# Teacher Resources Guide

## R E A L I T Y   M A T H
## for the Ohio Graduation Test
An Intervention Resource

# What's the Problem?
## R E A L I T Y   M A T H
## for the Ohio Graduation Test
### An Intervention Resource

## Produced for At-Risk Students in Grades 8-10
### by Ohio University Students at the
### WOUB Center for Public Media
Athens, Ohio

*Aligned with Ohio Academic Content Standards*
**Eight Short DVD Video Episodes**
**Teacher Resources Guide • Website**

For information please contact:

### *What's the Problem?*

WOUB Center for Public Media
9 South College Street
Athens, OH 45701
(800) 825-1771
woub@woub.org

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# Credits & Acknowledgements:

# What's the Problem?

## Overview

*What's the Problem?* is a series of eight 10-to-12 minute video episodes that focus on the uses of mathematics through parodies of different TV network reality shows.  Each episode will also include "Newsbreaks" and/or public service announcements called "Math Moments" that concentrate on individual mathematical concepts.

Some of the characters in the DVD video episodes are successful in their efforts to solve math problems due to their understanding of mathematical concepts targeted by Ohio's Grade 8-10 Mathematics Benchmarks.  Other characters without this understanding are not successful.

*What's the Problem?*  targets Ohio Mathematics Standards: Data Analysis and Probability; Number, Number Sense and Operations, and Measurement.

The video episodes present how math is used in the "real" world by focusing on the Grade 8-10 Benchmarks in the Ohio Academic Content Standards for mathematics (critical thinking/problem solving across the curriculum) to help students recognize how mathematics relate to situations in everyday life.

The video episodes highlight common mathematical mistakes made by students. The central purpose of the video episodes is to insert some humor into a topic that is often seen as overwhelming or intimidating. The video episodes provide entertaining and motivating ways for students to see how critical thinking and problem solving skills can be used at school and in life.

**The eight video episodes may or may not speak to learning how to do a skill in a particular Benchmark. They lead up to and should be followed by review, discussion, and supporting activities implemented by the teacher.**

The content is presented at a level that most students will be able to relate to, but not necessarily at the level of the Ohio Graduation Test in Mathematics. This *What's the Problem?* Teacher Resource Guide provides information about the purpose of the project and each video episode, the main idea, vocabulary, activities to complete before and after viewing the videos, activities to extend learning, and Internet WebQuests to practice concepts and evaluate learning success. These materials lead from the level of the math content in the video episodes to the level of knowledge and understanding needed to achieve success on the OGT in Mathematics.

## PURPOSE

**This project is designed to help those students in grades 8-10 who are struggling with preparing for the Ohio Graduation Test in Mathematics, specifically in the area of critical thinking and problem solving skills, by incorporating mathematics into other content areas and linking math skills to everyday life.**

This project was created because research utilizing Ohio Department of Education data, including results from the first year of the OGT, indicated that $8^{th}$ and $9^{th}$ grade students lag behind their required performance standards, especially in the region served by eTSEO and Ohio University Public Television.

According to recent Nielsen television ratings, reality-based programming such as *Fear Factor*, *The Amazing Race*, *Survivor* and home renovation specials consistently rank high among television viewing households and the target audience for this project—students in grades 8-10. This highly successful TV reality-based programming approach is used in the production of the *What's the Problem?* video episodes. Each episode revolves around a set of characters with whom the target-aged students are most likely to relate. In each dramatic portrayal, the characters are portrayed in a TV reality-based programming situation.

## TARGET AUDIENCE

The project content is intended for middle/junior high and high school students who are at risk in passing the Mathematics section of the Ohio Graduation Test.

As required by the state grant that funded this project, *What's the Problem?* is targeted to the needs of low wealth school districts, which represent 38 of the 52 districts (73%), in the WOUB/eTSEO region that are designated as being among the poorest two hundred school districts in Ohio.

## USING What's the Problem?

*What's the Problem?* takes advantage of the popularity of reality television to motivate students and help them realize that mathematics is real, applicable, and used in everyday life.  A refreshing and highly motivational resource, *What's the Problem?* was created to engage all students, but especially those who may not have experienced success with the mathematics found in Ohio statewide testing.  Using parodies of reality television, mathematical concepts that are commonly problematic to students as they take the Ohio Graduation Test are interwoven into the scripts of such episodes as *Fear Fraction* and *Changing Spaces* and *Elimidata*.

**The video episodes present fun, entertaining scenarios with mathematics content that provide a basis for the teacher to <u>begin</u> instruction on a topic.  Each episode shows mathematics being used in everyday conversations and situations.  Teachers can use an episode in two ways: 1) to prompt the students to develop a conceptual understanding of the material; 2) to engage students in an open dialogue about what mathematical understanding is needed to make sense of the episode.  The video episodes will provide a common experience on which to base discussion of typical misunderstandings and misconceptions about mathematics.**

The *What's the Problem?* Teacher Resources Guide provides ideas for extending the lesson as well as reinforcement activities for building on student understanding.  Once the mathematics is introduced and explored, reinforcement and extensions activities are available for teachers to use as needed.  This resource guide also provides ideas for assessing student understanding.

**While this set of materials is intended to supplement and enhance the regular classroom experience in mathematics for grades 8-10, it is expected that teachers will find it easy to adapt WHATS THE PROBLEM? for regular classroom instruction.   The project materials lend themselves well to whole class instruction, small group intervention, and individualized instruction.**

## Synopses of the DVD Video Episodes

- **Amazing Chase** – Geometry and measurement play a part in determining who will finish first in the Amazing Chase.

- **Changing Spaces** – Two pair of college roommates wrestle with area, volume and units of measure while redecorating each other's rooms.

- **Elimidata** – Prime numbers and combinations help decide who will win the date with the lovely Sara Savant.

- **Fear Fraction** – A knowledge of exponents and negative numbers help Linda survive the contests and win the $50,000 prize!

- **Simplified Life** – Two not-so-simple-minded girls bring mathematics enlightenment to a school by making sense out of numbers.

- **Surprise Attack: Business Makeover** – A skater dude helps a skateboard shop owner breathe life into his ailing business by helping him collect and interpret data.

- **Survival** – During a baseball game immunity challenge, the two teams make decisions based on statistics.

- **The Ohio-bournes** – A rock star's family living in retirement on a farm is having counting problems.

## Connecting DVD Episodes to the Ohio Academic Content Standards

- **Amazing Chase** can provide challenging thinking for Measurement Benchmark D and Mathematical Processes Benchmark A.

- **Changing Spaces** can provide challenging thinking for Measurement Benchmarks B and E.

- **Elimidata** can provide challenging thinking for Data Analysis and Probability Benchmark D and Mathematical Processes Benchmark F.

- **Fear Fraction** can provide challenging thinking for Number and Number Sense Benchmark I, and Measurement Benchmark A.

- **Simplified Life** can provide challenging thinking for Number and Number Sense Benchmarks A, F and I, and Mathematical Processes Benchmark F.

- **Surprise Attack: Business Makeover** can provide challenging thinking for Number and Number Sense Benchmarks G and I, and Data Analysis and Probability Benchmark C.

- **Survival** can provide challenging thinking for Number and Number Sense Benchmark E and Data Analysis and Probability Benchmark J.

- **The Ohio-bournes** can provide challenging thinking for Data Analysis and Probability Benchmark H, and Mathematical Processes Benchmark D.

## Content Overview

The following table represents some of the key concepts addressed in each episode.

| DVD Video Episode | Ohio Mathematics Standard | Benchmark Connection | *Content/ Thinking Challenges | Problem-Solving Strategy |
|---|---|---|---|---|
| **Amazing Chase** | Measurement | **D** – Use proportional reasoning and apply indirect measurement techniques, including right triangle trigonometry and properties of similar triangles, to solve problems involving measurement and rates. | • Time, yards, miles, feet, meters, direction | • Draw a map |
| | Mathematical Processes | **A** – Formulate a problem of a mathematical model in response to a specific need or situation, determine information required to solve the problem, choose a method for obtaining this information, and set limits for acceptable solution. | • Specific Situations/ Limited Resources | • Draw a picture |
| | Geometry & Spatial Sense | **E** – Draw and construct representations of two and three-dimensional geometric objects using a variety of tools, such as a straightedge, compass and technology. | • Profile Map | • Use formulas |
| **Changing Spaces** | Measurement | **B** – Use formulas to find surface area and volume for specified three-dimensional objects accurate to a specified level of precision. | • Conversions<br>• Area vs. Volume<br>• Fractional Parts<br>• Surface Area<br>• Percentages and Fractions<br>• Misunderstand-ings | • Make a table<br>• Draw a picture<br>• Draw a diagram to scale |
| | | **E** – Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision. | | • Make a table<br>• Use logical reasoning |

| DVD Video Episode | Ohio Mathematics Standard | Benchmark Connection | *Content/ Thinking Challenges | Problem-Solving Strategy |
|---|---|---|---|---|
| **Elimidata** | Data Analysis & Probability | **D** – Use counting techniques, such as permutations and combinations, to determine the total number of options and possible outcomes. | • Permutations<br>• Combinations | • Guess and Check |
| | Mathematical Processes | **F** – Use precise mathematical language and notations to represent problem situations and mathematical ideas. | • Prime Numbers<br>• Composite Numbers<br>• Math Vocabulary | • Reading/math language skills |
| **Fear Fraction** | Number & Number Sense | **I** – Estimate, compute and solve problems involving scientific notation, square roots and numbers with integer exponents | • $n^{th}$ power & "Squared"<br>• Negative Numbers | • Guess & Check<br>• Make a model |
| | Measurement | **A** - Solve increasingly complex non routine measurement problems and check for reasonableness of results. | • Celsius vs. Centigrade<br>• Conversion<br>• Fractions | • Make a table<br>• Logical reasoning |
| | Data Analysis & Probability | **J** – Compute probabilities of compound events, independent events and simple dependent events. | • Predictions | • Guess & check |
| **Simplified Life** | Number & Number Sense | **A** – Use scientific notation to express large numbers and numbers less than one. | • Scientific Notation | • Use objects |
| | | **F** – Explain the effects of operations on the magnitude of quantities. | • Multiplication of Decimals | • Use objects |
| | | **I** – Estimate, compute and solve problems involving scientific notation, square roots and numbers with integer exponents. | • Square Root<br>• Exponents | • Guess & check |
| | Mathematical Processes | **F** – Use precise mathematical language and notations to represent problem situations and mathematical ideas. | • Absolute Value | • Draw a picture |

| DVD Video Episode | Ohio Mathematics Standard | Benchmark Connection | *Content/ Thinking Challenges | Problem-Solving Strategy |
|---|---|---|---|---|
| **Surprise Attack: Business Makeover** | Number & Number Sense | **G** – Estimate, compute and solve problems involving real numbers, including ration, proportion and percent, and explain solutions.<br><br>**I** – Estimate, compute and solve problems involving numbers with integer exponents. | • Percentage<br>• Discounts<br>• Fractions<br>• Multiply by 0<br>• Exponents "Cubed" | • Write to explain solutions |
| | Data Analysis & Probability | **C** – Compare the characteristics of the mean, median and mode for a given set of data, and explain which measure of center best represents the data.<br><br>**J** – Compute probabilities of compound events, independent events and simple dependent events | • Measures of Central Tendency<br><br><br><br>• Predictions | • Draw a graph or a diagram<br><br><br><br>• Write to explain solutions |
| **Survival** | Number & Number Sense | **E** – Compare, order and determine equivalent forms of real numbers. | • Equivalent Forms | • Choose Operations |
| | Data Analysis & Probability | **J** – Compute probabilities of compound events, independent events and simple dependent events | • Odds/Averages (RBI, ERA, Batting Average) | • Make an organized list |
| **The Ohio-bournes** | Data Analysis & Probability | **H** – Use counting techniques, such as permutations and combinations, to determine the total number of options and possible outcomes. | • Combinations<br>• Permutations | • Draw a (tree) diagram |
| | Mathematical Processes | **D** – Apply reasoning processes and skills to construct logical verifications or counter examples to test conjectures and to justify and defend algorithms and solutions. | • Multi-step Problems | • Write an equation |

* The concepts listed in the "Content/Thinking Challenge" column for each episode provide language for communicating mathematical ideas referenced in the video episodes. These concepts also suggest mathematical processes or pedagogical challenges to encourage creative thinking for problem situations, and critical thinking to find the mathematical solution to problems.

## Using WebQuests to Extend Learning

**The mathematics content specialists who developed *What's the Problem?* believe that students can anchor their learning of mathematical concepts presented in the video episodes by engaging in WebQuests. We believe that involving students in WebQuests is vital to the successful use of *What's the Problem?* to improve the understanding of mathematical concepts and improving performance on the Ohio Graduation Test in Mathematics.**

This *What's The Problem?* Teacher Resources Guide contains many WebQuest citations for teachers and students to enjoy and achieve positive outcomes. At the time of publication of this document all URLs were active.

### WebQuest Defined:

This section was written by Bernie Dodge, San Diego State University, the "father" of WebQuests. Please visit http://webquest.sdsu.edu/about_webquests.html to read more about his work in developing and utilizing WebQuests for teaching and learning. Internet links were active at the time of publication of this document but may no longer be.

