



RAISING THE BAR WHILE HOGGING THE HAM  
(RADIO, THAT IS)

**Math Topic: Bar Graphs**

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**ABOUT THE AUTHOR**

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## **RAISING THE BAR WHILE HOGGING THE HAM (RADIO, THAT IS)**

**MATH TOPIC:** Bar Graphs

**GRADE LEVEL:** 4-6

**TIME ALLOTMENT:** Two 45-minute lessons

**OVERVIEW:** This lesson teaches students the importance of using the appropriate scale when constructing a bar graph. In CYBERCHASE Episode #210, "Raising the Bar," the CYBERCHASE kids discover bugs in the cybrary and report this to Ms. Fileshare, the librarian. The exterminator with the contract to rid the cybrary of the unwanted vermin manages to manipulate the bar graph to give the impression of having done a good job. The CYBERCHASE kids know this isn't the case but have to prove their point by 'showing,' not 'telling' the numbers in the form of a bar graph. They make a fundamental mistake the first time around, so that Ms. Fileshare is not convinced. Through some clever detective work, problem solving skills, and clues from a 'Squeaky Voice,' the kids demonstrate how scale is needed to construct a bar graph that can prove their accusations against their rival, Hacker. In CYBERCHASE FOR REAL, Harry and Bianca are given jobs selling refreshments in a movie theater. The one who sells the most candy can become Employee of the Month and win free movie passes. Harry and Bianca each make a graph to show how well they have done selling refreshments. The scales of the bar graphs are different, so the bars on Harry's graph appear taller than Bianca's. The results are puzzling because they have both sold the same amount. Segments of this episode, interaction on the CYBERCHASE Web site, and activities requiring the use of data in the construction of a bar graph to make a convincing argument will provide children with an understanding of how bar graphs can be used to compare values of different things quickly and easily.

**SUBJECT MATTER:** Mathematics

**LEARNING OBJECTIVES:** Students will be able to:

- Create a bar graph that quickly communicates an amount without the need to know exact data;
- Compare the values in different categories easily and at-a-glance using bar graphs;
- Determine the best scale to use on a graph so that the data is clearly communicated;
- Use bar graphs to persuade others;
- Compare and interpret the heights of bars on bar graphs that have the same scale quickly.

**STANDARDS:** From the National Council of Teachers of Mathematics Standards for grades K-12, available online at <http://www.nctm.org/standards/standards.htm>

**Representation (Grades PreK-12)**

- Create and use representations to organize, record, and communicate mathematical ideas;
- Select, apply, and translate among mathematical representations to solve problems;
- Use representations to model and interpret physical, social, and mathematical phenomena.

## MEDIA COMPONENTS:

### Video

CYBERCHASE Episode #210: "Raising the Bar"

### Web Sites

**CYBERCHASE Web Game:** "Bugs in the System"

<http://pbskids.org/cyberchase/games/bargraphs/bargraphs.html>

The Cybrary is infested, and children need to remove the bugs. The challenge is to use the *bar graph scaler* to successfully change the scale in order to accomplish the required tasks. Speed, skill, and a firm grasp of the scaling concept are needed to advance.

### Create Your Own Bar Graph

<http://nces.ed.gov/nceskids/graphing/bar.asp>

This site enables students to create and print their own bar graphs online.

### Scholastic Bar Graph Comparing Favorite Sports Watched

<http://teacher.scholastic.com/kidusasu/favsport/index.htm>

This bar graph examines students' favorite sports to watch.

### Scholastic Bar Graph Comparing Favorite Sports in which Students Compete

<http://teacher.scholastic.com/kidusasu/favsport/index.htm>

This bar graph examines students' favorite sports in which to participate.

### Scholastic Bar Graph Comparing Favorite School Uniform Colors

<http://teacher.scholastic.com/kidusasu/uniforms/chart3.htm>

This bar graph examines students' favorite colors for school uniforms.

## MATERIALS:

### For the class

- A bar graph from a newspaper or magazine
- If you prefer, you can create overhead transparencies of the three Scholastic bar graphs, available online at the links listed above.

### For each student

- Pen or pencil
- Graph paper
- Colored markers
- Lined paper to write down data to be used in the bar graph



## PREP FOR TEACHERS:

- **CUE** episode #210, "Raising the Bar" to the appropriate starting point, which is the scene in which the CYBERCHASE kids and Ms. Fileshare compare Hacker's graph with that of another exterminator. Bookmark the Web sites used in the lesson. Try the "Bugs in the System" activity on the CYBERCHASE Web site so that you are certain how it works. Create the transparencies of the Scholastic graphs if you wish.
- When using media, provide your students with a **FOCUS FOR MEDIA INTERACTION**, a specific task to complete and/or information to identify before, during, or after viewing video segments, Web sites, or other multimedia elements.
- To read about what kids know and don't know about this lesson's math topic, please turn to the last page of this lesson.

