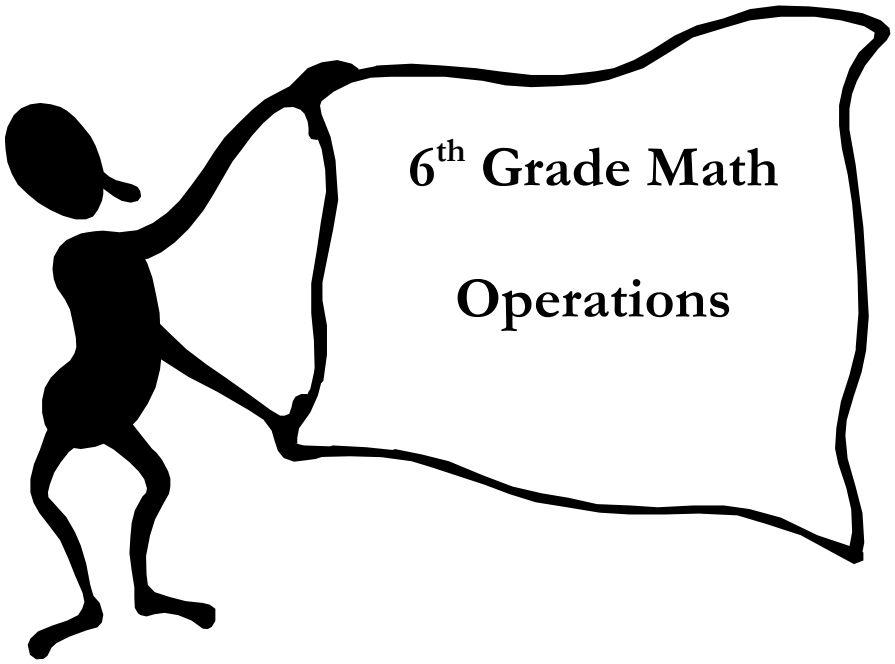
NEW YORK CITY DEPARTMENT OF EDUCATION
MAGNET PROGRAM DISTRICT 25 & 28

ASPIRES JHS 185

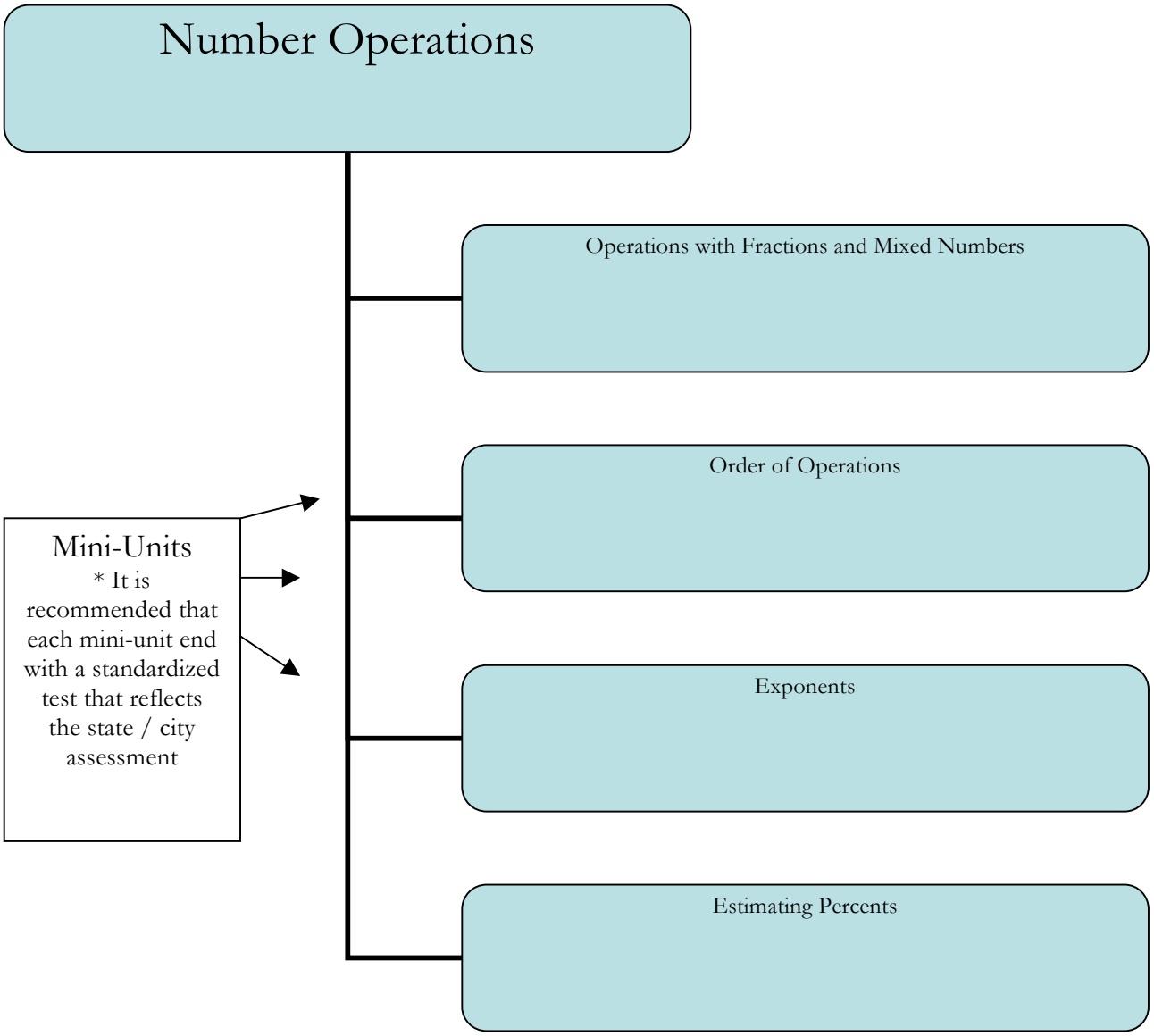


Essential Question: Why would our ability to design and build structures be limited if we did not have an understanding of fractions?
Suggested Time Frame: 5 weeks
Theme: Architecture and Construction

Graphic Overview of Unit

Suggested Time Frame: Five weeks

Essential Question:



Unit's Culminating Project: (briefly explain in 2-3 sentences):
Apply the concepts of fractions, decimals, percents, and exponents to create a construction company's purchasing plan for a new suspension bridge.

<table>
<tr><th colspan="2">Stage 1- Desired Results</th></tr>
<tr><td><u>Standards-Based Learning Goals:</u>
6.PS 3 Interpret information correctly, identify the problem and generate possible strategies and solutions
6.PS 7 Represent problem situations verbally, numerically, algebraically, and/or graphically
6.CM.2 Explain a rationale for strategy selection
6.CN.3 Connect and apply mathematical information to solve problems
6.CN.7 Apply mathematics to problem situations that develop outside mathematics in careers and areas of interest
6.N.16 Add and subtract fractions with unlike denominators.
6.N.17 Multiply and divide fractions with unlike denominators.
6.N.18 Add, subtract, multiply, and divide mixed numbers with unlike denominators.
6.N.19 Identify the multiplicative inverse of a number.
6.N.20 Represent fractions as terminating or repeating decimals.
6.N.21 Find multiple representations of rational numbers (fractions, decimals, and percents 0 to 100).</td><td>6.N.22 Evaluate numerical expressions using order of operations (may include exponents of two and three).
6.N.23 Represent repeated multiplication in exponential form.
6.N.24 Represent exponential form as repeated multiplication.
6.N.25 Evaluate expressions having exponents where the power is an exponent of one, two, or three.
6.N.26 Estimate a percent of quantity (0% to 100%).</td></tr>
<tr><th colspan="2">Concepts</th></tr>
<tr><td>Big Ideas for this Unit
<u>Continuance</u>
- We must be able to work with fractions and decimals, which form infinite steps in between the whole numbers.
<u>Interdependence and Relationships</u>
- In architecture and construction, quantities are interdependent—as one quantity changes (e.g. height of building), others must change as well (amount of concrete, steel, etc., or capacity).
- Relationships exist across different number systems, i.e. fractions, decimals, and percents, as quantities can be equivalently represented in each number system.</td><td>Magnet School Theme:
Architecture

