Community Garden Design Challenge

A school just agreed to donate some of its field area to design a community garden. The school is looking for young engineers and mathematicians who can help design the garden. Your challenge is to design a model of the garden using 3D Pop-ups to represent the vegetables. The garden model must be no larger than 5400 square cm (60 x 90 cm). It must contain at least four equally spaced rows of vegetables and no more than five equally spaced rows with a minimum plant width of 1 cm. There can be no more than 32 total plants in the garden, and no less than 20. The vegetables must be planted with the tallest to shortest, with the tallest planted in the back row. The garden must contain the following vegetables listed in descending order: Corn, tomatoes, squash, zucchini and carrots. Tomatoes, being the second tallest crop and must be planted in the row before the back row, is 16.5 cm. high. Since no vegetable should overshadow another, the different vegetables' heights must be in proportion to one another. The ratio is 7: 5.5: 4: 2.5: 1. You must complete the challenge within ten class periods. The school's principal is looking for the garden that will yield the most vegetables to feed those in need in the community. Regardless of how much money you spend, your garden will be judged by the final cost per vegetable grown in your garden. Having the most amount of vegetables using the least amount of money is beneficial. Buying vegetables which you do not plant is not beneficial. You will receive $50 from the Community Garden Fund to purchase your plants. The only materials provided will be cardstock for the plants, glue sticks and a 60 cm x 90 cm foam core board for each group.

A Design Portfolio- The Community Garden Design

Name _____

Date _____

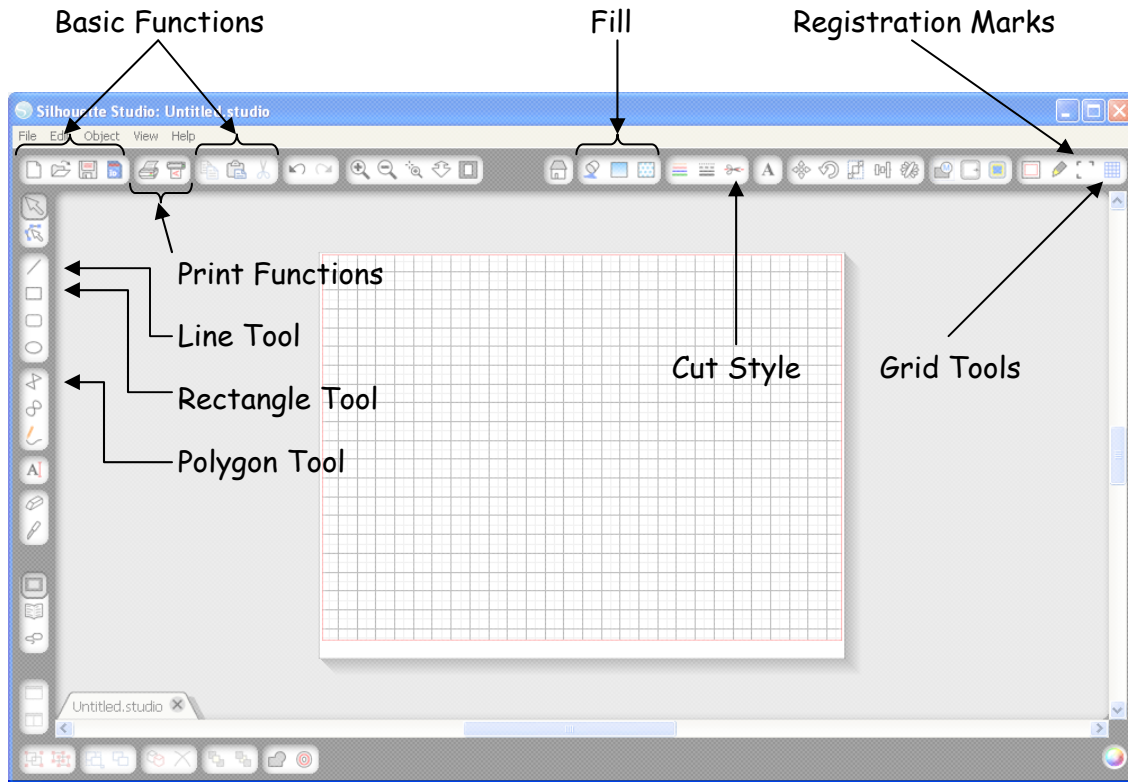In this design challenge, what is the problem you need to solve?