## INTRODUCTORY ACTIVITY:

1. Bring in a bar graph from a newspaper or magazine. Show the bar graph to your students, and ask: **What is a bar graph?** (*Guide your students to realize that a bar graph is a representation of different values using bars. The height of the bar indicates the amount in a given category.*) **When and why would someone want to use a bar graph?** (*When you want to compare values of different things easily and at a glance.*)

Have students look at the bar graphs from the Scholastic Web site on favorite sports to compete in and favorite sports to watch. A transparency can be shown and/or you can also distribute copies of the graphs to each student. Ask students to discuss the graphs. Emphasize that numbers have to appear on the bar graphs, and that the scale used on the vertical, or *y-axis*, has to be the same to compare two or more bar graphs visually and quickly.

Ask: **How are the graphs similar and how they are different?** (*The same sports are listed. Those same sports appear in the same order on both bar graphs. The same scale of increments of 50 going up to 600 is used of those surveyed. The difference is in the numbers for each. The green bar is highest showing that basketball is the favorite sport to watch. In terms of competing, the bar representing "Other" is tallest. Without having to even see the numbers, the top choice for each category is obvious. Favorites for watching are not the same as favorites for competing in.*)

2. Students can also be asked to discuss school uniforms. Tell students there are some schools that have voted to have uniforms. Have students imagine that uniforms have been selected for use in their school. What colors would they want them to be? Scholastic readers voiced their opinions on what colors they would choose if they had to have uniforms and this is the result of that vote. Distribute the bar graph from Scholastic reflecting a vote on school uniform colors. Students should also realize that a bar graph represents the amount in a given category. Each color is represented by a different bar and the height represents the number voting for that color.
3. Ask your students: **What information appears in this bar graph?** (*The number of votes increases in increments of 50 up to 500 votes and the colors voters liked including blue, white, red, green, yellow, black, and other. "Other" includes: purple, teal, brown, orange, and gold.*) **How is it organized?** (*Votes are by gender: Male and Female.*) **What are the favorite colors of males and females?** (*Both males and females prefer black. Black received the most votes and the bars are tallest for black, making it visually easy to spot the answer.*) Other types of graphs and charts involving Scholastic surveys on a variety of issues (for further class discussion) can be found at <http://teacher.scholastic.com/ilp/index.asp?SubjectID=3&SubheadID=32&TopicID=78>.
4. Explain that in the "Raising the Bar" episode, the CYBERCHASE kids have to convince Ms. Fileshare that the cybrary has more bugs that she realizes. Provide your students with a **FOCUS FOR MEDIA INTERACTION**, asking students to describe how Hacker convinces Ms. Fileshare that he should be hired to exterminate the Cybrary. **PLAY** the tape from the opening of the episode with Ms. Fileshare saying, "The cybrary is the place to go when you need to know." **PAUSE** the tape when you hear Buzz and Delete say, "We're in, Boss. Your plan

worked.” Check for comprehension by asking: **How did Hacker convince Ms. Fileshare he should be hired?** (*Hacker convinced Ms. Fileshare by showing her a bar graph comparing the number of bugs that he — as “The Vermin Vexer” — has exterminated. He compares his graph to another exterminator, and it appears as though he has exterminated many more bugs.*) Ask: **What’s the first thing you notice when you look at a bar graph?** (*The height of the bars*) **REWIND** the tape until you see a clear image of Hacker’s bar graph showing the bugs that the Vermin Vexer has caught. **PAUSE** video. Ask: **What is missing from Hacker’s graph? What was on the Scholastic graphs that is missing from Hacker’s?** (*There are no numbers on the y-axis, so there is no way to judge the scale of the graph.*)

### LEARNING ACTIVITY:

1. Remind students about the premise of the CYBERCHASE episode, “Raising the Bar.” **CUE** the video to the point where Inez states that “Things are getting worse.” Provide the students with a **FOCUS FOR MEDIA INTERACTION**, asking them to determine how the CYBERCHASE kids use Digit’s idea of stacking library carts to convince Ms. Fileshare. **PAUSE** the video when Ms. Fileshare says, “I’m convinced. Come with me.” Check for comprehension, and ask: **How did the CYBERCHASE kids use Digit’s idea?** (*Digit used a visual way of easily displaying a comparison of*



