WHEN CLOSE ENOUGH IS GOOD ENOUGH

Math Topic: Estimation

By Chris Czajka

ABOUT THE AUTHOR

Chris Czajka is associate director of local NTTI at Thirteen/WNET New York.

WHEN CLOSE ENOUGH IS GOOD ENOUGH

MATH TOPIC: Estimation

GRADE LEVEL: 3-5

TIME ALLOTMENT: Two 45-minute class periods

OVERVIEW: Is close enough ever good enough? In the case of estimation, it is! In this lesson, students will participate in a series of hands-on, online, and multimedia activities to examine the concept of estimation. After discussing the differences between an estimate and a guess, students will view a clip of the animated series CYBERCHASE, and make decisions about making a reasonable estimate to solve a problem. Following the video portion of the lesson, students will visit a variety of Web sites to test their estimation skills.

SUBJECT MATTER: Math

LEARNING OBJECTIVES: Students will be able to:

- Describe the difference between an estimate and a guess;
- Create reasonable estimates based on observation and hands-on activities;
- Articulate how estimation can be applied to real-world situations;
- Synthesize estimates based on interaction with online activities.

STANDARDS: From the National Council of Teachers of Mathematics Standards, grades 3-5, available online at http://standards.nctm.org/document/chapter5/numb.htm

Students will be able to compute fluently and make reasonable estimates. That is, students will be able to:

- develop and use strategies to estimate the results of whole-number computations and to judge the reasonableness of such results;
- select appropriate methods and tools for computing with whole numbers from among mental computation, estimation, calculators, and paper and pencil according to the context and nature of the computation and use the selected method or tools.

MEDIA COMPONENTS:

Video

CYBERCHASE Episode #104: “Snow Day to Be Exact”

Web Sites

Explore Science: Time Estimation
http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=50
This award-winning Web site contains highly interactive science activities for students and educators. This page challenges students to estimate how long it takes 30 seconds to pass.

Estimating Sums
http://www.aaamath.com/B/est27bx2.htm
This site contains hundreds of interactive math activities for grades K-8. This page tests students’ ability to round off numbers and then add them together.

Bacteria Cam
http://www.cellsalive.com/cam2.htm

Students can examine the many aspects related to cell biology at this site. This page allows students to view bacteria cells reproducing over the period of a day.

MATERIALS:

(For each student)

- A small, fun-size box (not a bag) of raisins or candies
- Pencil and paper

(For each group of 5 students)

- One "Jellybean Jostle" printout available at http://pbskids.org/cyberchase/games/estimation/jellybean_grid.html

(For the class)

- One set of "Jellybean Jostle" grid cards (cut up version of the printout)

PREP FOR TEACHERS:

- Prior to teaching this lesson, bookmark all of the Web sites used in the lesson on each computer in your classroom. Load the Shockwave plug-in, available at http://www.macromedia.com, onto each computer in your classroom.
- When using media, provide students with a **FOCUS FOR MEDIA INTERACTION**, a specific responsibility to complete during or after viewing of video, 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. Distribute the small boxes of raisins or candies to your students. Instruct your students NOT to open the packages. Tell your students that they will be able to enjoy the treats—in a little while—if they can help you determine the number of raisins or candies in the box.

2. Ask your students to guess and write down the number of candies (or raisins, or whatever) that are contained in their box. Students should write this guess down without sharing it with their neighbors. Explain to students that they are not allowed to open the boxes.