*A WebQuest is an inquiry-oriented activity in which some or all of the information that learners interact with comes from resources on the Internet. There are at least two levels of WebQuests that should be distinguished from one another.*

*Short Term WebQuest*
*The instructional goal of a short term WebQuest is knowledge acquisition and integration, described as Dimension 2 in Marzano's (1992) Dimensions of Thinking model. At the end of a short term WebQuest, a learner will have grappled with a significant amount of new information and made sense of it. A short-term WebQuest is designed to be completed in one to three class periods.*

*Longer Term WebQuest*
*The instructional goal of a longer term WebQuest is what Marzano calls Dimension 3: extending and refining knowledge. After completing a longer term WebQuest, a learner would have analyzed a body of knowledge deeply, transformed it in some way, and demonstrated an understanding of the material by creating something that others can respond to, on-line or off- line. A longer term WebQuest will typically take between one week and a month in a classroom setting.*

The following section contains many citations to help the teacher and students understand the concept and utilization of WebQuests.

- "WebQuests in Our Future: A Teacher's Role in Cyberspace" by Kathleen Schrock
  - http://kathyschrock.net/slideshows.htm
  - Kathleen Beck Schrock is the Administrator for Technology for the Nauset Public Schools on Cape Cod, MA. A large part of her job is involved with infusing technology throughout the curriculum.
- "Using a WebQuest in Your Classroom" Exactly what is a WebQuest?
  - http://www.internet4classrooms.com/using_quest.htm
  - Teachers new to WebQuests may review this information for the basic structure and purpose of WebQuest activities.

- "Math WebQuests"
  - o http://www.internet4classrooms.com/using_quest.htm
  - o The fundamentals of utilizing WebQuests in mathematics are outlined by Leah P. McCoy.

A WebQuest is an activity in which students utilize World Wide Web resources to obtain information that is then used in a group project. A math WebQuest is a project that uses Internet resources to obtain relevant data that is then analyzed and used in various mathematical exercises.

Most math WebQuests involve students working in cooperative groups in a constructivist setting to explore and understand mathematics. Math WebQuests involve reasoning and critical thinking through data collection on the Web. Data analysis is used to reach conclusions or answer questions.

Math WebQuests typically involve all five of the process standards in the National Council of Teachers of Mathematics (NCTM) Goals 2000: problem solving, reasoning, communication, connections, and representation.

## Other WebQuests Websites:

- Introduction to WebQuests: http://webquest.sdsu.edu/about_webquests.html
- Explanation of WebQuests: http://bestwebquests.com/what_webquests_are.asp
- Creating a WebQuest: http://www.wfu.edu/~mccoy/NCTM99/parts.htm
- Locate and Evaluate WebQuests: http://eduscapes.com/tap/topic4.htm
- Examples of mathematics WebQuests:
  - o http://bestwebquests.com
  - o http://webquest.org Follow the "Find a WebQuest" link.
  - o http://www.wfu.edu/~mccoy/NCTM99/examples.html

## Sample Math WebQuests:

- Best Weather City (Grades 3-8): http://www.wfu.edu/~mccoy/NCTM99/weather.html
- National Park Vacation (Grades 5-9): http://www.wfu.edu/~mccoy/NCTM99/vacation.html
- Thrill Rides–Most Thrilling Roller Coaster Rides (Grades 6-12): http://www.wfu.edu/~mccoy/NCTM99/coasters.html
- World Shopping Spree (Grades 6-12): http://www.wfu.edu/~mccoy/NCTM99/shopping.html
- Baseball Prediction (Grades 9-12): http://www.wfu.edu/~mccoy/NCTM99/baseball.html
- Baseball: http://talent.ed.uiuc.edu/baseballquest/index.htm
- Map Making-"Mathematics of Cartography" (Grades 7-12): http://www.math.rice.edu/~lanius/pres/map/
- Personal Budget WebQuest (Middle School – early High School) Set up a budget and a lifestyle: http://www.sbzinak.com/webquest/
- Geometry meets Poetry – Take a concept from geometry and portray it as a poem and an animated graphic: http://newman.needham.k12.ma.us/learningmaps/webquests/new_math_poetry/main.htm
- Trilingual Packaging Dilemma – A Geometry WebQuest for High School Students. Design a sturdy, attractive box for a game using triangles: http://www.personal.psu.edu/faculty/j/x/jxz8/Student_Webquests/Shirk/questks/index.htm

# Assessment Recommendations

Student assessment should be an integral part of learning and teaching, and should inform instruction. The following section offers guidance to the teacher using *What's the Problem?* on the value and implementation of assessment. See the Classroom Assessment for School Mathematics: K-12 Series by the National Council of Teachers of Mathematics ("Mathematics Assessment: A Practical Handbook for Grades 9-12", edited by William S. Bush, Anja S. Greer. NCTM. 1999)

The 'why' of assessment:
- To document students' learning of mathematics
- To communicate information and expectations to students, parents and other teachers
- To guide, improve, and provide opportunities for instruction

The 'how' of assessment:  These guiding questions can be useful for planning assessment:
- What are the mathematical concepts or skills I am trying to assess?
- What important learning behaviors should students have at this time?
- How will I assess what my students know and can do mathematically?
- How can I use the assessment to further guide student learning?

These are the fundamental principles forming the assessment component of *What's The Problem?*

All classroom teachers know which students struggle with mathematics; however, few teachers know what students really understand or what they think about when they are solving problems. Embedded assessment enables teachers to find out what their students really think about a problem, what they understand, what they find confusing, and what misconceptions they have in mathematical thinking. Each WebQuest activity recommended in this guide suggests formative, authentic assessment strategies. As students work through each WebQuest, teachers need to be informed of their progress and difficulties. This can only be achieved through open dialogue and frequent observation of student work.

To assess how well students understand the mathematical concepts, teachers might ask students to…
…Give a definition in your own words.
…Give examples and non-examples of the concepts.
…Use the concept in different ways to solve problems.

To assess how well students understand and perform skills, teachers might ask students to…
…Perform the skill at least one way.
…Perform the skill in more than one way.
…Create a procedure for this skill.
…Explain how the skill works.
…Explain why the skill works.
…Use the skill in different ways to solve problems.

To assess how well the students can reason deductively, teachers might ask students to…
…Justify a mathematical conjecture.
…Give examples that illustrate a conjecture.
…Give counterexamples of a conjecture.
…Explain how the problem is solved.

*What's the Problem?* is intended as an alternative resource to engage students in mathematics and to foster student achievement. **Teachers are integral to student achievement in mathematics, and must be active participants in each student WebQuest activity. Teachers maintain their engagement in each WebQuest activity through continued formative assessment**.

## Teaching Resources

The following websites are specific to mathematics and very significant for assisting Ohio's teachers, students, and parents to learning rigorous mathematics.

- **National Center for Educational Statistics**
    - o  Core academic assessment questions by subject, national 8th Grade level:
    - o  http://nces.ed.gov/nationsreportcard/mathematics/
- **Ohio Department of Education:**
    - o  Ohio Best Practice academic lessons and assessments: http://www.ode.state.oh.us - select Standards and Instruction > Instructional Management Systems (MIS).
    - o  Ohio Teachers – classroom assessment: http://www.ode.state.oh.us. Select Testing and Assessment.
    - o  Ohio Students Resources Site – interactive preparation for Ohio's OGT (Ohio Graduation Test): http://ohio.measinc.com/
- **Ohio Graduation Test Preparation from Computing Technology for Math Excellence:**
    - o  Number and number, number sense and operations:
      http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_NumberStrand.htm
    - o  Measurement:
      http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_MeasurementStrand.htm
    - o  Geometry and Spatial Sense
      http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_GeometryStrand.htm
    - o  Patterns, functions and algebra:
      http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_AlgebraStrand.htm
    - o  Data analysis and Probability:
      http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_DataStrand.htm
- **Ohio Resource Center for Mathematics, Science and Reading:**
    - o  http://ohiorc.org
    - o  The Ohio Resource Center for Mathematics, Science, and Reading (ORC) is a project of the State University Education Deans, is funded by the Ohio General Assembly and was established by the Ohio Board of Regents. ORC provides links to peer-reviewed instructional resources that have been identified by a panel of Ohio educators as exemplifying best or promising practice. Available resources also include content and professional resources as well as assessment and general education resources that will support the work of Pre K-12 classroom teachers and higher education faculty members. The resources are correlated with Ohio's Academic Content Standards, and with applicable national content standards.
    - o  The ORC collection of resources is not stagnant. New resources are constantly being added, and the collection itself is under constant review. The ORC has a number of special features, one of which is Standards Plus, which adds a career connection to appropriate lessons in the collection.
- **Learning Conductor:** An online tool for teaching standards-based mathematics:
  http://ohiorc.org/fyi.aspx/#470
    - o  Learning Conductor, a suite of online tools for standards-based mathematics, provides Ohio students with a new way to learn. From middle school through community college and workforce retraining, students and teachers can use this software to improve their understanding of mathematical concepts, to prepare for standardized tests, or to refresh their math skills.
- **Problem solving strategies and activities:**
  http://www.abcteach.com/directory/basics/math/problem_solving/
- **Word problems for kids**: http://www.stfx.ca/special/mathproblems/welcome.html

## ORC Lessons for *What's the Problem?* Video Episodes:

- Amazing Chase – ORC #608: Mathematics of Cartography (Promising Practice)

- Changing Spaces – ORC #3623: Design Your Own Bedroom (Promising Practice)

- Elimidata – ORC #267: The Smithville Families (Promising Practice)

- Fear Fraction – ORC # 594: Astronomical Scales (Promising Practice)

- Simplified Life – ORC #3313: Too Big or Too Small? (Best Practice)

- Surprise Attack: Business Makeover – ORC #1494: Baseball Statistics (Promising Practice)

- Survival – ORC #1097: Monty's Dilemma: Should You Stick or Switch? (Best Practice)

- The Ohio-bournes – ORC #4205: Ice Cream Cones: Lesson 3 of 4 (Promising Practice)

## Strategies for Solving Problems in the What's The Problem? Video Episodes

| Make an Organized List | Work Backwards | Make a Table |
|---|---|---|
| Solve a Simpler Problem | Look for a Pattern | Guess and Check |
| Make a Model | Draw a Picture or Diagram | Act It Out/Use Objects |
| Write an Equation | Look at the Problem Another Way | Use Formulas |
| Use Logical Reasoning or Identify Extra Information | Eliminate Possible Solutions | Determine if the Problem is Single-step or Multi-step |

## Guiding Principals in Teaching Problem Solving

- **Emphasize the solution process rather than the answer.**
- **Avoid answering questions like, "Is this right?"**
- **Emphasize the times when the problems do not involve a number.**
- **Encourage students to write or explain how they solved the problem.**
- **Multiple strategies can be used to solve the same problem.**

**Notes:**

# Amazing Chase

## How To Use the Amazing Chase

Geometry and measurement play a big part in determining who will win the Amazing Chase. Students will be using estimation to find the shortest distance between two points. Prior to viewing the episode, teachers should review indicated vocabulary with students. Before viewing, questions are provided to get students into a proper frame of mind for recognizing the mathematics in the episode.

After viewing Amazing Chase, review and reinforcement problems are provided to build on the material included in the episode. For a deeper look at the mathematics, extended activities allow students to show a conceptual understanding of the material.

The Resources section includes Internet links to two WebQuests that reinforce the mathematical content of this episode. One WebQuest involves orienteering and the other simulates plane flight and mathematics. Another website is suggested for more work with problem solving, measurement, scale (ratios and proportions), coordinate planes, and slopes of lines. This particular site also provides a list related careers. There are also links to the content as it appears in standardized testing.

## ❶ The Main Idea

Using estimation to find the shortest distance.

## ❷ Ohio Mathematics Academic Content Standards

The Amazing Chase can provide challenging thinking for Measurement Benchmark D and Mathematical Processes Benchmark A.

## ❸ Episode Synopsis

Three teams race from point A to point B in a hilly, forested area near a body of water. The teams must choose to travel on foot, by boat, or via bicycle. Geometry and measurement play a part in determining who will finish first.

### Newsbreak/Math Moments Purpose

This episode's Math Moment presents the mathematical problem of determining the thickness of an object after it has been folded a number of times. It is a good example of how to solve problems by acting them out.

### Vocabulary

- *Estimate* – An approximation of an answer or measurement.
- *Angle* – A plane figure formed by two rays having a common endpoint.

## ❹ Before Viewing – Focus Activities

**1.** Ask: What do you know about Military Time? *Learn what the students already know about it and if they know how to determine whether it is a.m. or p.m. by military time.*

*"Different professions and types of organizations [in the United States] write military time differently. The military, emergency services and hospitals usually write military time as hours and minutes <u>without</u> a colon and often add the word 'hour' afterward. Seconds are separated by a colon.  In science and engineering, colons are usually inserted between the hours, minutes, and seconds."*
  - *Example: 5:31 p.m. would be written as 1731 (or 1731 hours) by the military and 17:31 in scientific and engineering circles.*
  - *Source: "Military Time." Time Systems. 18 May 2006. Space Archive. 27 December 2006. <http://www.spacearchive.info/military.htm>*
  - *See also: Ask Dr. Math: http://mathforum.org/library/drmath/view/61445.html*

**2.** Say: The contestants in the episode you are about to see will be racing between two points at Heritage Lake, Ohio, beneath Hamilton Hill. This area is like our (*mention a local, public forested area such as the Wayne National Forest, a state park: Blue Rock, Forked Run, Jefferson Lake, Lake Logan, Salt Fork, etc, or another similar nearby area*).

