Using meaningful engaging projects to differentiate instruction
NCTM, 2023

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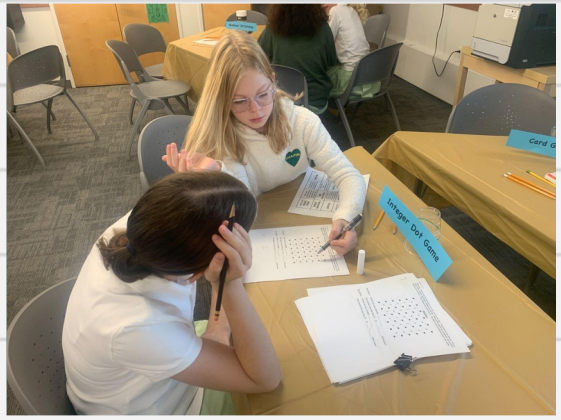

Differentiated Instruction

"Process through which teachers enhance learning by matching student characteristics to instruction and assessment. ... Teachers can differentiate content, process, and/or product for students.

Tomlinson, 1999

Using meaningful engaging projects to differentiate instruction!
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We embrace the diversity of our students' strengths, interest and learning styles..

Collaborative group projects that promote teamwork, communication skills, and an appreciation for the perspectives of others.

Individual activities: opportunities to pursue projects of their choice, allowing them to explore their passions and talents. This fosters a sense of ownership and motivation in their learning journey.

Do Nows/Warm-ups

Quick, independent, or collaborative activities that typically involves no (or minimal) guidance from the teacher.

Simplifying fractions

Mild

$$\frac{96}{80} =$$

$$\frac{15}{80} =$$

Medium

$$\frac{0.03}{9} =$$

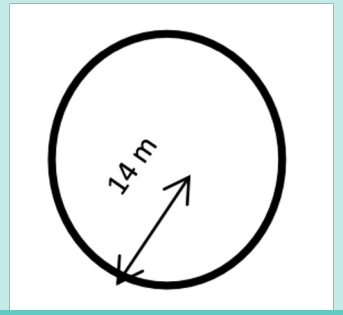
$$\frac{0.15}{1500} =$$

Spicy

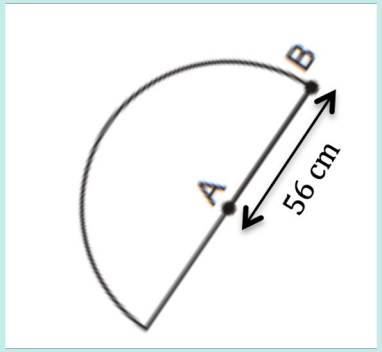
$$\frac{1 - \frac{1}{2}}{3} + \frac{1 - \frac{1}{4}}{3}$$

Area of Circles: Solve at least two problems. Use for $\frac{22}{7}$ for π

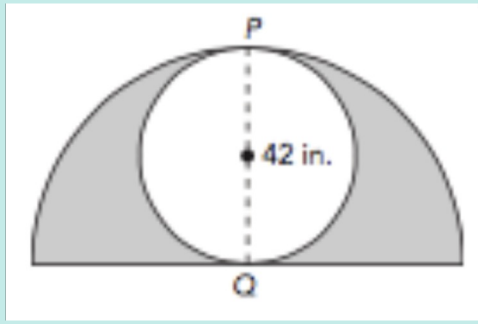
Find the area of the circle.



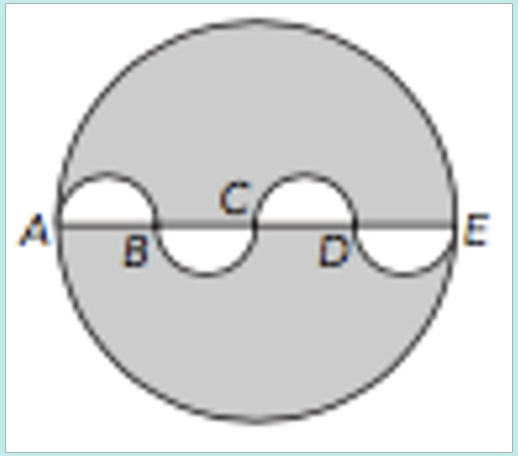
Find the area of the semi-circle.



