hand.
4. Click on a square in the spreadsheet that lies within the outline of the hand on the transparency. Type a "1" in that square. Point out that the number in the SUM column changed from 0 to 1 in this row and the TOTAL at the bottom of the page also changed from 0 to 1. Proceed to an adjacent square in the same row within the outline of the hand and again enter 1. Again have students note the changes in the SUM

Figure 1: Example of spreadsheet with traced hand



LESSON SUGGESTIONS

- ◆ Ask the principal (or other administrator) and kindergarten teachers for convenient times to visit.
- ◆ Double-check the accuracy of the formulas in the various cells. An incorrect letter, number, or mathematical sign can ruin the entire activity. Lock formulas to protect them from being accidentally changed or deleted by students (see Appendix).
- ◆ Trace the principal's hand before the activity and make copies on transparencies to distribute to the class.
- ◆ You may want to cut the transparencies to an appropriate size so that they can be easily overlaid on the laptop screen.
- ◆ Prepare a demo disk with fictitious data for demonstration purposes.
- ◆ Practice using the spreadsheet to anticipate questions.

column, and understand that the SUM column adds up all the 1s in the row, and the TOTAL row displays the sum of the sums.

5. Continue entering 1s in the appropriate squares on your demonstration sheet. Enter a 1 in any squares that are at least half filled by the outline. When you are finished entering the 1s you will have a mitten-like shape that represents a hand (see Figure 1).

Student groups open up Excel workbooks on their own laptops. Students take turns transferring their hand onto the spreadsheets labeled Student1, Student2, or Student3. Students should quickly become comfortable using this method of data entry. Do not save these changes to the workbooks.

Activity

Proceed to the kindergarten classroom. Take the laptops to the kindergarten with you and enter the data there, since the young students will enjoy seeing the resulting “mitten” on the spreadsheet when the data is entered. Each group should trace the hands of five kindergartners and write the kindergartners’ names on the transparencies.

Back in the classroom, provide each group with a transparent copy of the principal’s hand.

Have students enter the appropriate 1s onto the spreadsheet entitled Principal. On your demo computer go to the Data sheet, and have students do the same. Point out that the totals from the kindergartners’ and principal’s hands were automatically transposed to this data sheet.

Students should enter the names of the kindergartners’ whose hands they traced in the appropriate cells.

Data Analysis

Explain that groups will use computers to create graphs and aid in interpreting the collected data. You

may want to review the advantages of a bar graph and a pie graph for analyzing data.

Highlight the cells on the spreadsheet with Student1's name and hand size, and the principal's hand size. Using the chart wizard, create and label a bar graph comparing the number of squares in the student's hand vs. the principal's hand. When the graph appears on your sheet, show students how the size and position of the chart can be changed. This is important because the students will need to organize the data onto this sheet. Have teams create a bar graph for each kindergartner on the data sheet and label graphs with the names of the kindergartners. Position bar graphs vertically along the left side of the worksheet.

Demonstrate and then let students create and label five pie graphs. Align pie graphs on the right of the sheet next to the corresponding bar graph. Discuss the graphs and ask the class to summarize what each graph represents. Proceed to the Average sheet. Instruct students to make a bar graph and a pie graph to represent this data. Groups can discuss what the information on this sheet represents.

On the Conclusions sheet, each group will fill in the blanks with its interpretations of the data. Groups should form conclusions regarding the hand size of the average kindergartner compared to the principal's, and compare their conclusions to their original hypothesis.

Have groups explain their data and their conclusions to you. When they are ready, send groups to present conclusions to the principal.

ASSESSMENT

You can assess student performance based on student hypotheses, data collection skills, tables and graphs, and final report.

REFERENCES

Books

National Council of Teachers of Mathematics. *Curriculum and Evaluation Standards for School Mathematics*. Reston, VA: NCTM, 1989.

National Research Council. *National Science Education Standards*. Washington DC: National Academy Press, 1996.

Web sites

Frank Potter's Math Gems. A listing of more than 2000 Internet resources:
<http://www-sci.lib.uci.edu/SEP/math.html>

Microsoft Excel. Software support:
<http://support.microsoft.com/support/excel/using.asp>

APPENDIX: MICROSOFT EXCEL WORKBOOK SET-UP

Wherever "→" appears, it means "go to".

Type exactly what is written between the quotes.

Remember to save work regularly.