**3.** Say: The object of the contest is to complete the race in the shortest period of time. The contestants have the options of riding bikes, canoeing, or hiking.  If you were a contestant, what would you like to know before you chose a method of travel?

*The teacher needs to enter into discussion with the students relating the mathematics (geometry) to prove the winning strategy for crossing the moat. The winning strategy in the task was crossing a moat, which was shown at the opening of the episode. What mathematical explanations can you offer that prove the strategy is mathematically sound? For example: graphic representation, pictorial diagram, use of Pythagorean theorem.*

**4.** Say: As you watch the episode, look for other strategies you might use to address this problem.
> *Teacher Note: You may want to return to this question after the students have viewed the episode.*

## ❺ After Viewing – Review/Reinforcement Activities

**1.** Carry and Sam arrived at 16:20 (1620 in military notation) and are to depart 12 hours later. What time will Carry and Sam depart? Explain your answer.
*Carry and Sam will depart at 04:20 (0420 hours in military parlance or 4:20 a.m. on a 12-hour clock). 16:20 is 4:20 p.m. on a 12-hour clock.*

**2.** In this episode, the show host says "Dan and Mike, who arrived at 18:35 yesterday, will be the second to depart – 12 hours later – at 06:35 today."  Rewrite the arrival and departure times as a.m. and p.m.
*Arrival Time 18:35 = 6:35 p.m. Departure Time 06:35 = 6:35 a.m.*

3. The winning strategy in the task involved crossing a moat, which was shown at the opening of the episode. What explanation(s) can you offer that prove the strategy is mathematically sound?

4. If you are riding a bike at a rate of 20 miles per hour, how far will you ride in 45 minutes?
   *You will ride 15 miles in 45 minutes.*

5. If you are canoeing at a rate of 4 miles per hour, how far will you canoe in 45 minutes?
   *You will canoe 3 miles in 45 minutes.*

## ❻ Extended Activities to Improve Conceptual Learning

1. Dan and Mike walked north through the woods 300 yards, then headed east for half a mile, turned south and walked 1000 feet, and finally walked west 800 meters. How many feet did Dan and Mike travel?  Explain your answer.

   *Dan and Mike traveled 7182.67 feet. Convert all units into feet: 300 yards = 300 x 3 or 900 feet, $\frac{1}{2}$ of a mile = 5280 feet x .5 or 2640 feet, and 800 meters = 800 ÷ 0.3048 or 2642.6$\underline{7}$ feet. Add: 900 + 2640 + 1000 + 2642.67 = 718.67 feet.*

   *Websites for measurement conversions:*
   - *http://www.onlineconversion.com/length_common.htm*
   - *http://www.metric-conversions.org/measurement-conversions.htm*

2. Following the directions in the clue read by Dan (see question #1 above), approximately how far and in which direction should Dan and Mike walk to go immediately from the starting point to the ending point without following the directions in the clue? (They are looking for a shortcut.)

   *Direction: southeast, Distance: 104 ½ feet*
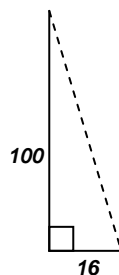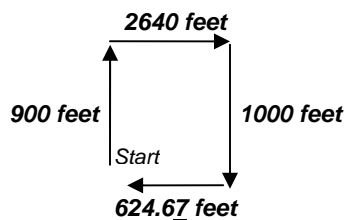


$$\sqrt{100^2 + 16^2} \approx 101\frac{1}{4} \, ft$$

## ❼ Resources

### WebQuests

- "Which Way is North?" Orienteering:  Finding Your Way Around:
  http://www.ncsu.edu/sciencejunction/terminal/lessons/wwn/
- "Aerodynamic Adventure" Activities built around a simulation about plane flight and math:
  http://its.guilford.k12.nc.us/webquests/aero/aero.htm

- "Mathematics of Cartography" by Cynthia Lanius: http://math.rice.edu/~lanius/pres/map/
  This site focuses on something along the lines of orienteering. It takes in problem solving, measurement, scale (ratios and proportions), coordinate plane, and slopes of lines—just to mention a few of the concepts being developed. It also provides a list of related careers, teacher notes and peripheral Web resources.

## Additional Resources

Standardized Test Preparation and Tips for Success. Preparing Your Students for the Ohio Graduation Test in Mathematics:
- Measurement
  - http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_MeasurementStrand.htm
- Geometry and Special Sense
  - http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_GeometryStrand.htm

## Ohio Resource Center for Mathematics, Science and Reading
http://www.ohiorc.org/

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ORC Lessons for *What's the Problem?* Video Episodes:

AMAZING CHASE – ORC #**608**: **Mathematics of Cartography**
- Resource Type: Content Resources
- Standards Alignment: Grades 6-10
- Topics: Mathematics -- Linear equations; Length, distance; Rates, ratio, proportion; Algebra; Measurement
- Professional Commentary: This site provides links to several online resources related to maps, including the history of mapmaking, a discussion of latitude and longitude, and an applet that provides distances between locations. A lesson plan sketch and several suggested problems are also included.

Locate a Lesson at the Ohio Resource Center by the ORC Lesson #

1. Navigate to http://www.ohiorc.org.
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**Advanced Search**

Search for resources that...

contain | free text | 608 | **in the** ORC Number

3. Type the lesson number in the center box of the top line of boxes.
4. Choose "ORC Number" from the drop down menu in the box following the words "in the".
5. Scroll to the bottom of the page.
6. Click Submit.

**NOTES:**

# Changing Spaces

## How To Use Changing Spaces

Changing Spaces allows students to look at the measurement standard.  They will be computing and applying area, surface area, and volume as they redecorate a dorm room.  Prior to viewing the episode, teachers should review indicated vocabulary with students.  Before viewing, questions are provided to get students into a proper frame of mind for recognizing the mathematics in the episode.

After viewing Changing Spaces, review and reinforcement problems are provided to build on the material included in the episode.  For a deeper look at the mathematics, extended activities allow students to show a conceptual understanding of the material.

The Resources section includes information and Internet links to several WebQuests that reinforce the mathematical content of this episode. The WebQuests have students designing fun houses, looking at the vocational application of area and perimeter, remodeling a room, designing a home, making home improvements, and practicing problem solving through real world situations. This section also includes Internet links to the content as it appears in standardized testing.

## ❶ The Main Idea

Being able to compute and apply area, surface area and volume.

## ❷ Ohio Mathematics Academic Content Standards

Changing Spaces can provide challenging thinking for Measurement Benchmarks B and E.

## ❸ Episode Synopsis

Two pair of college roommates wrestle with area, volume and units of measure while redecorating each others' rooms.

### Newsbreak/Math Moments Purpose

- The WMATH Breaking News newsflash in this episode gives election news with information on how the percentage of citizens who voted may affect the outcome of an election in unexpected ways.
- The Math Moment in this episode addresses a question about the number of uniformly dimensioned boxes a cabinet can contain.

### Vocabulary

- *Area* – The number of square units contained in the interior of a plane figure.
- *Surface Area* –The sum of the areas of all the faces of a three-dimensional figure.
- *Volume* – The measure of the amount of space enclosed by a three-dimensional figure.

## ④ Before Viewing – Focus Activities

1. Give the students a solid figure and ask them to find the surface area and volume, and then have them explain why surface area and volume are different.

2. Have students estimate the area of their desktop.  Once they have an estimation, they should measure and find the area of their desktop.  How did they do?  Did they use the correct units?

3. Ask the students to calculate one-fourth of one-third of 180 without multiplying by a fraction. *One-third of 180 = 60, one-fourth of 60 is 15.*

4. Write 5' and 5" on a display board using the symbols for feet and inches and ask the students to describe the difference between the two: 5' (feet) and 5" (inches).

5. Ask the students to write a description of how to find the surface area of a rectangular solid.

## ⑤ After Viewing – Review/Reinforcement Activities

1. A rectangle has a length of 10 inches and a width of 8 inches. Suppose the length is changed to 5 inches and the width is changed to 4 inches. How does the area of the new rectangle compare to the area of the old rectangle?
*The new rectangle is ¼ the size of the original rectangle. The first rectangle is 10 x 8 =80 in$^2$. The newly formed one is 4 x 5 = 20in$^2$.*

2. Jared's floor is 9 feet by 13 feet. a. What is the square footage of his room? b. Just for fun, what would his floor be in square inches?
*a. 9 x 13 = 117 ft$^2$.       b. 9 x 12 = 108 in. 13 x 12 = 156 in. 108 x 156 = 16848in$^2$.*

3. Jared now wants to paint his entire room, the walls, doors, and ceiling. Of course, he wants them to be all the same color. He also needs to figure out if he has enough money for the job. His room is 15 feet long, 12 feet wide, and eight feet high. A gallon of paint covers 400 square feet and costs $15.99.
   a. How many gallons of paint are needed?
   b. How much money does Jared need to complete the job?
      *a. 2 gallons       b. $32.98        15 x 12 = 612ft$^2$. 2 x 15.99 = 32.98*

4. When Mary pulled her measurement notes out at the paint store, she found that the slip of paper had globs of pink paint on it.  She could read only parts of her writing. Figure out the missing information:
   a. Floor: What is the length of the room?
               Width of room: 13 feet
               Length of room: "pink paint splash"
               Area: 312 square feet
      *The room is 24 feet long. 312 ÷ 13=24*
   b. Unfinished Desktop: What is the width of the desk?
               Width: "pink paint splash"
               Length: 4 feet 9 inches
               Area: 11.875 square inches
      *The desktop is 2 ½ feet wide. 11.875 ÷ 4.75=2.5*

c. <u>Inside of Door</u>: What is the area of the door?
        Width: 3.25 feet
        Height: 7 feet
        Area: "pink paint splash"

*The area is 22.75ft² or $22\frac{3}{4}ft^2$   7 x 3.25=22.75*

**5.** The room Mary and Maria are painting is 15 feet long by 12 feet wide by 10 feet high. They plan to paint all of the room's surfaces so they calculate the area that needs to be painted as 1800 cubic feet. Is this calculation correct? Support your answer.
*The answer is incorrect. Volume was calculated instead of surface area. The correct answer for surface area is 900 ft2. 2(15x12) +2(12x10) +2(10x15)=900.*

**6.** Timmy wants only one-third of his half of the room to be covered with furniture. What fraction of the room is this?

*The fraction is $\frac{1}{6}$    $\frac{1}{3}x\frac{1}{2}=\frac{1}{6}$*

## ❻ Extended Activities to Improve Conceptual Learning

**1.** Mrs. Smith has forty students in her class. Three-fourths of those students are girls. One-third of those students have blonde hair. What percentage of the girls do not have blonde hair?

*$66\frac{2}{3}$ % of the girls do not have blonde hair. 0.75x40=30 girls. $30\div3=10$ girls are blonde so 20 are not. $20\div30=.667$.*

**2.** Just by looking at the rectangular boxes and their measures, can you tell which one will have a greater surface area? Explain your answer, then solve. Be sure to include the units.



**Box A**
4"
10"
3"

**Box B**
8"
5"
3"
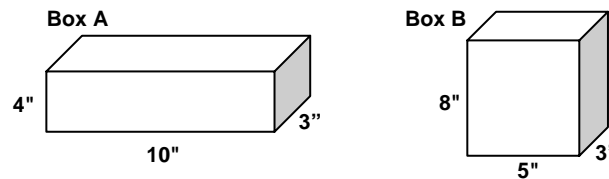
*Teacher Note: Objects are not drawn to scale.*

*It would be difficult to tell which rectangular box has the greatest surface area just by looking at the boxes and their measures. Students who confuse volume and surface area may feel that the surface areas of the two rectangular boxes are identical. Box A and Box B both have a volume of 120 in³. Box A (4 x 10 x 3 = 120 in³ and Box B (8 x 5x 3) = 120 in³. The surface area for Box A is 164 in² and for Box B is 158 in². Box A [(4 + 3 + 4 + 3) x 10] + [(4 x 3) x 2] = 164 in². Box B [(8 + 3 + 8 + 3) x 5] + [(8 x 3) x 2] = 158 in².*

3. Timmy realized his mistake with the symbols for feet and inches prior to opening the boxes of inflatable furniture. He had purchased boxes of furniture each measuring 15 inches by 24 inches by 3 inches. The trunk of his car is 25.5 cubic feet. If Timmy is returning 40 boxes of inflatable furniture to the store, can he do this in one trip? Why or why not? Explain your reasoning.

*This is a very good problem for entering into discussion with the students about total volume measurement (25.5 cubic feet) and how, in reality, the actual holding capacity is less than the total volume due to the dimensions of the objects being placed or stored. Some students may come up with an answer stating that all the boxes fit into the 25.5 cubic foot space (the total cubic space needed for the 40 boxes is 25 cubic feet); if so, a discussion may develop focusing on the practicality of splitting boxes in half to match the actual dimensions (shape) of a car trunk.*

## ❼ Resources

### WebQuests

Students can gain insight and practice by completing these WebQuests with the teacher's guidance and review.