How does the Big Idea in your unit connect to your theme?
Mathematical operations and the concepts of fractions, decimals, percents, and exponents will be applied in various architectural settings.</td></tr>
<tr><td>Enduring Understandings
Students will understand that quantities used in calculations often involve fractions.
Students will understand that procedures provide consistency. (Order of Operations)
Students will understand that multiple representations exist for individual quantities, and that each has its benefits and drawbacks. (Fractions, Decimals, and Percents)</td><td>Overarching Essential Question: (this question should connect to your school theme)
Why would our ability to design and build structures be limited if we did not have an understanding of fractions?</td></tr>
<tr><th colspan="2">Content and Skills</th></tr>
<tr><td>Content
Students will know…
- Unlike Denominators; Least Common Denominator; Simplest Form; Mixed Numbers; Multiplicative Inverse; Reciprocal Terminating Decimal; Repeating Decimal; Bar Notation; Improper Fractions
- Dividend; Divisor; Fractions, Decimals, and Percent Conversions
- Factors; Exponents; Base; Powers; Squared; Cubed; Standard Form; Exponential Form
- Numerical Expressions; Order of Operations; PEMDAS; Parentheses; Exponents; Multiplication; Division; Addition; Subtraction
- Part; Whole; Percent; Rounding; Estimation</td><td>Skills
Students will be able to…
- Identify the numerator and denominator of a fraction.
- Represent fractions with a common denominator.
- Represent fractions in simplest form.
- Add, subtract, multiply, and divide fractions.
- Add, subtract, multiply, and divide mixed numbers.
- Identify the arithmetic operation that is described in a verbal setting.
- Write numerical expressions from verbal expressions using the correct arithmetic operation.
- Identify the multiplicative inverse.
- Apply the order of operations to evaluate expressions.
- Represent quantities as fractions, decimals, and percents.
- Compare quantities in various forms.
- Evaluate formulas that include powers.
- Evaluate expressions containing powers.
- Identify the exponent and base of a power.
- Represent repeated multiplication in exponential form.</td></tr>
</table>

	- Explain the advantages and disadvantages of representing quantities in exponential form.

Stage 2- Summative Assessment Evidence

If students understand, know and are able to do the items in Stage 1, they should be able to show their understanding by completing an authentic task found in the world beyond the classroom.

- Focus:
  - Evaluate expressions containing fractions
  - Represent quantities as fractions, decimals, and percents

G- (goal)

The goal of this task is to create a detailed purchasing plan for a new suspension bridge connecting Manhattan and New Jersey.

R- (role)

The students will take the role of purchaser for the American Bridge Company, which is constructing the new suspension bridge.

A- (audience)

The purchasing plan must be submitted to the Port Authority.

S- (situation)

To alleviate traffic congestion on the George Washington Bridge, the Port Authority of New York and New Jersey is planning to build a new bridge to connect the two states.

P- (purpose and product)

The values used in the calculations described below will involve at least one non-whole number.

The Port Authority requires a detailed purchasing plan that indicates:

- Materials required (**Research** common bridge materials, or use teacher-provided list)
- Quantity of each material required (**Division**)
  - Calculations must be provided
- Cost of materials (**Multiplication**)
  - Three bids must be submitted, per unit and total cost, with calculations provided
  - How much would you save using the lowest bid, compared to the higher bids?
- How much material needs to be purchased (**Addition** and **Subtraction**)
  - Port Authority already possesses small quantities of each, but not enough
  - What percent of material still must be purchased (ESTIMATE)?
- Labor Costs
  - Construction rates provided.

Port Authority also requires rationale for building the new bridge.

- Research the major problems with the existing infrastructure.
  - How severe is the congestion on the George Washington Bridge?
  - Why is a bridge being built instead of a tunnel?
  - Why does the George Washington Bridge experience congestion, but the other crossings do not?

Student reflection

- Would you be able to create this purchasing plan without the knowledge of fractions?
- What other mathematical knowledge was crucial to the creation of this purchasing plan?

S- (standards for performance)

Accurately write and evaluate expressions containing fractions and mixed numbers.

Culminating Task
"New" George Washington Bridge Project

The Port Authority of New York and New Jersey operates the George Washington Bridge, a suspension bridge connecting New York City and New Jersey. Over the years, public outrage has been forming about the severe congestion on the George Washington Bridge. Drivers have waited through delays on the bridge routinely reaching two hours. Traffic accidents and scheduled bridge maintenance make the delays even worse.