1. Open Excel → Tools → Options → General → # of Sheets, type "9" → OK.
2. Open new Excel workbook. Save as "Bighand".
3. Highlight cell AC22 and proceed highlighting upwards and left to cell A1.
4. → Format → Row → Height, type "18" → OK.
5. → Format → Column → Width, type "3" → OK.
6. → Format → Cells → Border, click "Outline" and "Inside" → OK.
7. In cell AC23, type "=SUM(AC2:AC22)".
8. In cell AC1, type "SUM".
9. In cell AC2, type "=SUM(A2:AB2)" → ENTER. (0 should now be displayed in the cell. If anything else is displayed, click on the cell again and begin again, making certain the formula is exact.)
10. In cell AC2 → click on the Copy command → highlight cells AC3 to AC22, and click the Paste command or icon. (This enters the same formula into these cells so that the sum of the preceding cells in the row will be displayed. For now, 0 should appear in these cells.)
11. In cell A23, type "TOTAL" → ENTER.
12. Highlight AC23 to A23 → Format → Cells → Border → Outline → OK.
13. In Sheet 1, highlight AC22 to A1 → click on the Copy command or icon → click on Sheet 2 → cell A1 → click the Paste command or icon.
14. Repeat steps 3 and 4 in Sheet 2 to create borders.
15. Repeat steps 13 and 14 to create Sheets 3, 4, 5, and 6.
16. Highlight AC23 to A23, copy and paste into cell A23 on sheets 2, 3, 4, 5, and 6. You should now have six identical sheets with squares covering the screen with the last column, AC1 to AC22, depicting sums of 0, and row 23 depicting a total of 0. The SUM at the end of a row indicates the number of 1's entered in that row. The TOTAL is the total sum of all the rows.
17. Double click on the bottom of the sheet on the labeled Sheet 1 and rename it Principal by typing "Principal" while "Sheet 1" is highlighted.
18. Rename Sheets 2, 3, 4, 5, and 6 to Student1, Student 2, etc., through Student5.
19. Rename Sheet 7 to Data.
20. In cell A1 of Data, type "Student Name" → ENTER. Move cursor to cell B1, and type "Total # of Squares" → ENTER. In cell C1, type "Principal's Total # of Squares" → ENTER.
21. In cell B2 of Data, type "=Student1!AC23" → ENTER. In cell B3, type "=Student2!AC23" → ENTER. In cell B4, type "=Student3!AC23" → ENTER. In cell B5, type "=Student4!AC23" → ENTER. In cell B6, type "=Student5!AC23" →

- ENTER. (These formulas must be exact, since they direct the computer to go to the relevant Student page for the necessary totals.)
22. In cell C2, type "=Principal!AC23" → ENTER.
 23. Copy that exact formula into cells C3, C4, C5, and C6 (check to make sure it still says "=Principal!AC23" in each cell).
 24. In cell A9, type "Student Name" → ENTER. In cell A10, type "=A2" → ENTER.
 25. Highlight cell A10 and click the Copy command. Highlight cells A11 to A14, and click on Paste. The formula in cell A11 should read "=A3", A12 should read "=A4", etc.
 26. In cell B9, type "Total % of Principal's Hand" → ENTER.
 27. In cell C9, type "% Smaller" → ENTER.
 28. In cell B10, type "=INT((B2/C2)*100)" → ENTER.
 29. Highlight cell B10 and click the Copy command. Highlight cells B11 to B14 and click Paste (0s should appear in the boxes).
 30. In cell C10, type "= C2 - B10" → ENTER. In cell C11, type "=C2 - B11" → ENTER. In cell C12, type "=C2 - B12" → ENTER. In cell C13, type "=C2 - B13" → ENTER. In cell C14, type "=C2 - B14" → ENTER.
 31. Highlight cells C6 to A1 → Format → Cells → Borders, click Outline → OK.
 32. Highlight cells C14 to A9 → Format → Cells → Borders, click Outline → OK.
 33. Double click on Sheet 8 and rename it Average.
 34. Highlight columns A, B and C → Format → Column → Width, type "30" → OK.
 35. In cell A1 of Average, type "Total of Students' Hands" → ENTER. In cell A2, type "Average of Students' Hands" → Enter. In cell A3, type "Size of Principal's Hand" → Enter. In cell A5, type "Average Difference Between Student and Principal" → Enter. In cell A6, type "% of Average Student Hand to Principal's" → Enter.
 36. In cell B1 of Average, type "=SUM(Data!B2:Data!B6)" → ENTER. In cell B2, type "=AVERAGE(Data!B2:Data!B6)" → ENTER. In cell B3, type "=Principal!AC23" → ENTER. In cell B5, type "B3-B2" → ENTER. In cell B6, type "=(B2/B3)*100" → ENTER.
 37. Double click on Sheet 9 and rename it Conclusions.
 38. → Insert → Objects → Microsoft Word Doc. Using large font (such as 28 point), type "Our findings show that the principal's hand is more than/less than/equal to twice the size of the average six-year-old. The average hand of a kindergartner is _____ percent of the principal's hand. This is _____percent more/less than half the size of the principal's hand."
- Steps 39 and 40 lock the spreadsheets to protect the formulas:*
39. In Principal sheet → Tools → Protection → Protect Sheet (make sure all boxes are checked off; you can supply a password or leave it blank). Repeat on each of the 9 worksheets.
 40. In Principal, select the cell range you want to unlock (cells A1-AB22) → Format → Cells → Protection, click the 'Locked' box to clear it → OK. Repeat for Student1 through Student 5. In Data, unlock cells A2-A6.
 41. Save your file and exit Excel.