- "Using Area and Perimeter to Design a Fun House"**:**
  http://its.guilford.k12.nc.us/webquests/areaperim/areaperim.htm
- "Home Improvement" You are being hired as interior decorators to design newly remodeled rooms. http://www.gal-220.org/homeimp.htm#intro
- "Searching for Solutions." Practice Problem Solving Strategies through Real World Situations: http://faculty.goucher.edu/jcampf/searching_for_solutions.htm
- "Remodeling Your Room":
  http://www.eiu.edu/~readctr/800WebQuests/SparenbergWeb/index.htm

### Additional Resources

- "A Maths Dictionary for Kids": http://www.teachers.ash.org.au/jeather/maths/dictionary.html
- "Solving Real World Problems Involving Measurement":
  http://www.manatee.k12.fl.us/sites/elementary/palmasola/ps4glem3s1b.htm
- "Standardized Test Preparation and Tips for Success – Preparing Your Students for the Ohio Graduation Test"
  - Number, Number Sense, and Operations:
    http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_NumberStrand.htm
  - Measurement:
    http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_MeasurementStrand.htm
  - Geometry and Spatial Sense:
    http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_GeometryStrand.htm
  - Patterns, Functions and Algebra:
    http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_AlgebraStrand.htm
  - Data analysis and Probability:
    http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_DataStrand.htm

**Ohio Resource Center for Mathematics, Science and Reading**

http://www.ohiorc.org/

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ORC Lesson for *What's the Problem?* Video Episode

CHANGING SPACES – ORC #**3623**:  **Design Your Own Bedroom**
- Resource Type: Instructional Resources
- Practice Level: Promising Practices
- Standards Alignment: Grades 6-8
- Topics: Mathematics -- Surface area; Volume; Measurement; Technology
- Professional Commentary: Many students dream of designing their ideal bedroom. In this project, students are required to limit their designs by size (volume) and price....(see more)
- Career Fields: General Career Skills, Construction Technologies, Engineering & Science Technologies

Locate a Lesson at the Ohio Resource Center by the ORC Lesson #

1. Navigate to http://www.ohiorc.org.
2. Choose "Advanced Search" from the links in the left margin.
3. Type the lesson number in the center box of the top line of boxes. (See example below.)
4. Choose "ORC Number" from the drop down menu in the box following the words "in the".
5. Scroll to the bottom of the page.
6. Click Submit.

## Advanced Search

**Search for resources that...**

| contain | free text | | 608 | | in the | ORC Number |
|---------|-----------|--|-----|--|--------|------------|

**NOTES:**

# Elimidata

## How To Use Elimidata

Elimidata allows students to look at the data analysis and probability standard.  Students will recognize prime and composite numbers and use the counting principle. Prior to viewing the episode, teachers should review indicated vocabulary with students.  Before viewing, questions are provided to get students into a proper frame of mind for recognizing the mathematics in the episode.

After viewing Elimidata, review and reinforcement problems are provided to build on the material included in the episode.  For a deeper look at the mathematics, extended activities allow students to show a conceptual understanding of the material.

The Resources section includes information and Internet links for several WebQuests that reinforce this episode's mathematical content. It also includes Internet links to the content as it appears in standardized testing and for the *Greedy Pig Game* – a probability exploration.

## ❶ The Main Idea

Being able to recognize whether a number is prime or composite and applying the counting principle.

## ❷ Ohio Mathematics Academic Content Standards

Elimidata can provide challenging thinking for Data Analysis and Probability Benchmark D and Mathematical Processes Benchmark F.

## ❸ Episode Synopsis

Prime numbers and combinations help decide who will win the date with the lovely Sara Savant.

### Newsbreak/Math Moments Purpose

- Math Moment 1 – Probability. Determine the probability of a skating event occurring on a given day.
- Math Moment 2 – Measurement. Will a cabinet hold a given amount of boxes with each box having uniform dimensions?

### Vocabulary

- *Counting Principle* – A method for finding the number of ways that two or more events can occur by multiplying the number of ways each event can occur.
- *Divisible* – A number is divisible by another if, upon division, the remainder is zero.
- *Prime Number* – Any whole number greater than 1, which has exactly two factors, 1 and itself.
- *Composite Number* – Any whole number greater than 1, which has more than 2 factors.
- *Natural Numbers* – The set of numbers represented by {1,2,3 …}

- *Whole Numbers* – The set of numbers represented by {0, 1,2,3 …}

- *Rational Number* – Any number that can be represented as a fraction $\dfrac{a}{b}$, where a and b are integers.

- *Integers* – The set of numbers represented by { …-3,-2,-1,0,1,2,3…}

- *Combination* – A selection of a group of items or events from a set without regard to order.

- *Permutation* – A selection of a group of items or events from a set with regard to order.

- *Factorials* – Factorials are just products of all of positive integers equal to and smaller than a given number. They are indicated by an exclamation mark – "four factorial" is written as "4!" 4! means 1×2×3×4 = 24 and 6! = 1×2×3×4×5×6 = 720.

## ❹ Before Viewing – Focus Activities

1. We are going to be watching the ELIMIDATA video episode in which contestants will be bowling to stay in the game. The object is to bowl a game with a prime number as your final score. A perfect game is 300, which of course is not prime. Look and listen for scores that are prime numbers.

2. Ask students to define a prime number. Discuss whether or not 1 is a prime number. *It is not, since it has only one factor and primes must have two.*

3. Discuss how to determine if a number is divisible by 2, 3, 4, 5, etc.

## ❺ After Viewing – Review/Reinforcement Activities

1. How would you determine which number is not prime?
   a.) 89          b.) 213          c.) 111          d.) 41
   *Use the divisibility rules. 89 is prime, 213 follows the divisibility rule for 3 (2+1+3= 6), 111 (1+1+1=3) also follows the divisibility rule for 3, 41 is prime. Find a list of the rules at:*
   - *http://mathforum.org/dr.math/faq/faq.divisibility.html*
   - *http://math.about.com/library/bldivide.htm*

2. Draw or display the probability tree diagram shown in the thought bubble during the "Elimidata" episode. Ask the students to identify what you have displayed and have them explain why this is a correct answer to the problem of the number of different combinations of three sauces and four pastas.
   *The tree diagram shows all possible combinations if you follow the branches to the end. There are 12 branches.*

3. Damon's score was 193 and Randy's score was 228. Damon is the winner. Explain why, given the rules of the game, the higher score did not win.
   *The rules of the game stated that the winning score had to be a prime number. 228 is not a prime number. It has many factors (1, 2, 3, 4, 6, 12, 19, 38, 57,114, 228). 193 is prime. Its has only two factors (1, 193).*
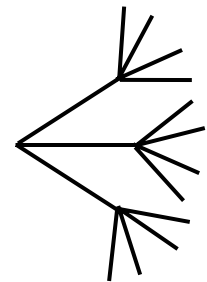
4. The ELIMIDATA contestants chose to eat at Sandy's Super Subs. The menu reads, "Create Your Own Sub." Choose one of each:

> Bread: white or wheat
> Meat: ham, turkey, chicken, or beef
> Cheese: American, Cheddar, Provolone, or Swiss

a. How many different sandwiches could be made if a contestant chose one of each ingredient?
*32 different sandwiches could be made. 2 x 4 x 4 = 32*

b. On an extremely busy day, Sandy ran out of provolone cheese and wheat bread. How many sandwich choices were now possible?
*12 sandwich choices were possible. 1 x 4 x 3 = 12*

c. Sandy wanted to be able to advertise that customers had over 100 possible choices of sandwiches. What is the fewest number of items she would have to add to her menu? Explain your reasoning then create a new menu for Sandy's Super Subs.
*Answers will vary. Accept answers students can support. For example:*
- *Only four items must be added if she is permitted to add new categories. She could add two condiments (mayonnaise and mustard) and two greens (lettuce and bean sprouts) and advertise 128 different sandwiches: 2 x 2 x 2 x 4 x 4 = 128.*
- *If the items must be added to the original categories, Bread, Meat, and Cheese, then the minimum number of items would be 5. She could add two breads (rye and pumpernickel), one meat (lamb), and two cheeses (Colby and mozzarella) and advertise 120 different sandwiches: 4 x 5 x 6 = 120.*

## ❻ Extended Activities to Improve Conceptual Learning

1. Sara wanted to get a quick bite to eat before the show, so she would not be so hungry at the restaurant. She stopped at her favorite sub diner but there were so many choices that she had trouble deciding what to order. How many different choices can Sara make?

| Bread | Toppings | Cheese | Condiments |
|---|---|---|---|
| White | Lettuce | American | Mayonnaise |
| Wheat | Tomato | Provolone | Ketchup |
| | Onions | | Mustard |

*Sara can make 36 different choices. 2 x 3 x 2 x 3 = 36.*

2. Think about the following two scenarios:
   - Scenario One:  Five students are running for class office.  These five students are running for two positions, president and vice-president.
   - Scenario Two:  Five students are running for class committee members. Two students will be chosen to serve on the committee.  (Each member of the committee has the same role.)

   Consider how many possible things could happen with each scenario. Explain your findings.

   *Scenario One: 20 different things could happen.*
   *Scenario Two: 10 different things could happen.*
   *Explanation:*
   - *In Scenario One, order matters. For example: Bill as President and Ericka as Vice President is not the same as Ericka as President and Bill as Vice President.*
   - *In Scenario Two, order does not matter. For example: Kali and Joe elected to the committee is the same as Joe and Kali.*

# ❼Resources

## WebQuests

- "Probability Problems"
  - What are the chances that you and a partner will get all ten answers correct?
  - http://www.mcs.k12.nc.us/wq/welsh/probability/default.htm
- "Winning the Lottery … Could You Be Next?"
  - You are going to determine the probabilities of winning two lottery games and report your calculations.
  - http://imet.csus.edu/imet4/tlburke/probability/main.html
- "Take Me Out to the Ballgame"
  - This activity will find the greatest baseball hitter of all time.
  - http://warrensburg.k12.mo.us/webquest/baseball/

## Additional Resources

- "What's the Probability?"
  - An introduction to probability.
  - A problem involving 8 sided dice.
  - http://southvalleyms.net/Resources/Probability.htm
- "Greedy Pig"
  - Introduce the game Greedy Pig and investigate probabilities surrounding the game, applying both experimental and theoretical probabilities to determine an ideal strategy
  - http://www.nzmaths.co.nz/Statistics/Probability/greedypig.htm
- "Standardized Test Preparation and Tips for Success – Preparing Your Students for the Ohio Graduation Test"
  - Number, Number Sense and Operations:
    http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_NumberStrand.htm
  - Measurement:
    http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_MeasurementStrand.htm
  - Geometry and Spatial Sense:
    http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_GeometryStrand.htm

- o Patterns, Functions and Algebra:
    http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_AlgebraStrand.htm
- o Data Analysis and Probability:
    http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_DataStrand.htm

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ORC Lessons for *What's the Problem?* Video Episodes

ELIMIDATA – ORC Lesson #**267**: **The Smithville Families**
- Resource Type: Instructional Resources
- Practice Level: Promising Practices
- Standards Alignment: Grades 5-9
- Topics: Mathematics -- Discrete Mathematics; Probability
- Professional Commentary: First, students review Pascal's Triangle by completing and discussing the entries of the first eight rows. They then determine the total number of possible girl/boy combinations in a five-child family.

Locate a Lesson at the Ohio Resource Center by the ORC Lesson #

1. Navigate to http://www.ohiorc.org.
2. Choose "Advanced Search" from the links in the left margin.
3. Type the lesson number in the center box of the top line of boxes. See example below.
4. Choose "ORC Number" from the drop down menu in the box following the words "in the".
5. Scroll to the bottom of the page.
6. Click Submit.

## Advanced Search

Search for resources that...

contain [free text ▾] [608] in the [ORC Number ▾]

**NOTES:**

# Fear Fraction

## How To Use Fear Fraction

Fear Fraction allows students to look at the number and number sense standard as well as the standards dealing with measurement and probability. Students will be using probability to make predictions. Prior to viewing the episode, teachers should review indicated vocabulary with students. Before viewing, questions are provided to get students into a proper frame of mind for recognizing the mathematics in the episode.

After viewing Fear Fraction, review and reinforcement problems are provided to build on the material included in the episode. For a deeper look at the mathematics, Extended Activities allow students to show a conceptual understanding of the material.

The Resources section includes several WebQuests that reinforce the mathematical content of this episode. These include exploring the world of fractions, problem solving, looking at endangered species, as well as practicing basic facts. The Resources section also includes Internet links to Fear Factor's content as it appears in standardized testing.

## ❶ The Main Idea

Using probability to make predictions.

## ❷ Ohio Mathematics Academic Content Standards

Fear Fraction can provide challenging thinking for Number and Number Sense Benchmark I, and Measurement Benchmark A.

## ❸ Episode Synopsis

Knowledge of exponents and negative numbers help Linda survive the contests and win the $50,000 prize.

### Newsbreak/Math Moments Purpose

WMATH Breaking News: This newsbreak is an explanation of scientific notation – with examples.

### Vocabulary

- *Odds* – The ratio of favorable outcomes to unfavorable outcomes.
- *Probability* – The chance of an event occurring. The probability of an event is equal to the number of favorable outcomes divided by the number of possible outcomes.

## ❹ Before Viewing – Focus Activities

**1.** Ask the students what they think the terms odds and probability mean.

**2.** Provide them with a scenario similar to this:
   a. Say: I put each of your names on a piece of paper and place it in a box.
   b. Ask: How many names are in the box? *The answer should equal number of students.*
   c. Ask: What are the odds of me pulling your name out of the box on the first try? *The answer should be number of slips remaining in the box after selecting one name compared to the number of names pulled out. Example: If 22 slips are in the box before pulling a name, then the odds of one name being successfully drawn in one try would be 1 to 21.*
   d. Ask: What is the probability of me pulling your name out of the box on the first try? *The answer should be number of slips in the box compared to the number of names being pulled out. If 22 slips are in the box before pulling a name, then the odds would be 1 out of 22.*
   e. Discuss student responses.

