Hello Students,

This resource packet includes a project that you can work on independently at home. You should also have project packets for some of the other courses you are enrolled in. Each project can be completed over multiple days, and the projects can be completed in any order. These projects are standards-aligned and designed to meet the Remote Learning instructional minutes guidelines by grade band.

High school project packets are available for the following courses:

- English 1
- Algebra
- Biology
- US History
- English 2
- Geometry
- Chemistry
- World Studies
- English 3
- Algebra 2
- Physics
- Civics
- English 4

Additional enrichment activities are also available and organized into Read, Write, Move, Design, and Solve categories to engage you in learning in many different ways while at home. Please be sure to also pick up an enrichment packet for access to these activities.

Use the table of contents on this page to navigate through the project packet.
HS Algebra 1 Project: The Best Deal

Estimated Time
~225 minutes

Grade Level Standard(s)
A-CED.A.2-3: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Caregiver Support Option
Caregivers can offer support in checking values for accuracy and reading/discussing interpretations of variables and situations.

Materials Needed
Pencil, paper, straight edge (ruler, ID card, edge of a book), calculator (optional)

Question to Explore
How do you determine the best deal? Is the best deal for you the same as the best deal for someone else?

Student Directions
In this project you will interpret situations, comparing costs, and determine the best deal for yourself. Unless otherwise indicated, use a separate sheet of paper for your responses.

Activity 1: Interpreting and Writing Equations
Read each situation carefully. Then interpret the mathematical expressions or create your own to match the story. Remember to define your variables if they are not given.

Jada has $20 to spend on games and rides at a carnival. Games cost $1. Rides are $1 each.
A. If Jada spent all of her money, which equation represents the relationship between the number of games, \(x\), and the number of rides, \(y\)?
   a. \(x + y = 20\)  
   b. \(2x + y = 20\)  
   c. \(x + 2y = 20\)
B. Explain what each of the other two equations could mean in this situation.

Here are some letters and what they represent. All costs are in dollars.
- \(m\) represents the cost of a food ticket.
- \(n\) represents the number of game tickets.
- \(s\) represents the cost of a game ticket.
- \(t\) represents the total spent on tickets.
C. What does each equation mean in this situation?
   a. \(m = 7.50\)  
   b. \(m = s + 4.50\)  
   c. \(ns = 6\)  
   d. \(m + ns = t\)
D. Write a new equation that could be true in this situation.

Write an equation for each situation. Remember to define your variables!
E. Games and rides cost $1 each and the student is spending $20 total on them.
F. Games cost $2.50 each and rides cost $1 each. The student is spending $15 total on them.
G. Games cost $1 each and rides cost $4 each. The student is spending $28 total on them.
Activity 2: Connecting Equations to Graphs
These equations represent the relationship between the number of games, $x$, the number of rides, $y$, and the dollar amount a student is spending on games and rides at two different amusement parks.

- Equation 1: $2.50x + y = 15$
- Equation 2: $x + 4y = 28$

For each equation answer the questions and draw their graphs on the grids provided.

A. Equation 1: $2.50x + y = 15$
   a. What is the number of rides that the student could ride if they don’t play games? On the coordinate plane, mark the point that represents this situation and label the point with its coordinates.
   b. What is the number of games the student could play if they don’t ride any rides? On the coordinate plane, mark the point that represents this situation and label the point with its coordinates.
   c. Draw a line to connect the two points you’ve drawn.
   d. Complete the sentences: “If the student did not play any games, they can ride ______ rides. For every additional game that he student plays, $x$, the possible number of rides, $y$, _________________(increases or decreases) by ______.”
   e. What is the slope of the graph? Where does the graph intersect the vertical axis?
   f. Rearrange the equation to solve for $y$.
   g. What connections, if any, do you notice between your new equation and the graph?

B. Equation 2: $x + 4y = 28$
   a. What is the number of rides that the student could get on if they don’t play games? On the coordinate plane, mark the point that represents this situation and label the point with its coordinates.
   b. What is the number of games the student could play if they don’t get on any rides? On the coordinate plane, mark the point that represents this situation and label the point with its coordinates.
   c. Draw a line to connect the two points you’ve drawn.
d. Complete the sentences: "If the student did not play any games, they can get on ______ rides. For every additional game that he student plays, \( x \), the possible number of rides, \( y \), ________________ (increases or decreases) by _______."

e. What is the slope of the graph? Where does the graph intersect the vertical axis?

f. Rearrange the equation to solve for \( y \).

g. What connections, if any, do you notice between your new equation and the graph?