_____

_____

_____

_____

_____

_____

Specifications are the things that my solution must have or do. They are the project requirements. **Constraints** are things that limit my solution. For example, a **constraint** may be how much I'm allowed to spend, or how much time I have to complete the challenge.

Fill in the chart on the next page with the **specifications** and **constraints** for this challenge.

Specifications	Constraints

Community Design Challenge Scavenger Hunt

You should know beforehand how to use the following functions of the Silhouette Studio program. The diagram below points to their locations in the program. Most functions are intuitive, and require only a minute to understand.

Basic Functions   Fill   Registration Marks

Print Functions

Line Tool

Rectangle Tool

Polygon Tool

Cut Style   Grid Tools

- Basic functions: Open, Save, Copy, etc.
- Print functions: see below
- Grid Settings: Enable "Show Grid" and "Snap to Grid." A grid setting of 1cm with 2 divisions (i.e. 0.5cm) is simple to use, although you may choose to instruct students to use different settings as appropriate.
- Registration Mark Settings: "Show Reg Marks." It may be helpful to place these initially, as they slightly restrict cutting area.
- Select tool for moving whole objects, edit point tool for moving individual vertices
- Line tool and rectangle tool. NOTE: By default, lines do not print. Although they can be made to have thickness, we will use them only to define edges.
- Cut Style: Know to use "No Cut" for closed shapes, "Perforate" for folds. You must have the line or figure selected.
- Fill Color: Only works with closed polygons drawn using closed figure tools (i.e. not just a collection of lines). You must have the figure selected. NOTE: Fill Gradient and Fill Pattern work in the same manner.

Work with your team partners to find out the following tools in Silhouette Studio.

How do you create a shape that is 4 cm tall and 2 cm wide?

_____

_____

How do you color in a shape?

Place in Program: _____

How do I make and draw on a grid that is divided in half?

_____

_____

In fourths?

_____

_____

How about duplicating the same plant?

_____

_____

How tall can you make a pop up plant? How short? Why? Experiment on the Silhouette Studio.

Tallest plant is: _____

Shortest plant is: _____

How do you create a perforation (fold) in the Cut Style Window?

_____

_____

Where is the logical place on your plant to perforate?

_____

Where is the logical place on your plant to cut?

_____

Find three other features on the Silhouette Studio and list functions.

Features   **Functions**

1._____

2._____

3. _____

After analyzing the model pop-up plants, create a 2D pop up design on the Silhouette program. Print it out by using the following method: Press Print Screen button and save to a ms word doc entitled 2D design. Print out and label on that page how each part will fold and cut, list all dimensions and measurements in cm. Paste on the back of this page, with all labels.

Our findings: _____

_____

_____

_____

_____

KSB 1: Silhouette Studio Pop-ups

During the course of this exercise, you will create your garden using pop-ups that you make in Silhouette Studio. However, it won't do the work for you! You have to know what you want it to do.

Suppose you wanted to make a popup of a square flower with a stem. It might look something like this:

This is going to be the **face** of your plant. But just cutting it out right now wouldn't make it pop up. Examine the pop-up your teacher has provided.

Let's draw a few more lines, to create something that will. Let's also reveal the function of the lines.
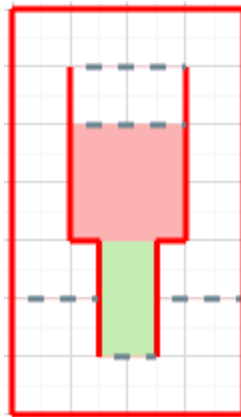
In this picture, there are three types of lines:
- Solid lines, that get **cut**
- Dashed lines, that get **perforated**
- Light gray lines, that form a **measuring grid**

Notice how the face has no fold or cut lines going through it, and how it is NOT being cut completely away from the base. Instead, when the paper is folded properly along the dashed lines, the face will "pop" out from the **base** which surrounds it. Since we don't want the whole piece of paper, we'll use a rectangle to define our base. Make a copy of the picture above and fabricate it, examining the cut and fold lines that result.