- numbers when he showed how much work he did compared to the others. It is presented in a bar graph form. The CYBERCHASE kids then make their own bar graph to convince Ms. Fileshare.)* Ask: **How did Matt show how many bugs are in the cybrary? How did they take that chart to Ms. Fileshare? Which section of the cybrary has the most bugs? What is Ms. Fileshare’s reaction to Matt’s evidence?** (*Matt stacks the library carts to show how many bugs were in each part of the library. Inez makes a portable version of Matt’s graph, which is a bar graph, to take to Ms. Fileshare. The history section has the most bugs. Ms. Fileshare is now convinced that the cybrary has a bug problem.*) If necessary, **REWIND** to confirm answers or allow students more time to obtain the information.
2. Provide students with a **FOCUS FOR MEDIA INTERACTION** by asking students to explain why Ms. Fileshare doesn’t think that the bug problem is as big as the CYBERCHASE kids do. **PLAY** from the previous pause point until you see Matt say, “She won’t believe anything I say ever again.” **PAUSE** the video. Check for comprehension by asking: **Why doesn’t Ms. Fileshare think the problem is very big?** (*Hacker showed her a graph that made the bug problem look very small.*) **What did both Hacker and the CYBERCHASE kids leave off of their graphs?** (*There are no numbers on the y-axis, and no scale to the graph.*) **CUE** the video until you see Jackie hold out her arms and say, “Hold on, make room, I gotta pace.” Provide your students with a **FOCUS FOR MEDIA INTERACTION**, asking them to determine how the CYBERCHASE kids figure out that Hacker manipulated the bar graph using the correct numbers to hide the truth. **PLAY** the tape. **PAUSE** the video when Matt says, “He didn’t have to, he wanted to, to hide

the truth.” Check for comprehension by asking: **How did the CYBERCHASE kids determine that Hacker manipulated the bar graph?** *(They compare scales. Their scale on their bar graph goes up to 14 which is the most bugs caught. Hacker’s scale goes up to 105, in increments of 15, so when he makes a bar graph with 14 bugs caught, it appears very small.)*

3. Bianca, in CYBERCHASE FOR REAL, wants to be employee of the month. Both she and Harry have been selling refreshments at the movie theater and use bar graphs to show how successful they have been. Both have the same amount of sales, but the bars on Harry’s graph looks much taller. Bianca has to figure out why hers appears so short, giving the impression that she has not sold as many refreshments. **CUE** the video to the beginning of the CYBERCHASE FOR REAL segment. Provide students with a **FOCUS FOR MEDIA INTERACTION** by asking them to look for how Bianca fixes her bar graph to reflect that she also has \$4,000 in sales. Have students discuss what needs to be done so that both graphs appear the same and they can both win the free movie tickets. **PLAY** the videotape until you see Bianca holding up her new graph with Harry’s showing that each sold \$4,000. **PAUSE** the videotape. Check for comprehension by having students respond with answers. *(Bianca showed the theater manager that she and Harry should both be named Employee of the Month in refreshment sales by explaining that her bar graph had a smaller scale than Harry’s. The scales were different, and that made the bar graphs look different. They both actually sold the same number of refreshment sales and both were winners.)* **REWIND** if necessary to obtain the correct answer.
4. Ask your students to log on to the CYBERCHASE Web game “Bugs in the System” at <http://pbskids.org/cyberchase/games/bargraphs/bargraphs.html>. Provide your students with a **FOCUS FOR MEDIA INTERACTION** by asking them to complete the activity on the site and get rid of the bugs in each room of the cybrary. After your students have completed the activity, ask: **What made the activity challenging? Why was it sometimes necessary to use the graph scaler?** *(Student answers will vary.)*

### **CULMINATING ACTIVITY:**

1. Tell students that there is a problem on the International Space Station (ISS). The astronauts on the International Space Station are using the ham radio to speak live with their families. However, Mission Control believes that the astronauts are making too many calls, and this chatty behavior is costing NASA a fortune. The astronauts and Mission Control officials must each present their case to Congress in the form of a bar graph to support their argument. The Mission Control officials must convince Congress that the astronauts ARE making too many ham radio calls. The astronauts must convince Congress that they ARE NOT making too many ham radio calls. Each group will be making a graph based on the same data.
2. Write the following data on the board. Tell students that the data reflects the names of astronauts and the number of phone calls each astronaut made during a one month period:

|                 |          |                |          |
|-----------------|----------|----------------|----------|
| Peggy Whitson:  | 12 calls | Ellen Baker:   | 17 calls |
| Chris Hadfield: | 15 calls | Michael Foale: | 25 calls |
| Sally Ride:     | 23 calls | Ed Lu:         | 13 calls |