**3.** Have the students figure out several probabilities using the demographics of the class—age, height, birth date, and gender.

**4.** Discuss the following topics:
   a. Temperature measurements (C and F). *Before viewing the episode students should know the freezing point of water.*
   b. Exponents. *Before viewing the episode students should know that $3^5$ means multiply 5 threes together (3 x 3 x 3 x 3 x 3).*

**5.** Ask students: If the water temperature is 75 degrees Fahrenheit, is it possible for the temperature to drop 100 degrees? Explain.

## ❺ After Viewing – Review/Reinforcement Activities

**1.** What is the difference between $2^9$ and $9^2$?
   *Accept reasonable responses. $2^9$ means 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 or 512 and $9^2$ means 9 x 9 or 81.*

**2.** A computer randomly selects a letter in the alphabet. What is the probability that the letter is one of the letters in the word "probability"?

   *The probability is $\dfrac{9}{26}$. The word "probability" has 9 different letters: p, r, o, b, a, i, l, t, y.*

**3.** Linda counted and charted 100 colored gummy worms.

| GUMMY WORM COLOR | NUMBER |
|---|---|
| Red | 30 |
| Blue | 20 |
| Green | 10 |
| Yellow | 15 |
| Orange | 25 |

    a. Linda ate 10 of the worms, 4 of which were yellow. If she picked another one to eat, what is the probability that it would be yellow?

*The probability is $\frac{11}{90}$. 100 – 10 =90 total worms. 15 – 4 =11yellow worms.*

    b. Change the probability to a percent.

$\frac{11}{90}$ *expressed as a percent is 12.2%.*

**4.** After her jump, Linda brings back a sign that reads "Lower Level 4". Explain why it makes sense for Linda to say, "Six minus negative four" when calculating how many stories down she went.
*Answers will vary. Accept answers students can support. Linda was on the sixth floor above the sidewalk and bungee jumped through an opening in the sidewalk, grabbing the sign from the fourth floor below ground level. Student need to understand that lower level 4 means a direction from the ground floor just as -4 (a negative four) means a direction to the left or down from zero.*

**5.** In the first Fear Fraction contest, Mark has to dunk his face in a liquid with a beginning temperature of 70 degrees Celsius. Then the temperature decreases 100 degrees Celsius. What will the final temperature of the liquid be?
*The temperature will be -30° Celsius.*

**6.** Contestants in Fear Fraction were allowed to choose how many worms they would eat. The choices were 2 to the sixth power or 6 to the second power.
    a. What was the mathematical mistake that Billy made causing him to choose 2 to the sixth power?
    b. How did this affect the number of worms he had to eat?
*A. Answers will vary. Accept responses that the students can support. In the episode Billy thought that 6 to the second power would be more worms than 2 to the sixth power. Billy seems only to have been thinking that 6 is greater than 2. Perhaps he interpreted the word power literally and felt a 6 would always have more "power" than a 2.*
*B. Billy, instead of eating only 36 (6 x 6) worms, had to eat 64 ( 2 x 2 x 2 x 2 x 2 x 2) worms.*

**7.** At one point the host tells Bob and Linda, "A quarter of our contestants were eliminated in the first round, and two thirds of the remaining contestants were eliminated in this round. Congratulations. You're our two Fear Fraction finalists." How many contestants started the competition?

*Eight (8) contestants began the competition. In this round $\frac{2}{3}$ left so $\frac{1}{3}$ remained. 2 is $\frac{1}{3}$ of 6.*

*In the first round $\frac{1}{4}$ left and $\frac{3}{4}$ remained. 6 is $\frac{3}{4}$ of eight.*

## ❻ Extended Activities to Improve Conceptual Learning

**1.** If the probability that an event will occur is 2/3, what are the odds that the event will occur?
*The odds are 2/1. Odds compare the number of positive results to the number of negative results. Of the 3 possible chances for the event to occur, two will be probably occur and one will probably not occur.*

**2.** The results of a survey of 300 randomly chosen students are shown in the table below.
    a. What is the probability that a student chosen at random favors chocolate?
    b. What is the probability that a female will not prefer vanilla?

| PREFERENCES FOR ICE CREAM | | | |
|---|---|---|---|
| Students | Vanilla | Chocolate | No Preference |
| Male | 30 | 90 | 20 |
| Female | 99 | 38 | 23 |

*a.* $\frac{128}{300} = \frac{32}{75}$      *b.* $\frac{61}{160}$

**3.** A common mistake when using exponents is to multiply the base times the exponent.
   c.   Graph the points in the tables.
   d.   Which table shows the correct way to evaluate exponents?  Explain your reasoning.

| Table 1 | | |
|---|---|---|
| **Example** | **Value** | **Point** |
| $2^1$ | 2 | (1, 2) |
| $2^2$ | 4 | (2, 4) |
| $2^3$ | 8 | (3, 8) |
| $2^4$ | 16 | (4, 16) |

| Table 2 | | |
|---|---|---|
| **Example** | **Value** | **Point** |
| $2^1$ | 2 | (1, 2) |
| $2^2$ | 4 | (2, 4) |
| $2^3$ | 6 | (3, 6) |
| $2^4$ | 8 | (4, 8) |

   a. *See graphs below. This might be a good time to discuss with students that exponential 'growth' is not a linear function. The correct graph of the exponential growth shows a curved function.*
   b. *Table 1 is the correct way to evaluate the exponents. Explanations will vary. Accept responses that students can support.*



*Table 1*



*Table 2*
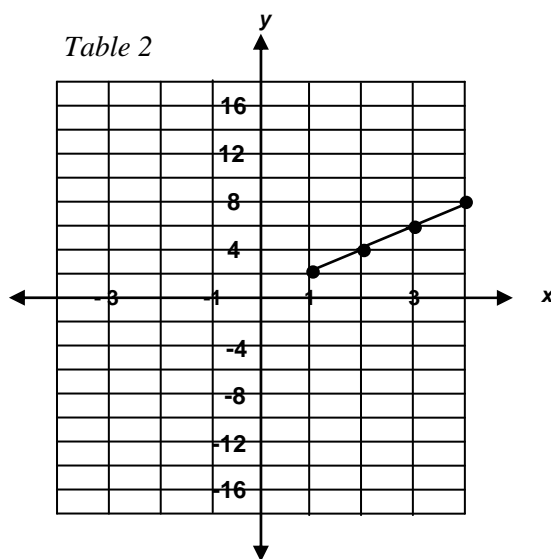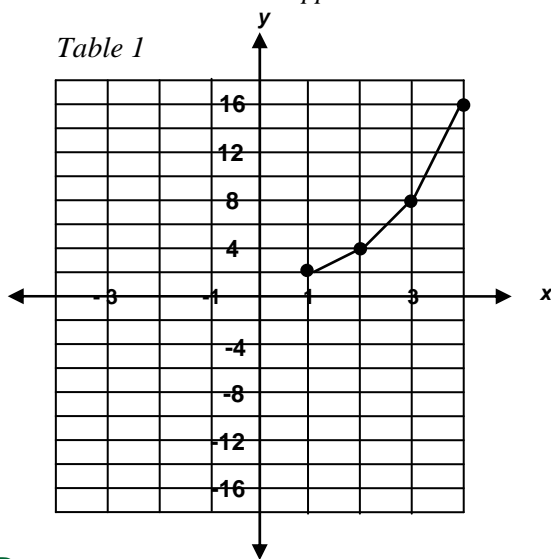
# ❼ Resources

## WebQuest

- "Cooking with Fractions"
  - Loretta Martin, Instructional Technology Teacher
  - http://www.k12.de.us/wmhenry/math.htm
- "Cooking with Fractions"
  - Lynn Fender, North Pekin Marquette Heights School District #102 and Samantha Fender, Eureka College
  - http://www.district87.org/staff/powelln/Eureka/Fender/fraction_webquest.html
- "Fraction Webquest"
  - Students will explore the world of fractions using the Internet.
  - http://www.taiwan1.com/freda/kidsmath/webquest.htm

- "WebQuest 1" Using Number Sense and Scientific Notation to Describe An Endangered Species:
  - Your essential goal is to find and analyze the mathematical and scientific facts surrounding your species and its endangerment, propose a solution to the problem, and present your research.
  - http://ttt.pugetsoundcenter.org/projects/2003/ttt03064/index.htm

## Additional Resources

- Math Anxiety:
  - For information and ideas on how to deal with student math anxiety, visit one or all of the following websites:
  - http://www.nwlincs.org/WyGEDtran/MathAnxiety.htm
  - http://math-and-reading-help-for-kids.org/articles/How_Practice_Problems_and_Worksheets_Can_Alleviate_Math_Anxiety.html
  - http://mathforum.org/library/ed_topics/psych_affective/
- "Algebra"
  - Here is an algebra tutorial comprising mathematical numbers; real number system; numerical representations in algebra (algebraic expressions); algebraic techniques (factoring); quadratic equations and inequalities; graphing.
  - http://library.thinkquest.org/10030/algecon.htm
- *Mrs. Glosser's Math Goodies*
  - Math Concepts such as factors, multiples, primes, composites, divisibility, and exponents.
  - http://www.mathgoodies.com/lessons
  - Click the Number Sense and/or Probability Free Lessons links.
- "Math and Science Gumbo"
  - Math and Science Gumbo takes the unique approach of using food and cooking to teach many principles of math and science. The series focuses on math concepts like unit pricing, fractions, estimation, units of measurement, area and so on. On the science side, the series looks at the concepts of physical and chemical change, preservation, refrigeration, enzymes, microorganisms and gas laws. Math and Science Gumbo is tied to Ohio's Academic Content Standards.
  - http://www.pbs4549.org/gumbo/
- "Standardized Test Preparation and Tips for Success – Preparing Your Students for the Ohio Graduation Test"
  - Number, Number Sense and Operations: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_NumberStrand.htm
  - Measurement: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_MeasurementStrand.htm
  - Geometry and Spatial Sense: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_GeometryStrand.htm
  - Patterns, Functions and Algebra: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_AlgebraStrand.htm
  - Data Analysis and Probability: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_DataStrand.htm

**Ohio Resource Center for Mathematics, Science and Reading**
http://www.ohiorc.org/

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The collection of resources is not stagnant.  New resources are constantly being added, and the collection itself is under constant review.  The ORC has a number of special features, one of which is Standards Plus, which adds a career connection to appropriate lessons in the collection.

ORC Lessons for *What's the Problem?* Video Episodes

FEAR FRACTION – ORC Lesson # **594**: **Astronomical Scales**
- Resource Type: Instructional Resources  Practice Level: Promising Practices
- Standards Alignment: Grades 8 - 12
- Topics: Mathematics -- Numbers and Operations; Exponents, Roots; Length, Distance; Rates, Ratio, Proportion; Units, Conversion; Measurement
- Professional Commentary: Students compute appropriate distances in different scale models of the solar system and universe using a variety of units, scale factors, and scientific notation. In so doing, students learn to write and solve equations that relate real distance measurements to scaled representations of the distances.
- Career Fields: Engineering & Science Technologies

Locate a Lesson at the Ohio Resource Center by the ORC Lesson #

1. Navigate to http://www.ohiorc.org.
2. Choose "Advanced Search" from the links in the left margin.
3. Type the lesson number in the center box of the top line of boxes.
4. Choose "ORC Number" from the drop down menu in the box following the words "in the".
5. Scroll to the bottom of the page.
6. Click Submit.

**NOTES:**

# The Simplified Life

## How To Use The Simplified Life

The standard of numbers and number sense is explored in The Simplified Life.  Students will look at mathematical operations. Prior to viewing the episode, teachers should review indicated vocabulary with students.  Before viewing questions are provided to get students into a proper frame of mind for recognizing the mathematics in the episode.

After viewing The Simplified Life, review and reinforcement problems are provided to build on the material included in the episode.  For a deeper look at the mathematics, extended activities allow students to show a conceptual understanding of the material.

The Resources section includes information and Internet links for WebQuests that reinforce the mathematical content of this episode. Students may work with numbers associated with NASCAR, the national debt, or creating a number system for an alien planet. This section also includes links to the content as it appears in standardized

## ❶ The Main Idea

Use scientific notation correctly**.**

## ❷ Ohio Mathematics Academic Content Standards

The Simplified Life can provide challenging thinking for Number and Number Sense Benchmarks A, F and I, and Mathematical Processes Benchmark F.

## ❸ Episode Synopsis

Two not-so-simple-minded girls bring mathematics enlightenment to a school.

### Newsbreak/Math Moments Purpose

- WMATH Breaking News: In this segment one reporter states the Pythagorean Theorem and another discusses population density.
- The Math Moment in this episode addresses a question about the number of uniformly dimensioned boxes a cabinet can contain.

### Vocabulary

- *Absolute Value* – A number's distance from zero on the number line.  The absolute value of a number is denoted by vertical lines before and after it – for example: |8| – which is read as "the absolute value of eight". See more about absolute value at: http://www.purplemath.com/modules/absolute.htm
- *Exponent* – In an expression of the form $X$ to the $n$ power ($X^n$), the exponent is n. An exponent indicates how many times the number to its left (the base) is to be used as a factor. $5^4$ is read as "5 to the fourth power" and means 5 x 5 x 5 x 5.