Now, let's have another look at that pop-up flower:
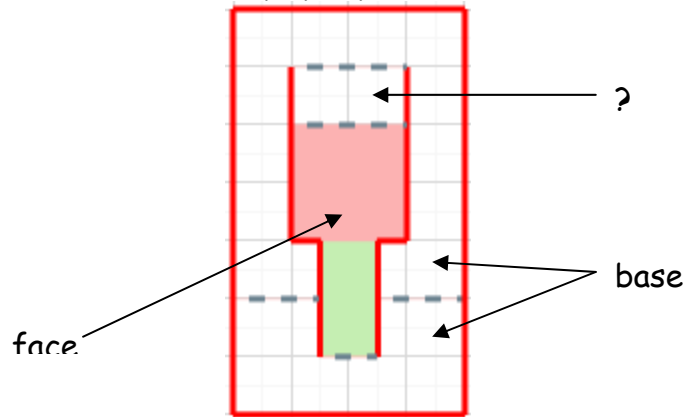
We have already identified two of the three parts to the pop-up, but what is that rectangle? It's the **riser**, used to push the top of the face away from the base. Why doesn't the bottom have one? Notice that the folds on the base (bottom) are one square apart. So too are the folds that form the riser. In this case, the **depth** of the pop-up is one square. **The folds that form the riser and the folds at the base must be the same distance apart, or else the pop-up won't work!** All fold lines must also all be **parallel**, and perpendicular to the height of the plant. Therefore, all lines parallel to the height (vertical) must be solid (cut).

It may help to visualize what parts will be upright (vertical) when popped out, and which are horizontal when you're done:
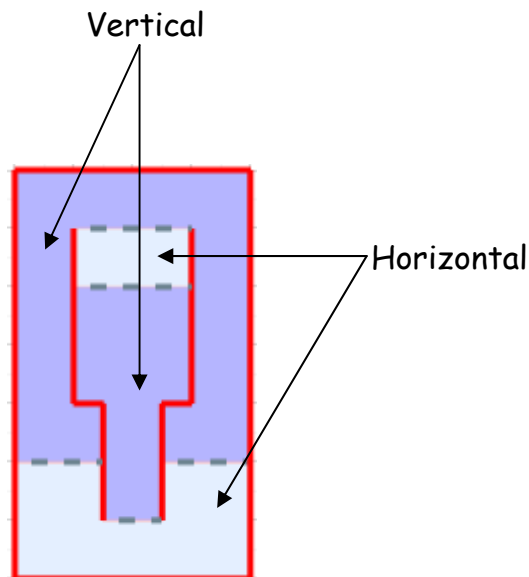
The **back** and the face (darker) will both be upright, while the riser and the **bottom** will be horizontal. In fact, **this is true for all pop-ups, regardless of size or shape.**

Do you always need to have the riser at the top of your face?
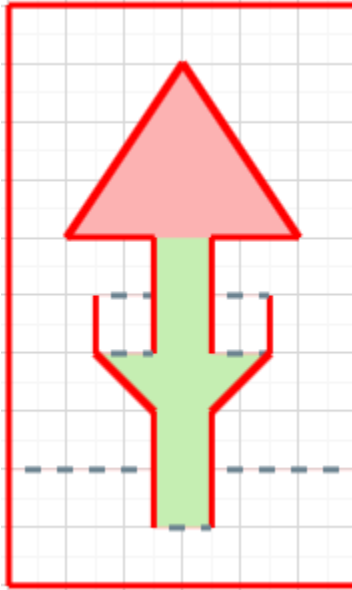
NO! The drawing above is also a valid pop-up. It has two risers (on the same plane) part-way up its stem. However, the risers are still the same depth (1 box) as the distance between the folds at the bottom. There will always be two folds at the bottom.
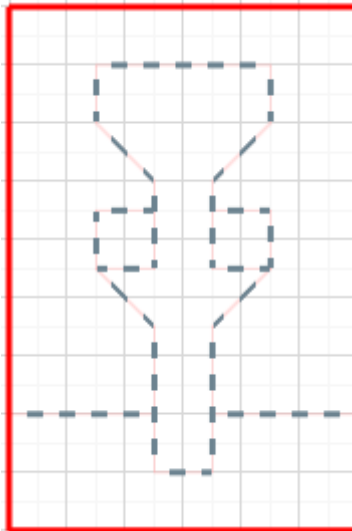
Now that you know a thing or two about pop-ups, answer the following questions:

1. Mark the pop-ups that **will not** work by writing an X on the line below. If the pop-up will work, identify its **depth** on the line. (One box=1cm)

_____ _____ _____ _____
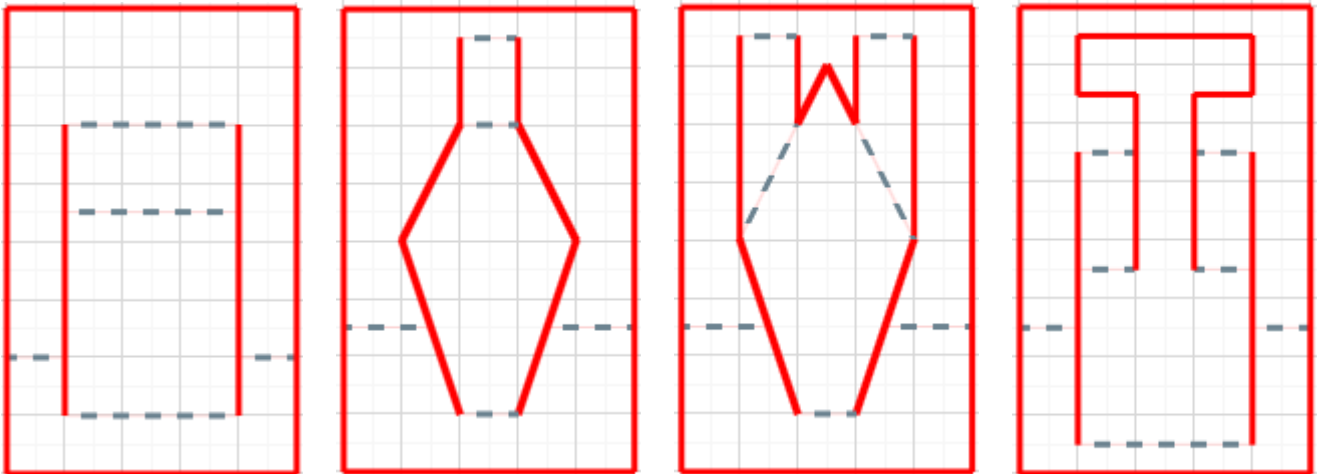
On the back of the paper, explain why any pop-ups don't work.

2. Examine the following drawing:

Depth: _____cm

Identify which fold lines need to be cut to make this pop-up work. Use your pencil or pen to make them solid. Then identify the depth on the line.

3. Imagine you wanted to make a pop-up with a triangular flower, and a narrow stem, like this:
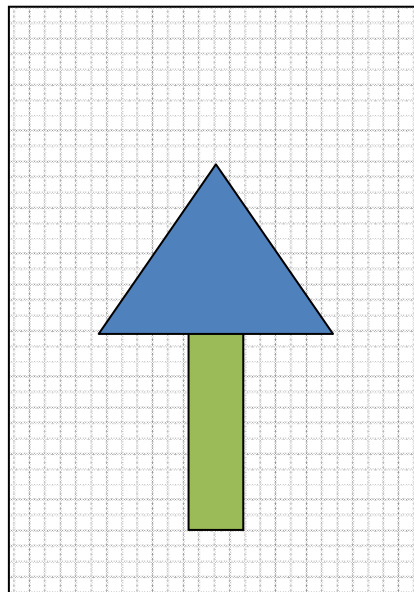
Depth: _____ boxes

Using what you've learned, draw around the shape to indicate where it should be cut (solid) and folded (dashed) to make a proper pop-up. Leave the triangular face intact. Label the depth of your pop-up on the line. Hint: You will not be able to create a riser unless you add area to either the rectangular or triangular face.