3. Ask your students for a sampling of their answers. Write their answers on the board. In all likelihood, the answers will vary enormously. Ask the participants why they think the answers are so varied. Ask: **What methods did you use to come up with your answers?** (*What you want them to say is that all they did was guess. There was really no scientific or mathematical reasoning behind their answers.)*

4. Tell your students that they can open their boxes, but do not remove any of the contents. Ask students to look inside the box, and make another estimate of the total number of items in the box and again write it down. Give students a minute or so to look inside their boxes, and then ask for a sampling of answers. *(The range of numbers this time should be smaller.)* Ask students how they came up with this new

estimate. *(Students may have counted the number of raisins or candies in the top layer of the box, and then multiplied by estimating the total number of layers.)*

5. Ask students to explain the difference between their first try at coming up with the number of raisins in the box, and the second try. *(Students should point out that they used some logic and observations in their second try.)* Ask your students if they can define for you what an 'estimate' is. *(Student answers will vary. If your students cannot define the term, explain that an estimate is a rough or approximate answer.)*

6. Explain to your students that in this lesson, you will be examining estimates. Sometimes, close enough is good enough. Have your students count out the actual number of raisins in each of their boxes, compare results and then allow them to eat the activity materials.

LEARNING ACTIVITY:

1. Explain to your students that they will be examining the concept of estimation using a video clip from the PBS series CYBERCHASE. **INSERT** CYBERCHASE "Snow Day to Be Exact," into your VCR. **CUE** the tape to where Inez says, "How do we get across?" and the children are standing on a snowy cliff. Provide your students with a **FOCUS FOR MEDIA INTERACTION**, asking your students to determine how the kids are going to cross the hole in the bridge. **PLAY** the tape until Inez says, "We don't want to waste time taking the barrels all they way over there." **PAUSE** the video. Check for student comprehension. *(The kids plan to fill the hole with barrels.)*

2. Ask your students if they think this method will work. **What possible problems could the CYBERCHASE kids run into?** *(They might not have enough barrels to fill the hole.)* **What might the kids do to test and see if they have enough barrels without taking them all to the hole?** *(Put just a few barrels in the hole to see how much they fill it.)*

3. Tell your students that they have just made a prediction. Provide your students with a **FOCUS FOR MEDIA INTERACTION**, and ask them to check their prediction against the next video segment. **PLAY** the video until Digit, at the bottom of the hole, says, "102?" *(Hopefully, your students will have made a correct prediction.)* Ask: **Do you think the kids will need 102 layers of barrels to fill the hole?** *(Probably not)* How could they determine the number of layers needed to fill the hole?

4. Provide your students with a **FOCUS FOR MEDIA INTERACTION**, asking them to see if their new prediction is correct. **PLAY** the video until Digit says, "We need three more layers!" **PAUSE** the tape. Was your students' prediction correct (*Probably)* Ask your students, **if there are four barrels in one layer, and they need three more layers, how many more barrels will be needed to fill the hole?** *(12 more barrels)*

5. Provide your students with a **FOCUS FOR MEDIA INTERACTION**, asking them to see if the kids' plan works, and to cheer if it does. **PLAY** the tape until Digit says, "I declare this bridge officially open," and the sled crosses the barrels. **FAST**

FORWARD the tape to the beginning of the CYBERCHASE FOR REAL epilogue. **STOP** the tape. Ask students how the CYBERCHASE kids used estimation to solve their problem. *(They saved time by making a rough calculation of how many barrels they would need to fill the hole.)*

6. Ask students if they have ever needed to fill a hole with barrels. *(Most will probably say no.)* Do they think that estimation is ever applicable in real life? Ask them to name a situation in which they would have to estimate. *(Student responses will vary.)*

7. Explain to your students that you will now examine a real-life situation in which estimation is used. For this portion of the lesson, you will be using the live action epilogue of CYBERCHASE, "Snow Day to Be Exact." Provide your students with a **FOCUS FOR MEDIA INTERACTION**, asking them to determine what exactly the young man's problem is. **START** the video when the young man (Harry) is standing in front of the TKTS booth and saying, "This is a great place where you can buy discount tickets for the next performance" (about 24 minutes into the episode).

8. **PLAY** the video until Harry gets back in line, and says to an older woman, "I told them how to make the line move faster," and the woman responds, "Yeah, I heard." **PAUSE** the video. Check for student comprehension. **What is the young man's problem?** *(He wants to either see a Broadway show or a movie, but if the line moves too slowly, he might not get a ticket for the Broadway show before the booth closes. Plus, he will miss the movie.)*

9. Ask: **How could Harry use estimation to determine whether he will get to the ticket window in time? What could he do?** Let your students brainstorm ideas. *(Student responses will vary.)* Provide students with a **FOCUS FOR MEDIA INTERACTION**, asking them to watch the video and see if Harry uses their ideas.