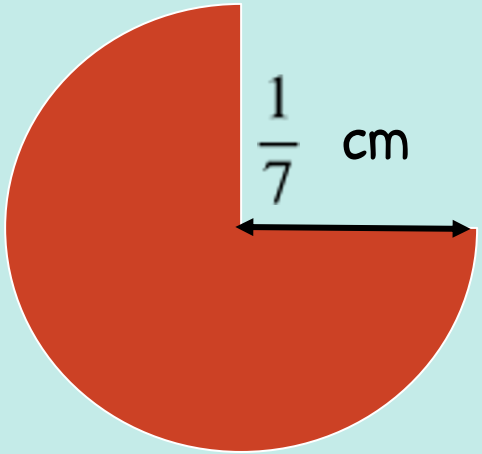
Find the area of the gray area.



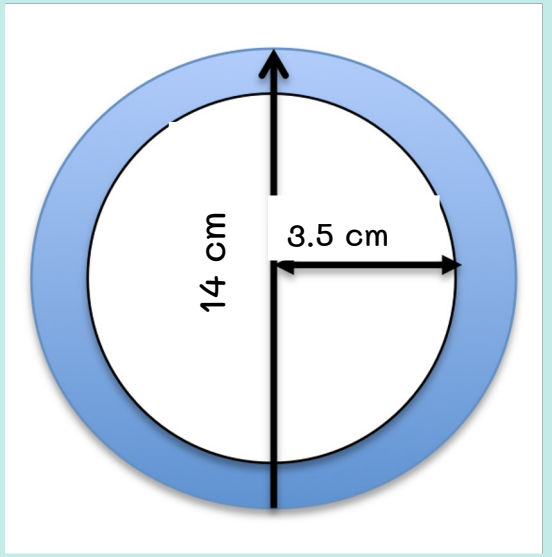
Find the shaded area AC = 7 cm



Find the area of the red shape



Find the area shaded in blue



Independence Practice

1) Individualized worksheets
2) Choice boards
3) Order of operations about me short project
4) Problem-solving portfolios
5) Probability scavenger hunt
6) Geometry Portfolio

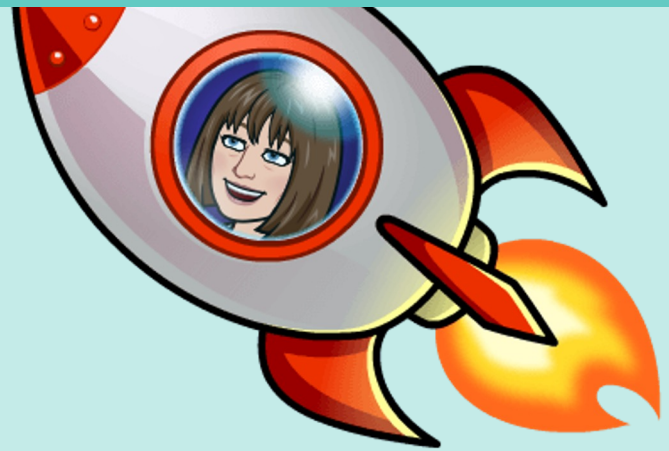
Suggestions:

- Guide students to select
- Assign/let them choose partners
- Have a teachers' table
- Have solutions available

Fractions Lesson 1

Medium
Simplifying fractions
Check your answers
Desmos Activity

Spicy
Simplifying fractions
Check your answers
Desmos Activity



Habanero spicy
(after you finish option B)