KSB 2: Ratio and Proportion

Consider the following <u>similar</u> rectangles:

| A | 5 cm |
| 12 cm | |

B   x

24 cm
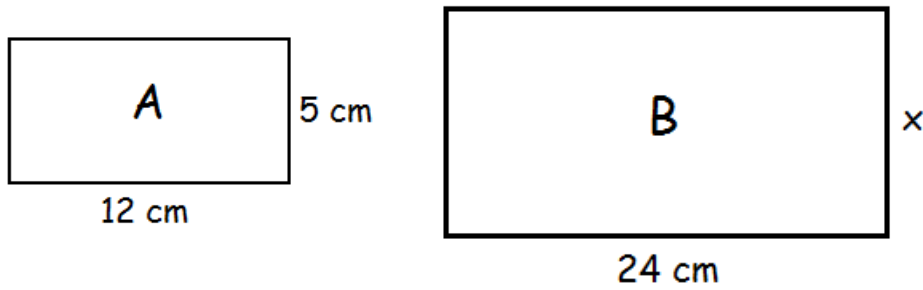
If you had to *give a calculated guess*, how long would you say height x is?
_____ cm

What reasoning did you apply? (e.g. did you think visually, did you compare different sides, did you guess).   Explain your thinking.

Since these rectangles are proportional to one another, how can we figure out the length of the unknown height of Rectangle B?

Proportions

Which sides correspond to one another? _____ and _____

_____ and _____

Let's use this information to set up our proportion.

$$\frac{12}{24} = \frac{5}{x}$$

$12x = 120$

$\frac{12x}{12} = \frac{120}{12}$ Now cross multiply:

$x = 10$ Then solve for x:

Is there another way to set up your proportion that would give you the same answer? Experiment in the space below.

Examples: Use a proportion to find the missing height. All shapes are proportional to each other. Be sure to show all work.

1)

5 m

12 m

x

36 m

Solution: _____

2)

7 in.

x

10.5 in.

6 in.

Solution: _____

3)

10.6 mm

4.1

21.2 mm

x
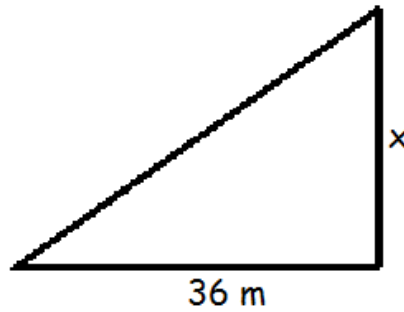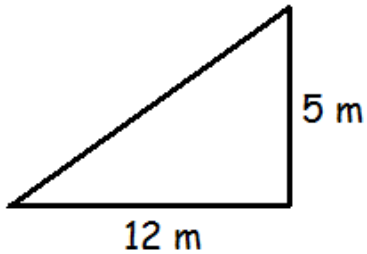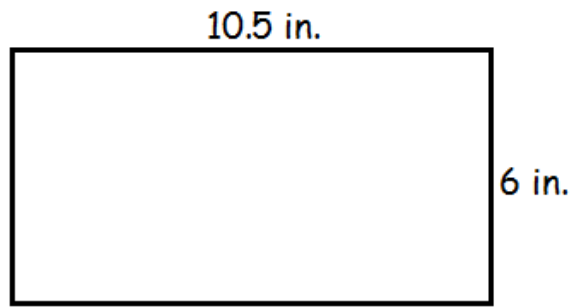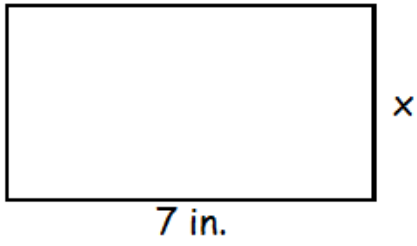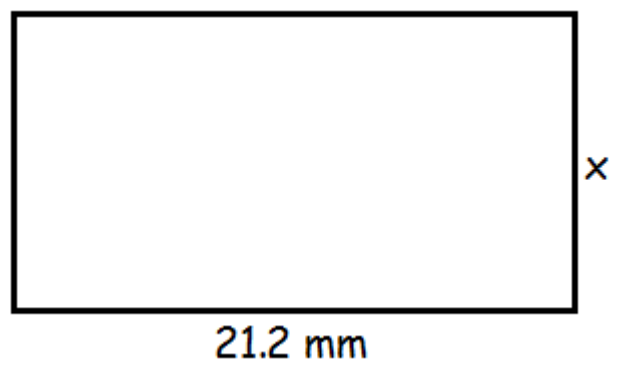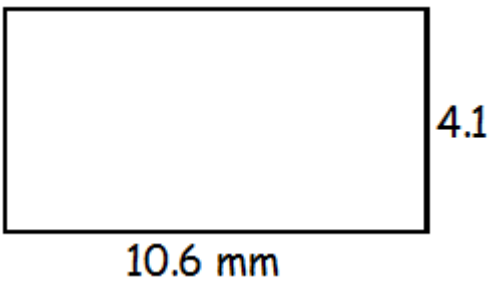
Solution: _____