10. **PLAY** the video. **PAUSE** the video when you see the young man and he says "Five minutes. Well, it's moving. Slowly, but it's moving." Ask: **How did Harry decide to estimate the amount of time it would take him to get to the head of the line?** *(He decided to time how long it would take him to get across one sidewalk square.)* **What time was it was when we stopped the tape?** *(5:45)* **How could Harry estimate if he has enough time to get to the ticket window before it closes?** *(Count the number of sidewalk squares between him and the window, and estimate that it will take five minutes to cross each.)* **What is the maximum number of sidewalk squares that he could cross before the ticket window closes?** *(Three)*

11. Provide your students with a **FOCUS FOR MEDIA INTERACTION**, asking them to determine the number of sidewalk squares between Harry and the ticket window. **PLAY** the video until Harry counts four sidewalk squares, and says "Okay. There are four sidewalk squares left." **PAUSE** the tape. Check for comprehension: **Should Harry stay in line or go to the movies?** *(He should go to the movies.)*

12. Provide your students with a **FOCUS FOR MEDIA INTERACTION**, asking them to see if the young man makes the right decision. **PLAY** the video until the end of the segment. Ask students what Harry was estimating. *(Time and distance)* Ask students if 'close enough' is always 'good enough'? For instance, would they want a waiter or salesperson to estimate the price of an item? Is estimation always appropriate?

CULMINATING ACTIVITY:

1. Tell your students that they will now have the opportunity to estimate on a variety of problems using a series of interactive Web sites. Have your students log on to the Explore Science: Time Estimation Web site at http://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=50. Provide your students with a **FOCUS FOR MEDIA INTERACTION**, asking your students to complete the activity on the site, and to record how close they are to a perfect estimation. *(Students will be asked to click their mouse when they estimate that 30 seconds have passed. The Web site will inform students how close they are to 30 actual seconds.)* Ask: **What is the Web site asking you to estimate?** *(Time)* **What strategies did you use to make your estimation?** *(Student answers will vary.)* Do they think that if they repeated the estimation they would come closer?

2. Have your students log on to the Estimating Sums site at http://www.aaamath.com/B/est27bx2.htm. Provide your students with a **FOCUS FOR MEDIA INTERACTION**, asking your students to complete the activity on the site, and record how many correct answers they get in two minutes (telling students that they must pay attention to the timer on the site). Be sure to remind students that they will be estimating, and not 'solving' the problems—no calculators or scratch paper allowed. Ask: **What is the Web site asking you to estimate?** *(Sums)* **What strategies did you use to make your estimate?** *(Student answers will vary.)* Do your students think if they repeated the activity they would get more correct answers?

3. Tell your students that since they are becoming such experts at estimation, you will be giving them a real brainteaser. Have your students log on to the Bacteria Cam Web site at http://www.cellsalive.com/cam2.htm. Explain that this Web site is a camera image of bacteria growing under a microscope over a period of time. Under each frame, the time is listed with the total number of bacteria. Provide your students with a **FOCUS FOR MEDIA INTERACTION**, asking your students to estimate the number of bacteria that would be present one hour after the Intermediate Slide. *(Student answers will vary according to the time of day. Students can estimate the number of bacteria based on the number that developed between the first frame and the intermediate frame.)* Ask students to check their estimates by moving the clock for the intermediate frame ahead by 60 minutes.