Mild

1. $\frac{4}{8} =$ _

3. $\frac{46}{60} =$

Medium

1. $\frac{30}{84} =$ _

3. $\frac{12}{400} =$

Spicy

1) $\dfrac{4}{\frac{3}{4} - \frac{3}{2}}$

Area Practice

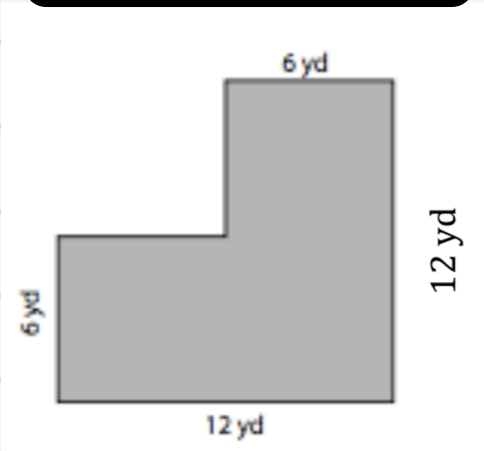
Compound Shape Level 1

Compound Shape Level 2

Compound Shape Level 3

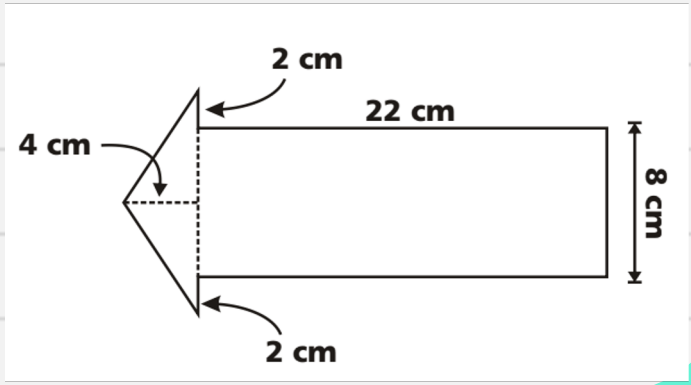
Links to answers on the next page

Mild



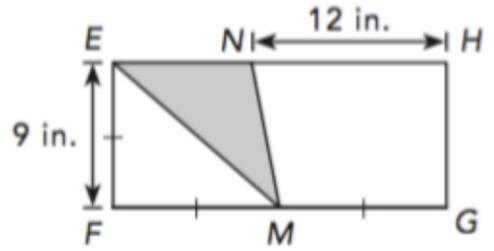
Medium

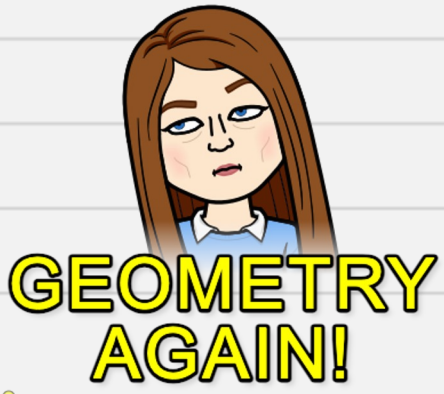
Find the area of the compound shape



Spicy

Figure *EFGH* is a rectangle. Point *M* is the mid-point of $\overline{FG}$.
If *EF* = *FM*, what is the area of triangle *EMN*?





Order of operations about me project

In this project, you will be creating a poster that represents different things about you. Since this is math class, you will be doing this with numbers!

Adapted from mrssidotimath

THE MONTH YOU WERE BORN: Write a numerical expression to represent the month you were born. **Include an exponent.**

FAMILY MEMBERS: Write a numerical expression to represent the number of family members you have living in your home. Include an exponent.

SHOE SIZE: Write a numerical expression to represent the size shoe you wear. You must use parentheses.

YOUR AGE: Write a numerical expression to represent how old you are. Include subtraction.

YOUR FAVORITE SEASON: Write a numerical expression represent your favorite season. Your value (answer) should equal the number of letters in your favorite season. Include multiplication.