4) Claire works at a florist and has been given strict instructions to trim 4 roses such that the height of the shortest stem is 12 inches, and each stem after that is 4 inches taller than the last. Using the space below, help Claire plan her actions by drawing a diagram of the roses. Using a ruler, draw each rose to scale such that 1 cm = 3 inches

Now let's take a look at a few more word problems.

Ratio Practice

1) Clark is trying out different types of plant food in his garden. He examines the heights of two different flowers in the garden and observes that the height of the shorter flower, Flower A, is 13.5 cm, and the heights of the flowers are in a ratio of 2.5 : 4. Using this information, determine the height of the taller flower, Flower B.   Use estimation to get an approximate answer and then use ratio and proportion to determine an exact answer.   Draw a diagram of your result.

Solution: _____

2) The ratio of the number of goals scored by two hockey players is 4 : 7. The player with the most goals scored 35. How many goals did the other player score?

Solution: _____

3) Olivia notices that there is ivy growing up the side of her house. There are three stems that are about to reach her window. The heights of the three different stems are in a ratio of 3 : 5 : 8. If the height of the tallest piece of ivy is 48 inches, find the heights of the other stems of ivy.

Solution: _____

4)   A tailor is adjusting the lengths of 4 pairs of pants for a very fussy customer. The customer left the tailor specific instructions, with the ratio of pant lengths being 4 : 5 : 9 : 11, and the length of the 2nd longest pair of pants being 36 inches. Help the tailor figure out how long the other pairs of pants must be in order to satisfy the customer.

Solution: _____

5)   The heights of five students in Ms. Roger's class are expressed in the ratio 1.3 : 4 : 6 : 8.4 : 10. The height of the shortest student is 39 inches. Find the heights of the other students.

Solution: _____

6)   Mr. Leonard, the school swim team coach, misplaced the race times for 4
      members of the swim team, but he does have the ratio of their times:
      2.7 : 5 : 6.3 : 8. The quickest time among the 4 swimmers was 35.1 seconds.
      Help Mr. Leonard by calculating the other swimmers race times.

Solution: _____

Tomatoes are the second tallest vegetable out of the five possible choices. They are 16.5 cm high. The ratio of the plants is
7: 5.5: 4: 2.5: 1 Set up and solve proportions to find the other heights of the veggies from tall to short (corn, tomatoes, squash, zucchini, and carrots)

Vegetable	Proportion Work	Height
Corn		
Tomato		16.5 cm.
Squash		
Zucchini		
Carrots		