4. Now we're going to bring the lesson back to CYBERCHASE and do an online-based activity that will echo the introductory activity. Give each group a copy of the "Jellybean Jostle" handout (from http://pbskids.org/cyberchase/games/estimation/index.html) but give it to them FACE DOWN and tell them not to look at it. Explain to the students that a candy store owner has dropped a jar of jellybeans on his tile floor that is laid out like a grid with 20 boxes. When they are all handed out, tell each group they can look at the picture for two seconds in order to make an estimate of the total number of jellybeans. Count out the two seconds and then have them flip the pages over. Take a poll of your groups' estimates. Next have each group take three cards from your stack of grid cards. Based on the number of jellybeans on each grid card, and knowing that there are 20 squares in the floor grid, have the students estimate how many jellybeans were dropped. (*There are 120 jellybeans. Answers will vary fairly widely, but if they are within 10 jellybeans they have done very well.)*

5. Review with your students all of the ways they have used estimation in this lesson. When else might they use estimation skills? Brainstorm a list of possibilities. As an assessment, ask each student to write a letter to a friend explaining what estimation is, and how estimation can be used in real-life situations. When *else* is 'close enough good enough'?

CROSS-CURRICULAR EXTENSIONS:

- **Social Studies.** Using a map with a scale of miles, ask your students to estimate distances between locations around the country. Check your estimates by logging on to Web sites such as Map Blast (http://www.mapblast.com) or Map Quest (http://www.mapquest.com).
- **Science.** Return to the Bacteria Cam Web site. How many bacteria would there be in a day? A week? A month? A year? Ask your students to research bacteria and develop a PowerPoint presentation or report on what bacteria is, the problems bacteria causes, and what bacteria needs to grow and thrive.
- **Language Arts.** Examine a classroom dictionary. Ask your students to estimate the number of words defined on each page, the total number of words beginning with each letter of the alphabet, and the total number of words defined in the dictionary. According to your estimates, what letter begins the most words? What letter begins the fewest?

COMMUNITY CONNECTIONS:

- Invite a stay-at-home mom or dad into your classroom to discuss how she or he uses estimation at the grocery store, in the kitchen, or while planning holidays and/or parties.
- Ask students to poll parents, family members, or other adults on how they use estimation in their jobs. Ask students to present their findings.
- Visit a local store or restaurant, and discuss with the manager how estimation is used in determining inventory or orders.

Math Topic: Estimation

(To go with **"**When Close Enough Is Good Enough")

What we can assume 8- and 9-year-olds already know about Estimation:
Estimation goes beyond paper and pencil math. To some kids, this can be a freeing experience since the math many of them have been exposed to in school is often geared toward written work and single, correct answers. Some teachers run contests: *How many marbles are in this jar? How many paper clips are connected in this strip?* Then the excitement of estimating and developing strategies for guessing becomes contagious.

Kids witness adults using an estimate as a first step in an action that will lead to an exact answer. For instance, they may hear parents estimate the amount of money expected as change at the cash register, and learn that estimation plays an important role in protecting them from mistakes with money.

Kids observe adults using estimates when planning construction. Estimating guides their thinking before any plans are committed to paper. They estimate how much material they will need for the project, and purposely estimate high to avoid running out mid-construction. Kids that have the opportunity to observe and participate in such construction projects can learn useful estimation strategies.

What confuses kids about Estimation:
Mathematics isn't always about getting the *right* answer; it's about getting useful answers. It is important for kids to learn when to be precise, when to estimate, and what strategies to use. Some kids, when asked to give an estimate, will first find the precise answer and then round it off. When kids feel they are restricted to coming up with one right answer, rather than thinking about what might be a close enough answer, they lack a true understanding of how to use estimation.

When kids hear the word 'estimate' in school, they may distrust it. They are accustomed to arriving at a single answer, which is either right or wrong. They are uncomfortable with the possibility that there can be an array of 'correct estimates.' They want to know if they were right. Saying that they were 'in the ballpark' is not particularly satisfying.

Kids are not familiar with tools that can help them become good estimators, such as using benchmarks or partitioning. They don't understand that rounding is a single strategy in the estimation bag of tricks. Kids learn that rounding is a skill that will help them become better estimators. However, some textbooks report one answer as the correctly rounded number. This can get in the way of the conceptual process. And after a while, kids may even dread the estimation work — they just want to be right!