FAVORITE HOLIDAY: Write a numerical expression to represent your favorite holiday. Your value (answer) should equal the number of letters in your favorite holiday. **Include division.**

CREATE YOUR OWN: Write a numerical expression to represent something unique and special about you. **Include brackets.**

Problem Solving Portfolios

A.	Rewriting the question in sentence form, leaving a space for the answer	1 point
B.	Using correct math methods and showing clear, organized work	4 points
C.	Getting the correct answer	3 points
D.	Working independently	2 points

1) The ratio of seeds to nuts to dried fruit (by weight) in a bag of trail mix is 2:5:4. There are 9 more ounces of nuts than seeds. What is the total weight of the trail mix?

2) Cheryl decided to create a flowerbed in front of her house. One-half of her flowerbed is planted with pink tulips. She plants three-fourths of the rest of the ground with purple iris. After that, she plants orange marigolds in one-half of what remains. The rest of the garden is planted with red gladiolas. What fraction of her garden is planted in red gladiolas? HINT: draw a picture.

3) The largest prime number currently known is of the form 277,232,917 – 1; in other words, it is one less than 2 multiplied by itself 77,232,917 times. This prime number is 23,249,425 digits long! Suppose I want to write this number out on one super long strip of paper (without commas). Using a 12-point font, 12 digits are one inch long. About how many miles of paper would I need to write the full number? (You can round your answer to the nearest whole number.)

Probability Portfolio

1) Which is more likely to occur in one trial? Drawing an ace or a spade in one draw or rolling a 2, 3, 7, or 11 with an ordinary pair of dice? **(3 points)**

1) What is the probability that if three cards are drawn from an ordinary deck of cars, no two will have the same value or will be the same suit? **(5 points)**

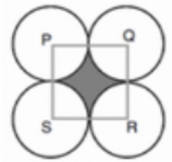
1) Assume that the probability of Artis Gilmore making a free throw is ¾. He is fouled and given three attempts to make 2 points (if he makes the first two shots, he does not try a third shot). What is the probability that he will score two points? **(5 points)**

Geometry PSP

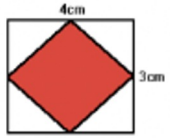
16) The diagram shows four touching circles. Each circle has a radius of 34 cm. P, Q, R, and S are centers of the circles and PQRS is a square. (S)

a) Find the perimeter of the shaded area

b) Find the area of the shaded area.



17) Find the area of the red square. The square was made by connecting all the mid-points of the sides of the rectangle. (M)



18) The side of the pentagon measures 8 cm. The heights of each of the triangles inside the pentagon measures 3 cm. Find the area of the shape. (S)

19) There are 3 circles:
A = the largest
B = the middle
C = the smallest

Circle A has a diameter of 20cm. The smaller circles are drawn so that the radius of Circle A is the diameter of Circle B, and the radius of circle B is the diameter of Circle C. What is the area of circle C? (S)

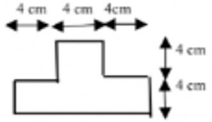
20) In a quadrilateral ABCD, angle A is 120 degrees, angle D is two thirds of angle C, and angle B is 90 degrees. Find angle C. Hint: Draw a picture. (S)

21) Find the area of the shape. (M)

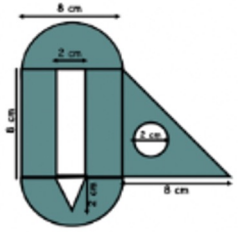
22)

a) Find the perimeter of the shape.

b) Find the area of the shape. (M)

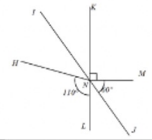


23) Find the shaded area: (S)

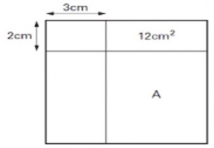


24) Investigate the Pythagorean Theorem. Explain it and show examples with answers. (S)

1) The figure is not drawn to scale. IJ and KL are straight lines. Find∠HNJ. (S/M)

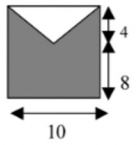


2) Find the area of square A. (M)



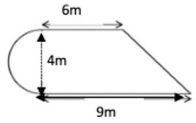
3)Create 8 shapes, all with an area of 12 square inches. Make sure you have a variety of shapes (not just rectangles and squares). (M)

