Mathematics

Grade 7AB

Lesson Plans

“The Wave”

Subject:
Mathematics: 7AB

Level:
Grade 7

Abstract:
In this lesson, the students will create, collect, and analyze data that fits a linear model. The students will perform “the wave” and record the number of seconds it takes to complete the experiment. After this has been performed, the data will be analyzed using Excel. The students will use their findings to make predictions and draw conclusions when applying their results to a real-life situation.

Invitation:

> How many of you have ever been to a sporting event? Have you ever done “the wave”? How did it start? What did it look like? Was it fun? How long did it take for the wave to go around the stadium?

All of the questions above can be used to transition into a discussion about what the wave is. Who invented it? Why do people participate in it? And, how long it takes for a wave to pass through twenty, thirty, one hundred, or ten thousand people.

Find a movie, tape of sporting event, or a streaming video off the Internet that demonstrates the wave in action. Have students time how long it takes for wave to make one revolution around the stadium.

Situations:
Where: The majority of this lesson will take place in the classroom using a variety of teaching strategies and activity settings. When working in the classroom emphasis can be placed on individuals, small groups, or the whole class. Nightly homework will be assigned. These assignments should be completed by the individual and checked daily for understanding.

When: This lesson is designed to assess the students understanding in a project-based assignment. The students should be able to collect data in a t-chart/table and draw conclusions from the data set. This lesson should be taught concurrently with the text being used.

How Long: This lesson is designed to be taught over a minimum of three to five class periods. The amount of time needed will depend upon how many groups present PowerPoint presentations at the end of this lesson.

Tasks:

Task 1: Introduce the Activity
As a class, students will discuss their experiences with "the wave."

Task 2: Assign Timekeeper Roles
The teacher will ask five students to operate the stopwatches and record the times. These students will need a writing utensil, a stopwatch, and a clipboard.

Task 3: Collect the Data
Go outside the classroom to a location big enough to perform the wave experiment. Select two students to begin the experiment. Model how to perform the wave experiment. The two students should practice the wave one time, and then perform the wave for timing. Send students up in groups of two to conduct the experiment. All of the students should face the same way and start with their hands below their hips. Every time two new students are added, have the whole group practice the wave. When they, and you, feel confident, perform the wave experiment. Make sure the timekeepers' times are within reason. Repeat the experiment if needed.

Task 4: Record the Data
After all the students have participated in the experiment return to the classroom. Have the timekeepers record their times on "The Wave Class Data Table." This sheet can be displayed on the overhead or copied onto butcher paper. Have every student copy this data into his or her lab. This data could also be projected using an LCD projector using Excel.

Task 5: Complete "Handout: The Wave Experiment – Part I"
Have table groups finish "Handout: The Wave Experiment – Part I." Specifically, have every student complete:

- Calculating the Average Wave Time on page 3 of the lab. Each student should fill out the t-chart on this page.
- Interpreting the Data on page 4 of the lab. All questions should be answered using complete sentences. When plotting the data emphasize accurate and neat work. Be sure to remind the students to label everything!

Task 6: Excel Spreadsheet
Groups of two to four students will create a spreadsheet in Excel. Depending on the proficiency of the class, they can use the “Spreadsheet Template” or create the table on their own.

Task 7: Creating a Chart
Using the Chart Wizard in Excel, create a scatter plot of the entire data table. The number of students will be the independent variable (x-axis) while the number of seconds will be the dependent variable (y-axis). See “Step Sheet: Creating a Data Table” for directions on how to perform this task. See “Sample: Spreadsheet with Chart” for an example.

Task 8: Graph the Line of Best Fit
After the ordered pairs have been plotted, graph the line of best fit for the average times. See “Step Sheet: Creating a Data Table” for instructions.

Task 9: The Wave Experiment – Part II
Pass out “Handout: The Wave Experiment – Part II.” Students will read the equation of the line of best fit from the Excel spreadsheet. When they have this equation, the lab asks them to interpret what the slope of this line represents. Next, a series of questions are asked that allow the students to make predictions using their mathematical model.

Task 10: Data Analysis Discussion
After Part II has been completed, have a whole-class discussion about any data discrepancies. Emphasize appropriate discrepancies as needed.

Task 11: PowerPoint Project
Groups of two to four students will create a PowerPoint presentation explaining their findings. See the sample PowerPoint project “The Wave: A Whole-Class Experiment” for an example. The teacher will outline the required slides for this project.

Task 12: PowerPoint Presentations
If time permits, each group will present their PowerPoint slide show. If time is short, volunteers can present their projects.

Interactions:
Full Class: The teacher will facilitate whole-class discussions and activities. Refer to individual task numbers for specifics. All of the Invitations, transition periods, and direct instruction are full-class interactions.