- *Scientific Notation* – A form of writing numbers as the product of a decimal number greater than or equal to 1 and less than 10 and a power of 10. Using scientific notation, 43,500 would be written as $4.35 \times 10^4$.

- *Square Root* – One of two identical factors of a number. Symbol: $\sqrt{\phantom{x}}$  Example: $\sqrt{25} = 5$ because 5 x 5 = 25.

## ❹ Before Viewing – Focus Activities

1. Discuss the base ten number system. Include place value and decimal notation in the discussion.

2. Ask the students to share what they know or understand about scientific notation. Discuss how to express numbers larger than one and smaller than one. Ask the students to explain the value of using scientific notation for extremely large numbers and extremely small numbers. Examples:
   - Larger than one: 5280 feet = $5.28 \times 10^3$ feet
   - Smaller than one: 0.0006 grams = $6.0 \times 10^{-4}$ grams

3. Ask the students if multiplication always produces a product greater than either factor? Have them explain.
   *No, multiplication does not always produce a product greater than either factor.*
   *Explanations may vary. Accept explanations that students can support.*

4. Tell students to consider what happens in a multiplication problem when a decimal is placed in front of a single digit factor.  For example: 25 x 5 = 125 and then place a decimal point in front of the 5 to make 25 x .5 = 12.5 (25 x 0.5 = 12.5).
   *In the example, the second answer is ten times less than the original answer. Adding a decimal point changes the answer in powers of ten.*

## ❺ After Viewing – Review/Reinforcement Activities

1. Barcelona thinks that $43.62 \times 10^3$ is written in scientific notation.  Michelle thinks it is not. Who is correct?  Explain your reasoning.
   *Michelle is correct since there are two digits to the left of the decimal point. In scientific notation there is only one digit to the left of the decimal point.*

2. Which number best represents the population where you live:  $3.0 \times 10^6$ or $3.0 \times 10^3$? Explain your reasoning.
   *$3.0 \times 10^6 = 3,000,000$ and $3.0 \times 10^3 = 3,000$. Answers will vary depending upon your location. Southeastern Ohioans are likely to live in population areas that are closer to 3,000 than to 3,000,000. Accept explanations that can be supported.*

3. Which expression represents 580,000 written in scientific notation?

   a. $0.58 \times 10^6$       b. $5.8 \times 10^5$       c. $58 \times 10^4$       d. $580 \times 10^3$
   *580,000 expressed in scientific notation is $5.8 \times 10^5$*

4. The substitute asks the class to write "$3.0 \times 10^5$" as an ordinary number. What number should the class have written?
   *The class should write 300,000.*

5. Find the absolute value of the following:

   a. $|-8| =$       b. $|14| =$       c. $|-1| =$
   
   *a. 8*       *b. 14*       *c. 1*

6. Find the square root of the following:

   a. $\sqrt{81} =$    b. $\sqrt{1} =$    c. $\sqrt{\dfrac{4}{25}} =$    d. $\sqrt{x^2} =$
   
   *a. 9*    *b. 1*    *c. $\dfrac{2}{5}$*    *d. x*

## ❻ Extended Activities to Improve Conceptual Learning

1. If each of the $3.0 \times 10^4$ people employed by Many Motors earned $4.0 \times 10^4$ dollars last year, how much money did the company pay out to its employees?
   *Many Motors paid out $1,200,000,000 or $1.2 \times 10^9$ dollars.*

2. Have students think again about the <u>Before Viewing</u> problem #4 (25 x 5 to 25 x 0.5). How does the result of the changed problem compare to the original problem? Have students try several more examples that they make up. Is there a pattern? Explain.
   *The product before the decimal is moved (25 x 5) is much larger – 125 – than after it is moved – 12.5. After several examples the students should be able to see that there is a pattern and explain the pattern. Explanations will vary but should include information about the decimal point moving a like number of places in the answer – in the same direction.*

3. What would happen if instead of putting the decimal with the single digit number you put it in between the 2 and the 5 to get 2.5 x 5? How is this answer alike or different from the other? Explain what is happening and why.
   *The answers are the same because, in both cases, adding the decimal point to change the number by making a tenth is dividing the product by ten – no matter whether you put it in the single digit number or in the double digit number.*

## ❼ Resources

### WebQuests

- "The NASCAR Numbers Webquest"
  - View numbers through the eyes of NASCAR to help students understand math and numbers a little better.
  - http://www.mtsd-vt.org/WebQuests/BLadabouche/Numbers/nascar_numbers_webquest.htm
- "Look Who's Footing the Bill"
  - Examine the national debt and balance the budget.
  - http://www.kn.pacbell.com/wired/democracy/debtquest.html

- "A Creative Encounter of the Numerical Kind"
  - Use your knowledge of our number system to help develop a number system for an alien planet.
  - http://studenthome.nku.edu/~webquest/gabbard/index.htm
- "Who Wants To Be a Ruler?"
  - Your task in this quest is to develop a board game which incorporates measurements from both systems – U. S. Customary and Metric.
  - http://studenthome.nku.edu/%7ewebquest/sutkampm/

## Additional Resources

- "Exponents: Scientific Notation": http://www.purplemath.com/modules/exponent3.htm
- "Browse [Dr. Math's] Middle School Number Sense/About Numbers [Category]"
  - Ask Dr. Math for insight into numbers:
  - http://mathforum.org/library/drmath/sets/mid_number_sense.html
- "The Development of Counting Systems and Notations":
  http://scitsc.wlv.ac.uk/university/scit/modules/mm2217/countsys.htm
- "Standardized Test Preparation and Tips for Success – Preparing Your Students for the Ohio Graduation Test"
  - Number, Number Sense and Operations:
    http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_NumberStrand.htm
  - Measurement:
    http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_MeasurementStrand.htm
  - Geometry and Spatial Sense:
    http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_GeometryStrand.htm
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ORC Lessons for *What's the Problem?* Video Episodes:

SIMPLIFIED LIFE – ORC Lesson #**3313**: **Too Big or Too Small?**

- Resource Type: Instructional Resources
- Practice Level: Best Practices
- Standards Alignment: Grades 5-9
- Topics: Mathematics – Numbers and Operations; Decimals; Fractions; Whole numbers; Number sense
- Professional Commentary: This lesson features three activities to promote number sense with large numbers, fractions, and decimal operations. In the first activity, students use proportional reasoning to determine whether $1 million in $1 bills would fit in a suitcase and how much it would weigh.
- Career Fields: General Career Skills

Locate a Lesson at the Ohio Resource Center by the ORC Lesson #.
1. Navigate to http://www.ohiorc.org.
2. Choose "Advanced Search" from the links in the left margin.
3. Type the lesson number in the center box of the top line of boxes. See example below.
4. Choose "ORC Number" from the drop down menu in the box following the words "in the".
5. Scroll to the bottom of the page.
6. Click Submit.

## Advanced Search

**Search for resources that...**

contain | free text ▾ | 608 | **in the** | ORC Number ▾

**NOTES:**

# Surprise Attack: Business Makeover

## How To Use Surprise Attack: Business Makeover

Surprise Attack: Business Makeover allows students to look at the number and number sense standard as well as data analysis and probability. Students will be using percents to make calculations, using measures of central tendency appropriately, and using probability to make predictions. Prior to viewing the episode, teachers should review indicated vocabulary with students. Before viewing, questions are provided to get students into a proper frame of mind for recognizing the mathematics in the episode.

After viewing Surprise Attack: Business Makeover, review and reinforcement problems are provided to build on the material included in the episode. For a deeper look at the mathematics, extended activities allow students to show a conceptual understanding of the material.

The Resources section includes information and Internet links to several WebQuests that reinforce the mathematical content of the episode. The WebQuests encourage students to think mathematically while determining the best baseball hitter of all time, designing, conducting, and analyzing a survey, and looking at statistical information on many sports figures. There are also links to the content as it appears in standardized testing.

## ❶ The Main Ideas

- Using percents to make calculations.
- Using central tendencies correctly.
- Using probability to make predictions.

## ❷ Ohio Mathematics Academic Content Standards

Surprise Attack: Business Makeover can provide challenging thinking for Number and Number Sense Benchmarks G and I, and Data Analysis and Probability Benchmark C.

## ❸ Episode Synopsis

A skateboard shop owner needs help with collecting and interpreting data from a skater dude to breathe life into his ailing business.

### Newsbreak/Math Moments Purpose

- Newsbreak: The WMATH Breaking News in this episode is a point–counter point about rational vs. irrational numbers.
- The Math Moment in this episode centers around a probability event – determining the probability of a skating event occurring on a given day.

## Vocabulary

- ***Mean*** - The sum of the set of numbers divided by the number of elements in the set.
- ***Mode*** - The number or object that appears most frequently in a set of numbers or objects.
- ***Probability*** - The chance of an event occurring. The probability of an event is equal to the number of favorable outcomes divided by the number of possible outcomes.
- ***Odds*** - The ratio of favorable outcomes to unfavorable outcomes.
- ***Discount*** - An amount that is subtracted from a regular price of an item.

## ❹ Before Viewing – Focus Activities

1. Ask the students to describe the difference between mean, median, and mode.
   *Descriptions will vary. Mean is the numerical average of a data set, median is the middle number of all the individual data points when they are arranged in order from least to greatest, and mode is the number which appears most frequently.*

2. Using the estimated number of songs the students in the class say they have stored on their cell phones, iPods, MP3 players and/or other electronic storage devices such as computers, have the students find the mean, median, and mode of those numbers.
   Answers will vary.

3. Ask students to mentally calculate a. 25% of 24 and b. 10% of 4,500.
   *a. 25% of 24 is 6          b. 10% of 4,500 is 450*

4. Ask students how many different teachers they have had during their school career.  List the number reported by each student on the board and have students find the mean for the number of teachers a student has had.
   *Answers will vary.*

## ❺ After Viewing – Review/Reinforcement Activities

1. Which would be cheaper: A $40 watch that is 15% off or a $60 watch that is 30% off? Justify you answer mathematically.
   *The $40 watch at 15% off is cheaper. Justifications will vary. Example: 100% – 15% = 85% and 0.85 x 40 = $34.00. 100% – 30% = 70% and 0.70 x 60 = $42.00.*

2. If Skater Dude purchased a skateboard for $112 and the original price was $160, what is the percent of discount?
   *30%     Example: (160 – 112) ÷ 160 = 0.3 or 30%*

3. DJ weighs 73.5 kg. If 55% of DJ's weight is oxygen, what is the oxygen weight in DJ?
   *40.425 kg          Example: 73.5 x 0.55 = 40.425*

4. When Mr. E says "Most people who walk past this store are sixteen years of age," to which measure of central tendency is he referring?
   *Mean. The data set laid out on the counter in this episode was {5, 5, 5, 5, 6, 6, 7, 8, 20, 22, 29, 29, 29, 29, 35}. The mean for the data is 16. The median was 8.*

5. Verify that 25% off $115 saves the customer $28.75.
   *Methods of proof will vary. One example: 115 x 0.25 = 28.75*

6. D.J. says that, at 25% off, the skateboard decks sold in the shop would cost $45 on sale. What is their original cost?
   *$60.00*

7. D.J. asks, "10% of 3,300?"
   a. How many people is that?
   b. If each bought a deck for $45 and $100 worth of extra equipment, how much would the Skate Shop take in?
   *a. 10 % of 3,300 =330 people*          *b. $47,850*        *330(100+45) = 47,850*

## ⑥ Extended Activities to Improve Conceptual Learning

1. Mr. E decided to offer a 2.5% discount for cash payments. Skater Dude's bill was $617.77 (before taxes) because he paid cash. How much was the original bill before taxes? Justify your answer mathematically.
   *$633.61 Methods of proof will vary. One example:*
   *100% – 2.5%=97.5 so $617.77 is 97.5% of the total price.* $\dfrac{97.5}{100} = \dfrac{617.77}{?} = 61777 \div 97.5 =$
   *633.61025 or $633.61.*

2. A radio is marked down 20% and the sign above it read 20% more off, is that 40% off? Justify your answer mathematically.
   *No, this does not mean 40% off. Methods of proof will vary. One example: If the radio cost $100 before the sale, the first price reduction would be 100 x .0.20 or $20 off. The price would then be $80. The second price reduction would be 80 x 0.20 or $16 off. The new price would be $64. The total price reduction would be $100 - $64 = $36 but 40% off of $100 would be $40. $36 does not equal $40.*

3. Using the data set Mr. E. collected, {5, 5, 5, 5, 6, 6, 7, 8, 20, 22, 29, 29, 29, 29, 35}, find the mean, the median, and the mode. Keeping in mind Mr. E.'s purpose, tell whether each measure of central tendency is or is not an effective representation of the data and why.
   *The mean is 16.          The median is 8.          The set has two modes, 5 and 29.*
   *Explanations will vary but none of the central tendency measures are effective measures of what Mr. E. wants to know. He wants to know if people between the ages of 13 and 19 i.e. teenagers are passing by his store. He needs to look at all of the data points to see the gap between age 8 and age 20 – no teenagers.*

## ⑦ Resources

### WebQuests

- "Take Me Out To the Ball Game"
  - Using statistical data you will determine the best ten years for various famous baseball hitters. Based upon your statistical information you will come to a conclusion:  Who is the best baseball hitter of all time?
  - http://warrensburg.k12.mo.us/webquest/baseball/

- "Your Opinion Sells"
    - o Design, conduct, analyze and write up a student opinion poll.
    - o http://www.personal.psu.edu/faculty/j/x/jxz8/Student_Webquests/Lindholm/questA.htm
- "Population Analysis"
    - o In this WebQuest students will analyze some REAL data, make some predictions based on their findings, and learn how such data and predictions are actually used to make important decisions right here in the United States.
    - o http://www.dedham.k12.ma.us/webquest/fall2000/mb/worldpop.html
- "Using Percents in Your Daily Life"
    - o This WebQuest is designed to enable you to realize how important percents are and how many applications of percents there are.
    - o http://coe.west.asu.edu/students/jkreiman/percents/index.html
- "My Dream Life"
    - o How will knowing percentages help you make your career choice?
    - o http://www.kn.sbc.com/wired/fil/pages/webmathan1.html

## Additional Resources

- "Standardized Test Preparation and Tips for Success – Preparing Your Students for the Ohio Graduation Test"
    - o Number, Number Sense and Operations: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_NumberStrand.htm
    - o Measurement: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_MeasurementStrand.htm
    - o Geometry and Spatial Sense: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_GeometryStrand.htm
    - o Patterns, Functions and Algebra: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_AlgebraStrand.htm
    - o Data Analysis and Probability: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_DataStrand.htm

## Ohio Resource Center for Mathematics, Science and Reading
http://www.ohiorc.org/

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ORC Lessons for *What's the Problem?* Video Episodes:

SURPRISE ATTACK: BUSINESS MAKEOVER – ORC Lesson #**1494**: **Baseball Stats**

- Resource Type: Instructional Resources
- Practice Level: Promising Practices
- Standards Alignment: Grades 5-8
- Topics: Mathematics – Mean, Median, Mode; Statistics; Data Analysis
- Professional Commentary: Students use baseball data available on the Internet to look at different ways data can be analyzed. First, they select data to calculate responses to pre-formulated questions.
- Career Fields: Marketing, Business & Administrative Services

Locate a Lesson at the Ohio Resource Center by the ORC Lesson #.