4) Find the shaded area. All measurements are in centimeters. (M)



5)This cube is made up of little cubes. I painted all the outside faces of this big cube and I pulled it apart. How many little cubes have 0 faces painted? 1 face painted? 2 faces painted? 3 faces painted? (M)

6)A house has a pool with the shape as shown. They want to make a cover for. How much to the nearest cent are they going to have to spend on material if it costs $5.00/$m^2$. (S)



7) The area of one side of the box is 120 cm^2. The area of another side of the box is 72 cm^2. The area of the top of the box is 60 cm^2. What is the volume of the box? (S)

8)Create a multi-panel cartoon in which 4 parallelograms explain how they know that they are parallelograms. Include different types of parallelograms. (M)

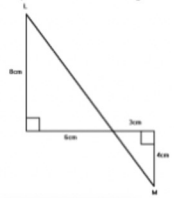
9)Practice 3 IXL skills from 6th grade geometry. Go to FF and start at skill 11. (M)

10) Create a math worksheet **with area problems**. Include 5 multiple choice questions and 3 short answer questions. Provide a solution key. (M)

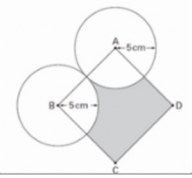
11) The length of a rectangle is four times as long as its width. The area of the rectangle is 100 meters squared. What are the dimensions of the rectangle? (M)

12) Make a presentation explaining the sum of angles of polygons. Extend your knowledge beyond triangles and quadrilaterals. (M)

13) Find the length of side LM. (S)



14) Find the shaded area. (S)



15) The points A, B, C, D, and E are located on a straight line in order. The distance from A to E is 20cm.The distance from A to D is 15cm. The distance from B to E is 10cm. C is halfway between B and D. What is the distance from B to C? Hint: Make a picture. (M)

Projects

1) They last more than one class period
2) They are open-ended
3) They have different entry points - same skill/content

What to include in a project

1) **Student Directions:**

   Description of the project

   Steps

   - As brief as possible
   - Direct/specific (as in how many slides you want).

1) **Time frame** (what to do each day - write that on the board during the project)
2) **My own example of the project** (doing the project yourself first is a must!)
3) **Rubric**
4) **Answer key if appropriate**

1) Integer choice (rational numbers)
2) Invention project (statistics)
3) Kids for a Cause (ratios)
4) Forgotten mathematician (geometry)
5) Instead of Project (number sense)
6) Fermi project (number sense)
7) Linear functions/exponential functions (algebra)

Integer Choice Project

A culmination of a unit on Integers.

Students, working in pairs, choose one or two projects to complete.

Students can propose a new choice to work on.

1) A, B, C, D, and E correspond to points on a thermometer. Use these clues to plot the points: **First problem:** B and D are negative D is warmer than C B is warmer than C E and D are the same distance from 0. E is colder than A. **Second problem:** A is warmer than C E is colder than B Eand F are the same distance from 0 D and C are negative B is positive A is the warmest D is closest to 0 *Part 2:* Create your own thermometer problem and include the answer.	2) Identify three real-life situations where integers could be used to convey information. Create a word problem using each situation. Negative numbers must appear in all three problems. You may base your situations on stories that appear in the news. Include your answers to the problems.
3) Create a 4 x 4 Magic Square where each row, column, and diagonal adds to –7. Each row and each column cannot repeat any integers. **You might have to first research magic squares.**	4) Solve the whodunnit puzzle and create a whodunnit puzzle for your friends.
5) Create a 10-problem quiz on four operations with Integers. Make sure you include an answer key.	6) Write a narrative story or comic strip that uses integers and operations with integers as part of the plot. Negative numbers must appear!

Invention Project

Students:

- Create: an app, a product, etc.
- Conduct a survey to test the viability of their invention
- Summarize and draw conclusions from the results of their survey through all the statistical tools learned in this unit.

Think about what you are going to invent! What will it do? Who is your audience? How will you get people excited about your idea? Your invention should be something that will make this a better world!

