**Saved by the Bell: The Research Behind Bell Work**

Perhaps the distractions and disruptions in Miss Bliss’ class would have been alleviated had she used bell work activities. As soon as the bell rings, students need to be focused, motivated, and ready to learn. Through the use of bell work activities, “there is great potential that [students’] learning skills will develop; [students’] academic background will deepen; and [students’] learning enthusiasm will increase“ (Madden, 1981). “In a *perfect* world, the start of class would be characterized by students primly sitting at their desks with sharp pencils, open textbooks, and clean notebook paper at the ready. In the *real* world, the start of class is all too often characterized by students slouched against desks gossiping about Friday night’s party while throwing annoyed glances at their teacher who is trying her best to direct their attention to the latest scene from Romeo and Juliet” (Margie, 2009).

Some advantages to bell work are:

* Providing structure in the classroom, by signaling to students that it is time to start class and help them realize that they came to class to work
* Introducing students to learning activities based on their interests and abilities and increases student participation
* Promoting recall, participation, classmate recognition, oral communication skills, and leadership initiative (Ducharme, 1997)
* Helping to provide connections between what students are learning in class and the real world
* Utilizing the entire class period by focusing students’ energies and attention, instead of having wasted time in the beginning of class
* Allowing time for the teacher to take attendance, walk around and check homework, or other housekeeping tasks
* Preventing disruptions by eliminating any opportunity for conversation or other distractions at the start of class (Hopkins, 2009).

It is important to always establish a time frame for the completion of bell work. Students need to be held accountable for completing the assigned activities. There are multiple ways to accomplish this. For example, bell work could be graded randomly once a week and students could be required to complete their bell work activities in a spiral notebook that is left in the classroom at all times so the teacher can easily access it. This also helps the teacher diagnose a student’s weaknesses and strengths as well as the effectiveness of the teacher’s lesson plans (Hickman, 2009).

**Main Categories for Bell Work**

There are three main categories for bell work activities. They include large group presentations, small group interaction, and independent study. For large group presentations, students are able to develop interests and to deepen knowledge about concepts more thoroughly than when they work on their own. Following large group presentations, teachers can provide direction for further investigation. Through small group interactions, students acquire communication skills and formulate questions, concerns or investigations. Through independent study students can work individually to deepen personal knowledge.

**Bell Work Activities**

Bayside Exam Prep

• Review for Regents exams can be broken up into one or two problems from old exams each morning.

• This gives students daily review, without taking up much class time.

Bayside Picks-“Drops in the Bucket”

• A bucket is filled with 3 or 4 different questions, which are based on previously covered material.

• These questions will be solved and recorded in a journal, which is collected and graded on a predetermined schedule.

• This reinforces previous knowledge for students, and strengthens knowledge needed for future lessons.

Bayside News

• Once a week, students look up current events involving the Science, Technology, Engineering, and Mathematics (STEM) subjects.

• Students then break up into smaller groups and share information they found, as well as why they believe it is relevant to STEM.

• This helps students connect to the material, and they may find topics they want to pursue in the future.

QQF: Bayside History

• The teacher writes a quote, a question, and a fact (QQF) on the board for students to copy into a journal as they come into class.

• The QQF will relate to the lesson to be covered in class that day.

• This promotes student learning of the history behind the mathematics they are learning in class.

Problem of the Day (POD)

• A word problem is written on the board, which can be solved using basic problem solving skills.

• The content will be related to the day’s lesson, and will also be real-world applicable.

Lists

• As students walk in the door, the teacher gives them a topic such as exponent laws or area formulas.

• The students will each create a list, which consists of pertinent information about the given topic.

• This encourages students to review previously learned material to better prepare them for future lessons and assessments.

Math Tricks

• A great way to get students excited about mathematics is to teach them a trick that involves mathematics, and have them try to figure the “trick” out.

• A variation is for the students to each research a trick and present it to the class.

• This helps establish communication skills, while keeping students interested in mathematics.

Did You Know?

• For this bell work activity, students will find out an interesting math fact that they can share with the rest of the class. For example, one could be:

Did you know that:

**Sample Problems**

**1.** *School Days*

Take *any* calendar. Tell your friend to choose 4 days that form a square. Your friend should tell you only the sum of the four days, and you can tell her what the four days are. How does the puzzle work?