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3. Type the lesson number in the center box of the top line of boxes. See example below.
4. Choose "ORC Number" from the drop down menu in the box following the words "in the".
5. Scroll to the bottom of the page.
6. Click Submit.

## Advanced Search

**Search for resources that...**

**contain** | free text | 608 | **in the** | ORC Number

**NOTES:**

# Survival

## How To Use Survival

Survival allows students to look at the number and number sense standard as well as data analysis and probability. Students will be looking at various ways of writing the same number. Prior to viewing the episode, teachers should review indicated vocabulary with students. Before viewing, questions are provided to get students into a proper frame of mind for recognizing the mathematics in the episode.

After viewing Survival, review and reinforcement problems are provided to build on the material included in the episode. For a deeper look at the mathematics, extended activities allow students to show a conceptual understanding of the material.

In the Resources section, information and Internet links are provided for several WebQuests that reinforce the mathematical content of this episode. These include balancing the national debt, Boudreaux's Time Travels, and predicting Shaq's basketball statistics. There are also Internet links to the content as it appears in standardized testing.

## ❶ The Main Idea

Recognize that the same number can be written in various ways.

## ❷ Ohio Mathematics Academic Content Standards

Survival can provide challenging thinking for Number and Number Sense Benchmark E and Data Analysis and Probability Benchmark J.

## ❸ Episode Synopsis

During a baseball game immunity challenge, the two teams make decisions based on statistics.

### Newsbreak/Math Moments Purpose

- Newsbreak: There are two concepts in the Breaking News for this episode 1) zero to the zero power is undefined and 2) what is a random survey.
- The Math Moment topic in this episode is estimating the measurement of an angle.

### Vocabulary

- *Average* (mean) - The sum of the set of numbers divided by the number of elements in the set.
- *Statistics* - A branch of mathematics concerned with methods of collecting, organizing, and interpreting data.
- *Probability* - The chance of an event occurring. The probability of an event is equal to the number of favorable outcomes divided by the number of possible outcomes.
- *Odds* - The ratio of favorable outcomes to unfavorable outcomes.

## ④ Before Viewing – Focus Activities

**1.** Ask the students to write 16 three as a fraction, an exponent, and a square root. Have the students choose other numbers and write them three different ways.

Answers will vary. Example: Fraction $\frac{16}{1}$, Exponent $2^4$ or $4^2$, Square Root $\sqrt{256}$

**2.** Ask the students if they know how to figure out a batting average for a baseball player, and then explain it to the class.
*Explanations will vary. Accept answers students can support. To calculate batting average, divide the number of hits a player makes by the number of times at bat – and express the answer to the third decimal place. For example: Hank has been at bat 39 times so far this baseball season and has gotten only 7 hits. Hank's batting average is 7 ÷ 39 = 0.179. Baseball statisticians would say that Hanks batting average is 179. Find more about batting averages at http://www.freemathhelp.com/battingaverage.html*

**3.** Discuss the differences between baseball player's batting average and a pitcher's ERA (Earned Run Average). *Demonstrate how to calculate ERA. See the following sites: How to calculate ERA: http://www.ehow.com/how_9733_calculate-earned-run.html and ERA Described: http://www.homerunweb.com/era.html*

**4.** Brainstorm as many ways as you can think of to write an equivalent form of 9 and then as you watch the video episode, see how many you came up with that were not in the video episode.

## ⑤ After Viewing – Review/Reinforcement Activities

**1.** Find the missing piece of information in each row.

| AT BAT | HITS | BATTING AVERAGE |
|--------|------|-----------------|
| 18 | ? | .389 |
| 33 | 21 | ? |
| ? | 12 | .444 |

*Row 1: 7        Row 2: .636     Row 3: 27*

**2.** Hank says that 130 out of 162 is the same as 80%. Is he correct? Justify your answer mathematically.
*Yes. Justifications may vary. One example: 130 ÷ 162 = 0.8024, round to 0.80 which is 80%.*

**3.** Lance says, "Hank's pitched 106 innings for us and has given up 61 runs. That would divide out to .57". Does it? Justify your answer mathematically.
*Justifications may vary. One example: 61 ÷ 106 = 0.5754. If the student rounds down, then Hank has the correct answer. If the student rounds up, then Hank is incorrect.*

4. Lance says, "Hank's pitched 106 innings for us and has given up 61 runs. That would divide out to 0.57." Amy says that multiplying .57 by 9 gives an ERA of 5.13.  Is she correct? Justify your answer mathematically.
   *No, to calculate ERA multiply the runs given up times nine, then divide the results by the total number of innings. 61 x 9 = 594 and 594 ÷ 106 = 5.1792 or 5.18 ERA. For directions on how to calculate ERA, see the website: http://www.ehow.com/how_9733_calculate-earned-run.html or http://mathforum.org/library/drmath/view/52796.html*

5. Hank said that a major league slugger averages 105 RBIs per year playing 130 games.  How many RBIs would this be if the slugger continued to bat in runs for 162 games?
   *131 RBIs  His batting average would increase proportionately.*
   *105 RBIs ÷ 130 games = X ÷ 162 games. So 105 x 162 ÷ 130 = 130.846 ~131 RBIs*

## ⑥ Extended Activities to Improve Conceptual Learning

1. Doug had 8 hits out of 10 for a batting average of .8.  Lance had 6 hits out of 9 at bats for a batting average of .667.  Lance says his batting average is higher than Doug's because 667 is greater than 8.  Is he correct?  How would you prove it?
   *No. Explanations may vary. One example: 0 .8 = 0.800 which is read as an 800 batting average while 0.667 represents the batting average 667 – and 800 > 667.*

2. The numbers seen on the backs of the Pinetarikus players are 3 x 3, |-9|, $3^2$, $\sqrt{81}$, 2 + 3 + 4, and $\frac{27}{3}$.  At the end of the episode, all but Lance (who draws a smiley face) vote to eliminate #9.  Decide who got voted off and defend your choice.
   *Answers will vary. Accept answers that students can justify. Lance seems to be the only one aware that all of the players are #9. Students may feel that he should be rewarded while all the others are eliminated.*

3. Explain the difference between the absolute value of -6, written as |-6|, and the integer -6.
   *Explanations will vary. Accept answers that students can justify. One example: The |-6| means that we are six units from zero whereas the integer -6 means that we are 6 units to the left or down from zero on the number line.*

## ⑦ Resources

### WebQuests

- "Look Who's Footing the Bill!"
  - Balancing the National Debt
  - http://www.kn.pacbell.com/wired/democracy/quickquest.html
- "Boudreaux's Time Travels"
  - Help him find a home.
  - Teacher Page: http://www.mindenhigh.com/teachers/ldick/tech/wqbtt/teacher.htm
  - Student Page: http://www.mindenhigh.com/teachers/ldick/tech/wqbtt/index.htm
- "Attack of the $8 Popcorn"
  - Why do movies cost so much? Why do concessions cost so much? And, where does all that money go?
  - http://express.howstuffworks.com/wq-movies.htm

- "The Titanic"
    - What can numbers tell us about her final voyage?
    - http://asterix.ednet.lsu.edu/~edtech/webquest/titanic.html

## Additional Resources

- "When am I Ever Going to Use Math"
    - This WebQuest explores: biographical essays, mathematical applications in the real world, career opportunities, and educational requirements to meet goals
    - http://coe.west.asu.edu/students/msyrkel/webquestusemath.htm
- "Standardized Test Preparation and Tips for Success – Preparing Your Students for the Ohio Graduation Test"
    - Number, Number Sense and Operations: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_NumberStrand.htm
    - Measurement: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_MeasurementStrand.htm
    - Geometry and Spatial Sense: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_GeometryStrand.htm
    - Patterns, Functions and Algebra: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_AlgebraStrand.htm
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ORC Lessons for *What's the Problem?* Video Episodes:

SURVIVAL – ORC Lesson #**1097**:  **Monty's Dilemma: Should You Stick or Switch?**

- Resource Type: Instructional Resources
- Practice Level: Best Practices
- Standards Alignment: Grades 8 - Postsecondary
- Topics: Mathematics -- Probability; Connections, Applications; Problem Solving
- Professional Commentary: This lesson presents a classic game-show scenario: You pick one of three doors in hopes of winning a prize. The host opens one of the two remaining doors which reveals no prize, then asks if you want to stick with your original choice or switch to the other unopened door.

Locate a Lesson at the Ohio Resource Center by the ORC Lesson #.

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## Advanced Search

**Search for resources that...**

| contain | free text | 608 | in the | ORC Number |
|---------|-----------|-----|--------|-----------|

**NOTES:**

# The Ohio-bournes

## How To Use The Ohio-Bournes

The Ohio-bournes allows students to look at the data analysis and probability standard.  Students will be exploring permutations and combinations.  Prior to viewing the episode, teachers should review indicated vocabulary with students.  Before viewing, questions are provided to get students into a proper frame of mind for recognizing the mathematics in the episode.

After viewing Ohio-bournes, review and reinforcement problems are provided to build on the material included in the episode.  For a deeper look at the mathematics, extended activities allow students to show a conceptual understanding of the material.

The Resources includes information and Internet links to several WebQuests that reinforce the mathematical content of this episode.  The WebQuests include: developing skills in basic probability, practicing real world problems, and the "Dilemma of the Dangerous Meatloaf". There are also links to the Ohio-bournes content as it appears in standardized testing.

## ❶ The Main Idea

Using combinations and permutations to determine outcomes.

## ❷ Ohio Mathematics Academic Content Standards

The Ohio-Bournes can provide challenging thinking for Data Analysis and Probability Benchmark H, and Mathematical Processes Benchmark D.

## ❸ Episode Synopsis

A rock star's family living in retirement on a farm is having counting problems.

### Newsbreak/Math Moments Purpose

There are no newsbreaks or Math Moments in this episode.

### Vocabulary
- *Permutation* - A selection of a group of items or events from a set with regard to order.
- *Combination* - A selection of a group of items or events from a set without regard to order.