1) **Invention:** Describe in detail what your invention does and why we need it.

1) **Survey:** Create 5 survey questions based on your invention.
   Four of your questions should generate numerical data
   One of the questions your answers should be able to be grouped in interval.
   One of your questions should generate categorical data

3) **Data Collection:**

   Survey 10-15 people in your class about their opinions on your product and record their answers.
   Organize your data in a Google Sheet.

4) **Summarize data:** calculate measures of central tendency

5) **Graphs:** create different graphs using Google Sheets and Desmos.

6) **Conclusion:** examine and reflect over your invention and use the answers to your survey questions to improve your invention.

Kids for a Cause Project

Pick a cause and use rates and ratios to communicate the urgency of your cause.

A) Explain why your cause is important

B) Include the original rate related to time.

C) Calculate two Equivalent Rates

D) Add a Visual Aid

Food waste example

Original Rate:

In 2010, in the USA we threw away 133,000,000,000 lbs of food.

Equivalent rates:

We will be throwing away about 364,383,561 pounds of food each day.

We will be throwing away about 15,182,648 pounds of food in an hour.

Visual Aid:

15,182,648 pounds of food each hour - is equivalent to the weight of about 1,500 African elephants!

Forgotten Mathematician Project

Most of us heard of Pythagoras or Descartes, the mathematicians behind right triangles and the Cartesian math. But have you heard of Sofia Kovalevskaya or Benjamin Banneker? Through this project you will create a monument to honor a mathematician of your choice whose important contributions to the field of mathematics is not known by the general population.

PART 1 - Group

- Monument must include at least 3 different 3 dimensional shapes

  A written description explaining the overall design of your monument including all of the shapes used and accurately named.

  A short paragraph explaining why we should honor your mathematician. Discuss the contributions of your honoree to the field of mathematics.

PART 2 - Individual piece - Calculations

The exact surface area of one shape must be calculated.

- The exact volume of a different shape must be calculated.

Instead of Project

Day 1:

1) Pick a cause to support. Research and ensure you can determine the specific financial needs to support your cause.
2) Decide what fraction of the current military budget ($740 billion) you want to allocate.

Day 2:

1) Determine how much money will be needed for your cause.
2) Provide all calculations that helped you arrive at your answer.
3) Create your slide presentation.

Final product: 3+ slides

1) Your cause and the money you are spending (name the fraction or percent of the military budget)
2) All calculations
3) Sources

Fermi Project

Goal of the project: to use number sense, operations, and critical thinking to create and answer an interesting Fermi Question. Fermi questions can be answered by making estimates and assumptions. Answering a Fermi question requires the use of critical thinking skills and rough estimates.

Examples of Fermi questions:

- "How many piano tuners are there in New York City?
- "How many watermelons fit inside the Vatican?"

Your project should include:

1) A question that is of interest to you.
2) A question which to be able to solve you need to make **assumptions** (like how often people get their pianos tuned).
3) A question that to requires at least 4 steps to solve

Linear Functions Project

Process:

1) Group class Wave experiment
2) Students design their own linear experiments
3) Students collect data and use their data to make predictions

Student Work includes:

- Table of values
- Interpretation of slope and y-intercept in the context of their experiment
- Equation and graph of the line of best fit.
- Predictions using the line of best fit.

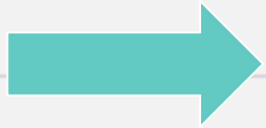
Exponential Functions Project

1) Students create a story that involves an exponential function.
2) Students pose a question related to their story. For example, "When will the population reach 20,000?
3) Students come up with the function that will model the situation, and explain each component of their equation.a
4) Students use a spreadsheet to model and graph their situation.
5) Students answer their original question.

Suggestions

1) Start small - one project this year!
2) Email us if you have any questions regarding implementation.
3) Focus on the process not the output.
4) Have fun! That means you and your students!

- QR Code for this presentation



- Handouts are in a google folder
- Everything on my blog

Maria and Fanny