Partners: Interaction between partners can occur when correcting homework, discussing answers, and using the computers.

Small Group: The small group activities include, correcting work, completing any guided practice, computer work, and group presentations.

Individual: Depending upon how many full class, partner, and small-group activities are implemented, more or less individual activity settings may be used. The individual should complete all Invitation exercises and nightly homework.

Standards:
Algebra and Functions
1.5 Represent quantitative relationships graphically and interpret the meaning of a specific part of a graph in the situation represented by the graph.
3.4 Plot the values of quantities whose ratios are always the same (e.g., cost to the number of an item, feet to inches, circumference to diameter of a circle). Fit a line to the plot and understand that the slope of the line equals the quantities.
4.1 Solve two-step linear equations and inequalities in one variable over the rational numbers, interpret the solution or solutions in the context from which they arose, and verify the reasonableness of the results.
4.2 Solve multistep problems involving rate, average speed, distance, and time or a direct variation.

Measurement and Geometry
1.3 Use measures expressed as rates (e.g., speed, density) and measures expressed as products (e.g., person-days) to solve problems; check the units of the solutions; and use dimensional analysis to check the reasonableness of the answer.

Statistics, Data Analysis, and Probability
1.1 Know various forms of display for data sets, including a stem-and-leaf plot or box-and-whisker plot; use the forms to display a single set of data or to compare two sets of data.

Mathematical Reasoning
1.2 Formulate and justify mathematical conjectures based on a general description of the mathematical question or problem posed.
2.2 Apply strategies and results from simpler problems to more complex problems.
2.3 Estimate unknown quantities graphically and solve for them by using logical reasoning and arithmetic and algebraic techniques.
2.4 Make and test conjectures by using both inductive and deductive reasoning.
2.5 Use a variety of methods, such as words, numbers, symbols, charts,

graphs, tables, diagrams, and models, to explain mathematical reasoning.
2.6 Express the solution clearly and logically by using the appropriate mathematical notation and terms and clear language; support solutions with evidence in both verbal and symbolic work.
2.8 Make precise calculations and check the validity of the results from the context of the problem.
3.1 Evaluate the reasonableness of the solution in the context of the original situation.

Assessment:

- Invitation Assessment: If "warm-ups"/transition exercises are normally collected in your class, then you should collect this exercise. Otherwise, questioning and visual inspection can be used.

- Small-Group Activities: The papers should be collected for all in-class small group activities.

- Small-Group Computer Work: Each group member should have a specific task when using the computer(s). Each member should be graded on effort, on-task performance, and their individual understanding.

- "Spreadsheet and Chart Rubric:" Use in conjunction with the "Sample Spreadsheet" to assess each groups spreadsheet and chart.

- "PowerPoint Presentation Rubric:" Use the rubric to assess the small-group presentations. It can be modified to suit what you are emphasizing for this project.

Tools:

General:

- Five to seven stopwatches (two are extra)
- Five clipboards
- Enough copies of each handout
  - The Wave Experiment – Part I
  - The Wave Experiment – Part II
- Calculators

Technology:

- Microsoft Excel
- Microsoft PowerPoint
- Class computer
- Student computers
- LCD projector or TV monitor with appropriate computer connections

Project Tips and Alternatives:

Tip #1:

Find examples (videos/mpegs) of the wave being performed in "real life." Several examples can be found on the Internet by performing a search for "Stadium Waves." This will help during the Invitation portion of this lesson.

Tip #2:

Expand on why class data does/does not match real-life examples of the wave.

Tip #3:

Walk students through the appropriate step sheets while displaying the associated Excel and PowerPoint examples.

Tip #4:

Before the students create the chart in Excel, have them complete this task by hand for homework. They can approximate the line of best fit. This will allow for an interesting discussion as to why the computer generated line of best fit differs from their own.

Attachments:

- "Sample: Spreadsheet with Chart"
- "Spreadsheet Template"
- "Step Sheet: Creating a Data Table"
- "The Wave Spreadsheet Rubric"
- "The Wave: A Whole-Class Experiment"
- "The Wave PowerPoint Rubric"
- "Sample: The Wave Class Data Table"
- "Handout: The Wave Experiment - Part I"
- "Handout: The Wave Experiment - Part II"

Web Resources – Content:

A list of linked web resources related to the content of this lesson can be found on the Lesson Page.

Web Resources – Excel:

A list of linked web resources for Excel can be found on the Excel Resources page.

Assistive Technology:

Please refer to the Assistive Technology section for information on methods and devices to help ensure that all students have access to the curricula in the least restrictive environment.