

IMP 1 September & October: Patterns

Topics to be covered

General learning skills and methods: In the course of this unit, students will:

- Become familiar with alternative forms of assessment, such as self-assessment and portfolios
- Develop strategies for solving problems
- Do investigations where the task is not clearly defined
- Express mathematical ideas orally and in writing
- Learn about group cooperation and roles in group learning
- Learn about the use of a graphing Calculator, including programming
- Make presentations within small groups and to the whole class Use concrete mathematical models in various situations
- Work in groups to analyze problems

Specific mathematical content. In the course of this unit, students will:

- Analyze and create In-Out tables
- Develop proofs concerning consecutive sums, angle sum for polygons, and other contexts
- Find, analyze, and generalize geometric and numerical patterns
- Use a concrete model to understand and do arithmetic with positive and negative integers
- Use variables to express generalizations
- Work with geometric concepts, including angle and polygon
- Work with order-of-operations rules for arithmetic
- Write a calculator program to simulate an In-Out machine

PA STANDARDS: 2.2A2, 2.2A5, 2.2A8, 2.2B1, 2.2F, 2.3B1, 2.3B2, 2.3C1, 2.3C4, 2.4A1, 2.4A3, 2.4E5, 2.5A1, 2.5A2, 2.5A3, 2.5A4, 2.5B1, 2.5B2, 2.5B3, 2.5B4, 2.5C1, 2.5C2, 2.5C3, 2.5C4, 2.6D3, 2.8A1, 2.8A4, 2.8A5, 2.8B, 2.8C1, 2.8C2, 2.8C3, 2.8C4, 2.8D1, 2.8D4, 2.8R, 2.9C1, 2.11D3, 2.11D4

IMP 1 November & December: The Game of Pig

Topics to be covered

Probability

- Calculating and interpreting expected values
- Calculating probabilities based on equally likely events and area models
- Deciding whether events are independent
- Expressing probability as a number between zero and one
- Extending a probabilistic analysis from a simple situation to a similar but more complex one
- Solving problems involving conditional probability
- Using "the long run" to develop the concept of expected value

Representations of probability

- Constructing mathematical models, particularly area models, for probabilistic situations
- Creating situations that fit a given probabilistic model
- Making and interpreting frequency bar graphs

Simulations

- Comparing the theoretical analysis of a situation with experimental results
- Seeing how the number of trials in a simulation affects the results
- Using a computer simulation to compare strategies
- Using simulations to estimate probabilities
- Writing a calculator program to create a simulation

Strategies

- Developing and analyzing strategies
- Learning what constitutes a "complete strategy"

PA STANDARDS: 2.1A8, 2.2A1, 2.2A2, 2.2A3, 2.2A4, 2.2A5, 2.2A6, 2.2A7, 2.2A8, 2.2A9, 2.2A11, 2.2A12, 2.2B1, 2.2B2, 2.2B3, 2.2B4, 2.2B6, 2.2F, 2.4A3, 2.5A1, 2.5A2, 2.5A3, 2.5A4, 2.5B1, 2.5B2, 2.5B3, 2.5B4, 2.5C1, 2.5C2, 2.5C3, 2.5C4, 2.6D2, 2.6D3, 2.7C1, 2.7C2, 2.7D1, 2.7D2, 2.7D3, 2.7E1, 2.7E2, 2.7E3, 2.7E4, 2.7E5, 2.8D4, 2.8R, 2.11A2

IMP 1 January & February: The Overland Trail

Topics to be covered

Algorithms, variables and notation:

- Developing meaningful algebraic expressions
- Developing numerical algorithms for problem situations
- Expressing algorithms in words and symbols
- Expressing linear approximations to data algebraically
- Interpreting algebraic expressions in words using summary phrases
- Solving equations for one variable in terms of others
- Solving problems involving two linear conditions
- Using subscript notation

Data and decision-making:

- Compiling and organizing data
- Creating examples that fit a set of constraints
- Finding numbers that fit several conditions
- Interpreting ambiguous problems
- Making estimates and plans for various situations
- Using tables of information and lines of best fit to make predictions and estimates

Graphs and modeling:

- Finding lines of best fit intuitively
- Interpreting graphs intuitively and using graphs intuitively to represent situations
- Making graphs from tabular information
- Making graphs on a graphing calculator
- Quantifying graphs with appropriate scales
- Using graphs to represent equations and writing equations that describe graphs
- Using multiple representations-graphs, In-Out tables, and algebraic relationships-to describe situations
- Using the point of intersection of graphs to satisfy two conditions
- Using zoom and trace facilities to get information from a graphing calculator
- Working with rate problems of various types