You work for the American Bridge Company, a bridge construction company that wants the Port Authority to hire it to build a new bridge to help reduce the traffic problems on the George Washington Bridge. For a chance to win the contract, American Bridge Company must submit a proposal to the Port Authority. You are responsible for part of the proposal. Your part of the proposal shall consist of:

SECTION I: Rationale for building the new bridge.
- Research the major problems with the existing infrastructure.
  - How severe is the congestion on the George Washington Bridge?
  - Why is a bridge being built instead of a tunnel?
  - Why does the George Washington Bridge experience congestion, but the other crossings do not?

SECTION II: How many packages of each material are required to build the bridge? (**Division**)
- Asphalt for Roadway
  - 4760 feet long
  - 300 cubic feet of asphalt required per foot
  - Sold in 3 1/4 cubic feet packages
- Steel cable for Suspension Cables
  - 5335 feet required
  - Sold in 4 1/5 feet packages
- Steel beams used in roadway and towers
  - Height of towers: 600 feet each (total of two towers)
  - 35 4/5 tons of steel required for each foot
  - Sold in 1/2 ton packages
- Concrete for Anchorages
  - 110,000 cubic yards of concrete required
  - Sold in 3 1/5 cubic yard packages

SECTION III: What is the cost for each of the required materials? (**Multiplication**)
- Asphalt: $60.75 per 3 1/4 cubic feet package
- Steel cable: $48.50 per 4 1/5 feet package
- Steel beams: $64.80 per 1/2 ton package
- Concrete: $18.25 per 3 1/5 cubic yard package

SECTION IV: How many workers should be hired?
- The cost for labor, c, is given by the following equation: $c = 7 + 25(t^2 - \square \times t) \times n$
  - C = total cost; t = number of weeks working; n = number of workers hired
  - Complete the following table. Then, determine the number of workers that will result in the lowest cost.

t (weeks)	n (workers)	$c = 7 + 25(t^2 - \square \times t) \times n$
50	200	
62½	160	
75	120	
87½	80	

SECTION V: How much material needs to be purchased? (**Addition** and **Subtraction**)
- How many packages of each material does the Port Authority have?
- What percent of required material does the Port Authority have (**Estimate**)?
- How many packages of material does the Port Authority need to purchase, and how much would it cost?
- The Port Authority already has:
  - Asphalt: 9,000 cubic feet
  - Steel Cable: 2,000 feet
  - Steel Beams: 20,000 tons
  - Concrete: 32,000 cubic yards

SECTION VI: Students present the plan in a gallery walk.
Students write their reflections on;.
- Would you be able to create this purchasing plan without the knowledge of fractions?
- What other mathematical knowledge was crucial to the creation of this purchasing plan?
- Students discuss their reflections with their classmates in pairs or in a group.

CULMINATING PROJECT RUBRIC

	LEVEL 4	LEVEL 3	LEVEL 2	LEVEL 1
PACKAGE CALCULATIONS	The numbers of packages required are all correctly calculated. Work is shown completely.	The numbers of packages required are mostly correctly calculated. Work is mostly shown.	Some of the numbers of packages required are correctly calculated. Some work is shown.	The numbers of packages required are not correctly calculated. Work is not shown.
COST CALCULATIONS	The costs for packages required are correctly calculated. Work is shown completely.	Most costs for packages required are correctly calculated. Most work is shown.	Some costs for packages required are correctly calculated. Some work is shown.	The costs for packages required are not correctly calculated. Work is not shown.
PERCENT CALCULATIONS	The percentages are calculated correctly. Work is shown completely.	Most percentages are calculated correctly. Most work is shown.	Some percentages are calculated correctly. Some work is shown.	All percentages are calculated incorrectly. Work is not shown.
VERBAL ELEMENTS	Problems and solutions are discussed thoroughly. Student consistently makes connections between different disciplines, past and present, cause-effect relationships.	Problems and solutions are discussed somewhat thoroughly. Student mostly makes connections between different disciplines, past and present, cause-effect relationships.	Problems and solutions are not discussed thoroughly. Student sometimes makes connections between different disciplines, past and present, cause-effect relationships.	Problems and solutions are not discussed thoroughly. Student does not make connections between different disciplines, past and present, cause-effect relationships.