## ❹ Before Viewing — Focus Activities

1. Students in the Spanish Club are selling pizzas with two toppings. Buyers may choose from the following toppings: pepperoni, sausage, mushroom, green pepper.  How many different combinations are possible?
   *6 (pepperoni/sausage, pepperoni/mushroom, pepperoni/green pepper, sausage/mushroom, sausage/green pepper, and mushroom/green pepper)*

2. Ask the students why a combination lock for a school locker should actually be called a permutation lock.
   *Explanations may vary. It should be called a permutation lock because order does matter. If the lock's opening code is 23-45-67, one cannot enter the numbers in some other combination (say 45-67-23) and expect the lock to open. For a detailed description of combination locks see: http://www.mathagonyaunt.co.uk/STATISTICS/ESP/Perms_combs.html*

3. If you can choose from among 5 different shirts and three different pairs of slacks, how many different outfits could you wear? If you then have to choose from among four pairs of shoes, how many possible different outfits are there now?
   *a. 15 (5 x 3 = 15)       b. 60 (5 x 3 x 4 = 60)*

4. You are making a pizza. You have pepperoni, sausage, and ham in the refrigerator. How many different choices of pizzas could you make with those ingredients?
   *7 different pizzas could be made: 3 one-topping pizzas - pepperoni, sausage or ham: 3 two-topping pizzas - pepperoni/sausage, pepperoni/ham, or sausage/ham; and 1 three-topping pizzas.*

## ❺ After Viewing – Review/Reinforcement Activities

1. Joke, the son, thinks that choosing five CDs from a group of 20 CDs to take on a trip is a permutation. Creepy thinks that it is a combination. Who is correct? Explain your reasoning.
   *Creepy is correct. Explanations will vary. It is a simple combination. Joke may play his CDs in any order he desires.*

2. Eight points are drawn on a circle. How many different line segments can be drawn between any two points?
   *27, 7 + 6 + 5 + 4 + 3 + 2 + 1+ 0 =27*

3. Creepy, the daughter, is making shoes for the pigs and chickens. She counts 126 feet and 21 pigs. How many chickens are there?
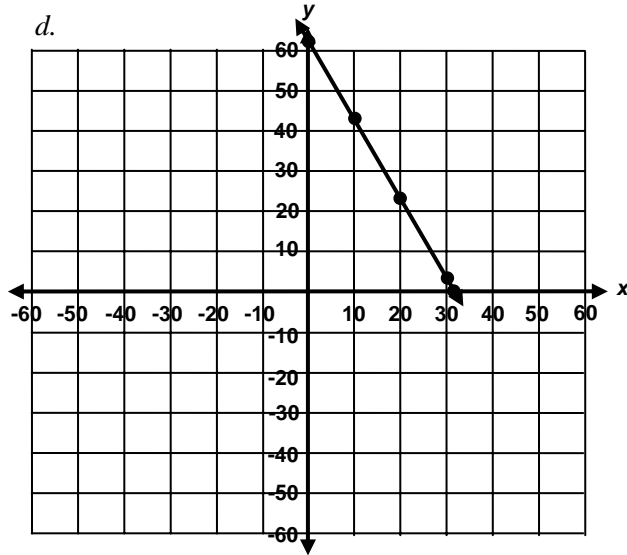   *21, (126-21 x 4)÷2=21*

4. Using *P* for pigs and *C* for chickens: a. Write an equation stating that the total number of feet is 126.  b. Solve the equation for *C*, c. Make a table of at least five ordered pairs for (*C, P*), and d. Draw a graph using the ordered pairs.

   a. Equation: $4P + 2C = 126$      b. $C = (126 - 4P)/2$

c.

| P | C |
|---|---|
| 1 | 61 |
| 2 | 59 |
| 3 | 57 |
| 4 | 55 |
| 5 | 53 |
| 6 | 51 |
| | |
| 10 | 43 |
| 20 | 23 |
| 30 | 3 |
| 31 | 1 |
| | |

d.



5. If Creepy had counted 24 feet but didn't know how many heads there were, list all possible solutions to her problem.

| Answer | |
|---|---|
| P | C |
| 0 | 12 |
| 1 | 10 |
| 2 | 8 |
| 3 | 6 |
| 4 | 4 |
| 5 | 2 |
| 6 | 0 |

6. When Izzy and Joke are discussing what kind of toppings to put on a pizza, they find the following:  with two toppings, tofu and pepperoni, there are three possible pizzas; with three toppings, pepperoni, tofu and bacon, there are 7 possible pizzas; and with four toppings, pepperoni, tofu, bacon and sweet tarts, there are fifteen.  Make a table, find a pattern, and find out how many possible pizzas there are using the list of 8 toppings they finally decide on: pepperoni, bacon, sweet tarts, caramel, tofu, tomatoes, arugula and dirt.

| With 8 toppings they could have 255 different pizzas. | | |
|---|---|---|
| **Number of Toppings** | **Number on Combinations** | |
| 1 | 1 | |
| 2 | 3 | |
| 3 | 7 | *Let n represent the number* |
| 4 | 15 | *of toppings. The pattern* |
| 5 | $2^n-1 = 2^5-1$ or 31 | *which emerges is $2^n-1$* |
| 6 | $2^n-1 = 2^6-1$ or 63 | |
| 7 | $2^n-1 = 2^7-1$ or 127 | |
| 8 | $2^n-1 = 2^8-1$ or 255 | |

## ❻ Extended Activities to Improve Conceptual Learning

**1.** If there are 504 ways in which three students can be selected first, second, and third place in a math competition, how many students are competing?
*9 students are competing. Students can solve this by trial and error as long as they realize that this is a permutation problem in which the order does make a difference.*
*Trials using n! for the first three options:*
- *10 x 9 x 8 = 720 – therefore 10 students is not the solution.*
- *9 x 8 x 7 – 540 – therefore 9 students competing is the solution.*

**2.** With 126 feet, could there have been 23 chickens? Could there have been 23 pigs? Justify your answer mathematically.
*Yes, there could be 23 chickens (126 – 2 x 23) ÷ 4 = 20 pigs. Yes, there could have been 23 pigs (126 – 4 x 23) ÷ 2 = 17 chickens. Justifications will vary.*

**3.** Would it be possible to choose a number of chickens or a number of pigs that would make the problem impossible to solve? Justify your answer mathematically.
*Yes, to both scenarios. There is no solution to this problem if we start with no chickens, any even number of chickens, more than 63 chickens, or more than 31 pigs.*
- *No chickens – that means that 126 feet belong to the pigs and 126÷4 feet per pig = 31.5 pigs*
- *Any even number of chickens – that means the number of feet available after subtracting the chickens' feet is not divisible by 4. Example: 2 chickens (126-2 x 2) ÷4 = 30.25*
- *More than 63 chickens –that means more than 126 feet thus no solution*
- *More than 31 pigs – that means at least 128 feet thus no solution*

**4.** A sausage and pepperoni pizza would be the same as a pepperoni and sausage pizza. Order doesn't matter. Make up a probability problem where order *does* matter. Provide the solution and explain why order does, in fact, matter.
*Answers will vary.*

## ❼ Resources

### WebQuests

- "The Dilemma of the Dangerous Meatloaf"
  - o Determine whether meatloaf is a healthy food or a dangerous food that could make you ill unless you eat it only occasionally or start making it differently.
  - o http://imet.csus.edu/imet1/scotty/webquest/meatloaf.htm
- "Probability: Experimental vs. Theoretical"
  - o This lesson was adopted from Life by the Numbers, "Chances of a Lifetime."
  - o The purpose of this lesson is to introduce students to probability. It is designed to give students the opportunity to investigate odds both experimentally and theoretically.
  - o http://lhs.lexingtonma.org/Teachers/King/webquest%20Lori/webquest.htm

- "Everybody Wins"
  - This lesson encourages students to develop their skills in basic probability as well as promote-solving skills.
  - http://www.sampson.k12.nc.us/Countypage/Technology/Web%20Quests/Marcelle%20Joyner%20Webquest/Everybody%20Wins.html

## Additional Resources

- "Ask Dr. Math: FAQ Permutations and Combinations"
  - http://mathforum.org/dr.math/faq/faq.comb.perm.html
- "Permutations and Combinations"  What are they?
  - http://rachel5nj.tripod.com/NOTC/pandc.html
- "Standardized Test Preparation and Tips for Success – Preparing Your Students for the Ohio Graduation Test"
  - Number, Number Sense and Operations: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_NumberStrand.htm
  - Measurement: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_MeasurementStrand.htm
  - Geometry and Spatial Sense: http://www.ct4me.net/Ohio_Graduation_Math_Test_Prep_GeometryStrand.htm
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THE OHIO-BOURNES – ORC Lesson #**4205**: **Ice Cream Cones: Lesson 3 of 4**

- Resource Type: Instructional Resources
- Practice Level: Promising Practices
- Standards Alignment: Grades 5 - 9
- Topics: Mathematics -- Numbers and Operations; Whole numbers
- Professional Commentary: In this last of two lessons on combinations, students find all of the different double dip ice cream cones that can be made from eight flavors of ice cream. An activity sheet, solutions, and problem extensions are included.

Locate a lesson at the Ohio Resource Center by the ORC Lesson #.

1. Navigate to http://www.ohiorc.org.
2. Choose "Advanced Search" from the links in the left margin.
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5. Scroll to the bottom of the page.
6. Click Submit.

## Advanced Search

**Search for resources that...**

**contain** | free text ⌄ | 608 | **in the** | ORC Number ⌄

# Ohio Mathematics Standards

## Number, Number Sense and Operations

Students demonstrate number sense, including an understanding of number systems and operations and how they relate to one another. Students compute fluently and make reasonable estimates using paper and pencil, technology-supported and mental methods.

**A.** Use scientific notation to express large numbers and numbers less than one.
**B.** Identify subsets of the real number system.
**C.** Apply properties of operations and the real number system, and justify when they hold for a set of numbers.
**D.** Connect physical, verbal and symbolic representations of integers, rational numbers and irrational numbers.
**E.** Compare, order and determine equivalent forms of real numbers.
**F.** Explain the effects of operations on the magnitude of quantities.
**G.** Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.
**H.** Find the square root of perfect squares, and approximate the square root of non-perfect squares.
**I.** Estimate, compute and solve problems involving scientific notation, square roots and numbers with integer exponents

## Measurement

Students estimate and measure to a required degree of accuracy and precision by selecting and using appropriate units, tools and technologies.

**A.** Solve increasingly complex non-routine measurement problems and check for reasonableness of results.
**B.** Use formulas to find surface area and volume for specified three-dimensional objects accurate to a specified level of precision.
**C.** Apply indirect measurement techniques, tools and formulas, as appropriate, to find perimeter, circumference and area of circles, triangles, quadrilaterals and composite shapes, and to find volume of prisms, cylinders, and pyramids.
**D.** Use proportional reasoning and apply indirect measurement techniques, including right triangle trigonometry and properties of similar triangles, to solve problems involving measurements and rates.
**E.** Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.
**F.** Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.

## Geometry and Spatial Sense

Students identify, classify, compare and analyze characteristics, properties and relationships of one-, two- and three-dimensional geometric figures and objects. Students use spatial reasoning, properties of geometric objects, and transformations to analyze mathematical situations and solve problems.

**A.** Formally define geometric figures.
**B.** Describe and apply the properties of similar and congruent figures; and justify conjectures involving similarity and congruence.
**C.** Recognize and apply angle relationships in situations involving intersecting lines, perpendicular lines and parallel lines.
**D.** Use coordinate geometry to represent and examine the properties of geometric figures.

**E.** Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools, such as straightedge, compass and technology.

**F.** Represent and model transformations in a coordinate plane and describe the results.

**G.** Prove or disprove conjectures and solve problems involving two- and three-dimensional objects represented within a coordinate system.

**H.** Establish the validity of conjectures about geometric objects, their properties and relationships by counter-example, inductive and deductive reasoning, and critiquing arguments made by others

**I.** Use right triangle trigonometric relationships to determine lengths and angle measures.

## Patterns, Functions and Algebra

Students use patterns, relations and functions to model, represent and analyze problem situations that involve variable quantities. Students analyze, model and solve problems using various representations such as tables, graphs and equations.

**A.** Generalize and explain patterns and sequences in order to find the next term and the nth term.

**B.** Identify and classify functions as linear or nonlinear, and contrast their properties using tables, graphs or equations.

**C.** Translate information from one representation (words, table, graph or equation) to another representation of a relation or function.

**D.** Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.

**E.** Analyze and compare functions and their graphs using attributes, such as rates of change, intercepts and zeros.

**F.** Solve and graph linear equations and inequalities.

**G.** Solve quadratic equations with real roots by graphing, formula and factoring.

**H.** Solve systems of linear equations involving two variables graphically and symbolically.

**I.** Model and solve problem situations involving direct and inverse variation.

**J.** Describe and interpret rates of change from graphical and numerical data.

## Data Analysis and Probability

Students pose questions and collect, organize, represent, interpret and analyze data to answer those questions. Students develop and evaluate inferences, predictions and arguments that are based on data.

**A.** Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability.

**B.** Evaluate different graphical representations of the same data to determine which is the most appropriate representation for an identified purpose.

**C.** Compare the characteristics of the mean, median and mode for a given set of data, and explain which measure of center best represents the data.

**D.** Find, use and interpret measures of center and spread, such as mean and quartiles, and use those measures to compare and draw conclusions about sets of data.

**E.** Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collection and analysis.

**F.** Construct convincing arguments based on analysis of data and interpretation of graphs.

**G.** Describe sampling methods and analyze the effects of method chosen on how well the resulting sample represents the population.

**H.** Use counting techniques, such as permutations and combinations, to determine the total number of options and possible outcomes.

**I.** Design an experiment to test a theoretical probability, and record and explain results.
**J.** Compute probabilities of compound events, independent events, and simple dependent events.
**K.** Make predictions based on theoretical probabilities and experimental results.

## Mathematical Processes

Students use mathematical processes and knowledge to solve problems. Students apply problem-solving and decision-making techniques, and communicate mathematical ideas.

**A.** Formulate a problem or mathematical model in response to a specific need or situation, determine information required to solve the problem, choose method for obtaining this information, and set limits for acceptable solution.
**B.** Apply mathematical knowledge and skills routinely in other content areas and practical situations.
**C.** Recognize and use connections between equivalent representations and related procedures for a mathematical concept; e.g., zero of a function and the x-intercept of the graph of the function, apply proportional thinking when measuring, describing functions, and comparing probabilities.
**D.** Apply reasoning processes and skills to construct logical verifications or counter-examples to test conjectures and to justify and defend algorithms and solutions.
**E.** Use a variety of mathematical representations flexibly and appropriately to organize, record and communicate mathematical ideas.
**F.** Use precise mathematical language and notations to represent problem situations and mathematical ideas.
**G.** Write clearly and coherently about mathematical thinking and ideas.
**H.** Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.