PA STANDARDS: 2.2A1, 2.2A2, 2.2A4, 2.2A8, 2.2B1, 2.2C1, 2.2C2, 2.2C3, 2.2E4, 2.2F, 2.3A1, 2.3A2, 2.3A3, 2.3C2, 2.4A1, 2.4A2, 2.4A3, 2.5A1, 2.5A2, 2.5A3, 2.5A4, 2.5B1, 2.5B2, 2.5B3, 2.5B4, 2.5C1, 2.5C2, 2.5C3, 2.5C4, 2.6C1, 2.6D2, 2.6D3, 2.8A1, 2.8A2, 2.8A4, 2.8A5, 2.8B, 2.8D1, 2.8D4, 2.8H1, 2.8H2, 2.8H3, 2.8H4, 2.8K1, 2.8K2, 2.8L3, 2.8M1, 2.8Q1, 2.8R, 2.11C2

March & April: The Pit and the Pendulum

Topics to be covered

Experiments and data:

- Collecting and analyzing data
- Expressing experimental results and other data using frequency bar graphs
- Planning and performing controlled scientific experiments
- Recognizing the phenomenon of measurement variation
- Working with the concept of period

Functions and graphs:

- Fitting a function to data using a graphing calculator
- Making predictions based on curve fitting
- Using function notation
- Using graphing calculators to explore the graphs of different functions

Statistics:

- Calculating the mean and standard deviation of data, both by hand and with calculators
- Developing concepts of data spread, especially standard deviation
- Distinguishing between standard deviation and sample standard deviation
- Learning about the normal distribution
- Making area estimates to understand the normal distribution
- Using standard deviation and the normal distribution in problem contexts
- Using standard deviation to decide whether a variation in experiment results is significant
- Working with symmetry and concavity in connection with the normal distribution and standard deviation

Pa Standards Citations

2.2A8, 2.2A11, 2.2A12, 2.2B1, 2.2B2, 2.2B6, 2.2C1, 2.2C2, 2.2C3, 2.2C4, 2.2E, 2.2F, 2.3A1, 2.3A3, 2.3C3, 2.3C4, 2.4A3, 2.4E4, 2.4E5, 2.5A1, 2.5A2, 2.5A3, 2.5A4, 2.5B1, 2.5B2, 2.5B3, 2.5B4, 2.5C1, 2.5C2, 2.5C3, 2.5C4, 2.6A1, 2.6C1, 2.6D2, 2.6D3, 2.6D4, 2.6I1, 2.6I2, 2.7B1, 2.7B2, 2.7B3, 2.7B4, 2.8A2, 2.8A4, 2.8B, 2.8L3, 2.8R, 2.8S, 2.8D4

IMP 1 May & June: Shadows

Topics to be covered

Algebra of proportions:

- Developing equations of proportionality from situations involving similar figures
- Developing informal procedures for solving proportions

Experiments and data:

- Collecting and analyzing data
- Planning and carrying out controlled experiments

Logical reasoning and proof:

- Formulating and refining conjectures
- Proving that vertical angles are equal
- Proving the angle sum property for triangles using the properties of parallel lines
- Working with the concept of counterexample in understanding the criteria for similarity

Parallel lines and angles:

- Discovering that vertical angles are equal
- Discovering the properties of angles formed by a transversal across parallel lines
- Rediscovering the angle sum properties of polygons

Right triangles and trigonometry:

- Developing formulas relating sine and cosine
- Using sine, cosine, and tangent to solve problems
- Learning standard terminology applied to right triangles, including hypotenuse leg, opposite, and adjacent
- Learning the right triangle definitions of sine, cosine, and tangent

Similarity and congruence:

- Applying properties of similar triangles to physical situations
- Developing intuitive ideas about the meaning of "same shape" and learning the formal definitions of similarity and congruence
- Discovering criteria for polygons to be similar and, in particular, for triangles to be similar
- Using scale drawings to solve problems
- Working with the concept of corresponding parts of similar figures

The triangle inequality:

- Discovering the triangle inequality
- Investigating the extension of the triangle inequality to polygons

Shadows

PA STANDARDS: 2.1A2, 2.1A4, 2.1A11, 2.2A8, 2.2B1, 2.2F, 2.3B1, 2.3C1, 2.3C4, 2.4A3, 2.4E5, 2.5A1, 2.5A2, 2.5A3, 2.5A4, 2.5B1, 2.5B2, 2.5B3, 2.5B4, 2.5C1, 2.5C2, 2.5C3, 2.5C4, 2.8D4, 2.8N5, 2.8R, 2.9B1, 2.9B2, 2.9B3, 2.9B4, 2.9B5, 2.9D1, 2.9D2, 2.9D3, 2.9D4, 2.9I, 2.10B4