*Solution:*

Let's pretend that the 4 numbers that the person chose were the numbers 18, 19, 25, and 26. She adds up the four numbers and tells you only that the sum is 88. You make a couple of calculations and tell her the numbers. What calculations? Let’s figure that out with algebra. We can call the first number . Then you know that the next numbers would be , ,and . We had our friend add up the four numbers, which equals 88:

Solving for n, we find

So, in the end, we subtracted 16 and divided by 4, and this will work every time! This gives you the first number ***.*** (Then add 1, 7 and 8 for the other numbers) (Lanius, 2008).

**2.** *Checkerboard and Dominoes Problem*

Suppose you have a checkerboard, and a set of dominoes. Each domino is twice the area of a square of the checkerboard. Clearly, you could cover the entire checkerboard with thirty-two dominoes. But here's the question: Suppose you chopped off two opposite corners of the checkerboard. Can you now completely cover the remainder of the board using thirty-one dominoes?

*Solution*

If you are removing opposite corners, you are removing two squares of the same color. This leaves 32 squares of one color, and 30 squares of the other color. Since every domino must cover two squares (one square of each color), it is *impossible* to fully cover the checkerboard.

## 3. *Monty Hall and Counterintuitive Probability*

Suppose you are on a game show, and Monty Hall (the game show host) shows you three doors, and tells you that there is a prize behind only *one* of them. He asks you to choose one door.
Once you've chosen a door, Monty (who knows where the prize is) opens one of the *other* doors to show you that it doesn't contain a prize. He then asks you if you want to change your guess (to the other door which remains closed) or keep your guess. Which is the wisest course of action?

*Solution*

Believe it or not, you are better off *changing* your guess. Your probability of winning by changing your guess is 2/3, as opposed to 1/3 probability of winning by keeping your guess the same. This is very counterintuitive, and many people don't believe it - even after seeing a rigorous mathematical proof. For a simulation, visit <http://people.hofstra.edu/Steven_R_Costenoble/MontyHall/MontyHallSim.html>.

**4.** *The Pearl Problem*

You have nine pearls, eight are real and one is a fake. All the real ones weigh the same, and the fake weighs less than the real ones. Using a balance scale twice, how can you weed out the fake one?

*Solution*

Weigh any three pearls against any other three. If one side is higher than the other the fake pearl is on that side. If the scale is balanced, the fake pearl is in the three you did not use. For the second weighing take any two of the bad three and weigh one against the other. If one side goes up, then that side has the fake pearl. If the two sides stay the same, the unused pearl of the three is a fake.

**5.** *The Jug Problem*

Two friends who have a non-marked eight-quart jug of water wish to share it evenly. They also have two empty jars, one holding five quarts, the other three. Again, neither have any markings. How can they each measure exactly 4 quarts of water?

*One possible solution:*

Let jug A hold 3 quarts, B hold 5 quarts, and C hold 8 quarts. Then follow the following steps:

 **Amount in Jug (quarts)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Step #** |  | **Jug A** | **Jug B** | **Jug C** |
| 0 |  | 0 | 0 | 8 |
| 1 | Pour C into B | 0 | 5 | 3 |
| 2 | Pour B into A | 3 | 2 | 3 |
| 3 | Pour A into C | 0 | 2 | 6 |
| 4 | Pour B into A | 2 | 0 | 6 |
| 5 | Pour C into B | 2 | 5 | 1 |
| 6 | Pour B into A | 3 | 4 | 1 |
| 7 | Pour A into C | 0 | 4 | 4 |

For a simulation, visit <http://www.cut-the-knot.org/ctk/Water.shtml>



**6.** *Königsberg Bridge Problem*

Given the city of Königsberg to the right, can you find a path that starts and ends in the same place, while crossing each and every bridge only once?

*Solution:*

The solution to this problem is that it cannot be done. An equivalent problem is the following:

Find an Eulerian circuit of the graph to the right:

For a graph to contain an Eulerian circuit, it must have exactly zero vertices of odd degree (the number of edges touching it). Since this graph has four vertices of odd degree, there is no Eulerian circuit in the graph.

7. Stackable Spheres

Say we have a five-layered stack of spheres in the shape of a pyramid, whose base is a square (see the diagram below). How many spheres are in the stack? What if we add a layer? What if we have a stack with 8 layers? How about 55 layers? In general, how many spheres will be in a stack with *n* layers?

Solution:

We will do the general case first. If each layer is in the shape of a square, and there are n layers, then we have spheres. This can be represented as the following formula:

Thus, if there are 5 layers, n = 5, and the number of spheres is . Similarly, when n = 55, the number of spheres is 56980, and we can plug in any value of n that we choose.

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