3. Divide your class into groups of four students. Within each group, ask two students to assume the role of astronauts and two students to assume the role of Mission Control officials. Ask a student to again explain what the goal of the astronauts is (*The astronauts' goal is to create a bar graph that will convince Congress that they ARE NOT making too many ham radio calls.*) Ask another student to explain what the goal of the Mission Control officials is (*The Mission Control officials' goal is to create a bar graph that will convince Congress that the astronauts ARE making too many ham radio calls.*)
4. Ask: **How might the astronauts use the data to make a bar graph that will look like they are making very few ham radio calls?** (*The astronauts should select a scale for the y-axis that uses much larger numbers than the number of ham radio calls. For example, make the scale go from 1 to 100, increasing in increments of 10. If students cannot describe this concept, ask them to recall what Hacker did to make it look as though he did a good job exterminating the bugs in the cybrary.*)
5. Ask: **How might Mission Control officials use the data to make a bar graph that will look like the astronauts are making a lot of ham radio calls?** (*The Mission Control officials should use a smaller scale on the y-axis, to make the number of calls appear larger. For example make the scale go from 0 to 26, increasing in increments of one.*)
6. Distribute graph paper to your students. Ask your students to create a graph based on the role they are playing
7. After students have completed their graphs, ask all of the astronauts to come up to the front of the room and display their graphs. Play the role of a member of Congress and react to the information as it is presented on the astronauts' graphs. (*If the astronauts have done their job, the graph will appear as though very few phone calls were made.*)
8. Ask all of the Mission Control officials to come up to the front of the room and display their graphs. Play the role of a member of Congress and react to the information as it is presented on the Mission Control graphs. (*If the Mission Control officials have done their job, the graph will appear as though a lot of phone calls were made.*)
9. Ask your students to explain to you why the data on the two different sets of graphs appears so different on each set of graphs? How can the data be presented more fairly?
10. Ask students to log on to the Bar Graph Creator Web site at <http://nces.ed.gov/nceskids/graphing/bar.asp>. Provide your students with a **FOCUS FOR MEDIA INTERACTION** by asking them to create a bar graph that displays the astronauts' phone call data fairly.

### **CROSS-CURRICULAR EXTENSIONS:**

- **Science.** Ask students to use a bar graph to track high and low temperatures in their city for a week.
- **Social Studies and Current Events.** Ask students to collect various cell phone advertisements and graph either the cost of the plans or monthly minutes.
- **English/Language Arts.** Ask students to do a survey and make a bar graph of the

most popular types of books the class reads. Categories might be mystery, science fiction, adventure, sports or animals.

**COMMUNITY CONNECTIONS:**

- Ask a Ham Radio enthusiast to come to your classroom and discuss their hobby.
- Collect graphs from newspapers and magazines to track how bar graphs are used in the media. Display them on the bulletin board.
- Work with the school cafeteria staff to track data on the number of meals sold in the cafeteria each day for a week. Create bar graphs based on the data.

## Math Topic: Bar Graphs

(To go with “Raising the Bar While Hogging the Ham (Radio, That Is)”)

### **What we can assume 8- and 9-year-olds already know about BAR GRAPHS:**

By grades 3-5, kids are fairly knowledgeable and competent with reading bar graphs. They use them frequently in science, but more in social studies.

At this age, kids gather research from the Internet and from reference books, such as the Almanac. They are beginning to realize that accumulating data as a printout of numbers does not reveal a ‘picture’ of the data. For large amounts of data, you can’t easily discriminate, understand or sort it out. Kids are beginning to see that *picturing* data helps them mobilize ideas.

### **What confuses kids about BAR GRAPHS:**

Kids can be fooled by the size of squares on the graph paper! If the squares on the graph paper are larger, the bars in the graph can create a greater impact than they would if the squares were smaller. Kids, when confronted with two bar graphs that differ only in the size of the squares think the larger squares show ‘more.’

When the bars are shown horizontally in one graph and vertically in another, students have difficulty realizing the two graphs display the same information.

Students have little experience rearranging the bars to make the data clearer to someone else. They don’t realize that the categories for each bar of the bar graph can be displayed in *any* order and therefore can be rearranged largest to smallest, for example, to make the graph easier to interpret.

Kids can *read* most simple bar graphs effectively, but they have limited practice in interpreting the information, and little if any experience making and using bar graphs to make a point or to persuade someone. While they realize that a graph creates a mathematical picture, they don’t realize that, as with any picture, the creator has the power to put his or her own twist on the presentation.

For example, they are not familiar with what happens when you change the scale: Changing the scale can lead the eye of the viewer either away from change or toward the change, depending on the needs of the presenter.

Kids naively believe that ‘anything in print must be true’ and have not developed strategies for questioning the picture they are looking at. Our daily lives are saturated with data and visual communications that try to persuade. In response to this glut of information, we want kids to be able to ask themselves questions like: *Am I willing to accept the interpretation of this data as presented to me? Can I represent the information more clearly? Is there another side to the information? How do I decide what this data means?*