C. Now graph both equations on the same coordinate grid. Then answer the following questions.

a. If you do not want to play any games and only go on rides, which amusement park would you choose? Why?

b. If you do not want to go on any rides and only play games, which amusement park would you choose? Why?

c. After how many rides and games are the two amusement parks going to cost approximately the same amount? What point on the graph represents this situation?

So far you have written equations, interpreted equations, graphed equations and used equations to answer questions about attending a carnival. Now, you will take all of those skills and apply them to another situation: determining which heating system is the most beneficial and cost-effective.

**Activity 3: A New Heating System**

A homeowner wants to replace their old heating system. Energy is measured in kilowatt-hours (kWh). It takes about 11,700 kWh of energy to heat the house for the winter. The current heating system uses natural gas and is 60% efficient, which means that for every 100 kWh of natural gas it uses, it produces 60 kWh of heat. With the homeowner’s current system, it costs $975 to heat the house. Assume that natural gas costs $0.05/kWh and electricity costs $0.21/kWh.

The homeowner also has an air conditioner that uses 2,500 kWh of electricity per year and produces 290 kWh of cooling for every 100 kWh it uses. They also have a water heater that uses 4,300 kWh of electricity per year and produces 90 kWh of heat for every 100 kWh it uses. These systems could also be replaced if there is a cheaper option, but it isn’t necessary.
Here are three other types of heating systems the homeowner could replace their current system with:

- A new furnace which also runs on natural gas and is more efficient. For every 100 kWh of natural gas it uses, it produces 95 kWh of heat. This system costs $5,000 to install.
- A geothermal heat pump. This system uses electricity instead of natural gas, but it produces 4 kWh of heat for every 1 kWh of electricity it uses. It costs $14,000, but it’s very low-maintenance and it also replaces the air conditioner and water heater.
- A grid-tied solar array. This system is connected to the electrical grid so that when it generates more energy than the house needs, the extra electricity can be sold back to the grid. Over the whole year, the house will use as much electricity as is sold back, which means the homeowner would basically be heating and cooling the house for free. It costs $16,000 to install.

Determine how much money is spent over the year for the gas and electric to run the heating system, air conditioner, and water heater.

A. Air Conditioner

<table>
<thead>
<tr>
<th>290 kWh</th>
<th>x kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Produced</td>
<td>Total Produced</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>100 kWh</th>
<th>2,500 kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Used</td>
<td>Total Used</td>
</tr>
</tbody>
</table>

\[
\frac{290 \text{ kWh}}{100 \text{ kWh}} = \frac{x \text{ kWh}}{2,500 \text{ kWh}}
\]

\[
7,250 \text{ kWh} = x
\]

B. Water Heater: Using the example above, determine how many kWh are produced to run the water heater for the year.

<table>
<thead>
<tr>
<th>_____ kWh</th>
<th>x kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Produced</td>
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</table>

C. Total kWh of electricity used: 7,250 kWh + _____ kWh = _____ kWh
Cost for electricity used: _____kWh □ $0.21/kWh = _____
For the three alternate heating systems identify the cost for installation (use the steps above) and determine how much money would be saved each year. Then write an equation to represent each situation.

D. A new furnace
   a. Cost for installation: ____________
   b. Savings per year: ____________
   c. Equation: _____________________

E. A geothermal heat pump
   a. Cost for installation: ____________
   b. Savings per year: ____________
   c. Equation: _____________________

F. A grid-tied solar array
   a. Cost for installation: ____________
   b. Savings per year: ____________
   c. Equation: _____________________

G. Which system would you recommend?
   a. Make a graph to convince the homeowner to switch to this system.
   b. How long will it take to save as much money as the new system cost?
Activity 4: Reflection

1. How can we use equations and graphs to make decisions about our finances?
2. Do you think the best decision for you is the same as the best decision for someone else? Why or why not?
3. Is it easier to compare two or three situations algebraically (with equations) or geometrically (with graphs)? Why do you think that method is easier?

Cross Content Connection:

Economics/Science: Each month the amount of gas and electricity used is compared to the month and year before. Customers receive monthly statements that show how much gas or electricity they used. That amount is compared to last month and the same month the previous year.

1. Last year the average temperature in Chicago in March was 32°F. This year the average temperature in Chicago in March was 39°F. How do you think that affected one’s gas bill from last year to this year?
2. This year more people were home in March due to the CoronaVirus (COVID-19). Do you think that affected the gas or electric bill more? Explain your reasoning.