KSB 3: Worksheet - Designing your Popups

In this exercise, you will design a popup of your own. The height of the popup must be 10cm, and the depth between 1cm and 3cm. You must use a triangle, square, or trapezoid as the "vegetable," and a stem. Begin by drawing only the face below. Include all measurements.
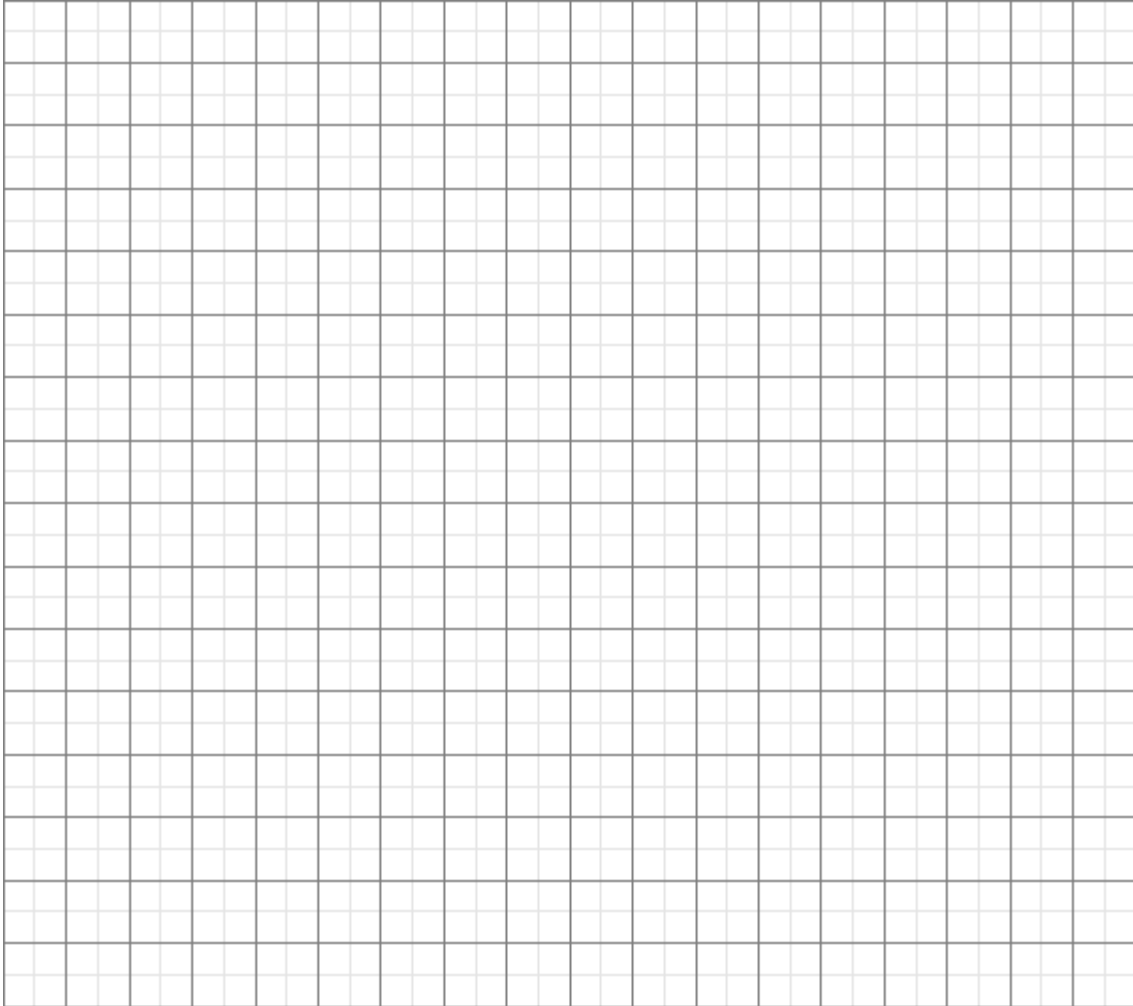
This will be the starting point for your design. Next, you will need to add one or more risers on the same plane. In words, explain where you plan to put them, and why. If you must make any changes to the face you drew, explain why as well.

_____

_____

_____

Put your initial drawing in the space belowand add the riser(s) you described above. Your drawing should include measurements for the risers and any modifications, but does not need to duplicate all measurements from the first drawing. Your drawing should clearly indicate cuts and folds on the risers.
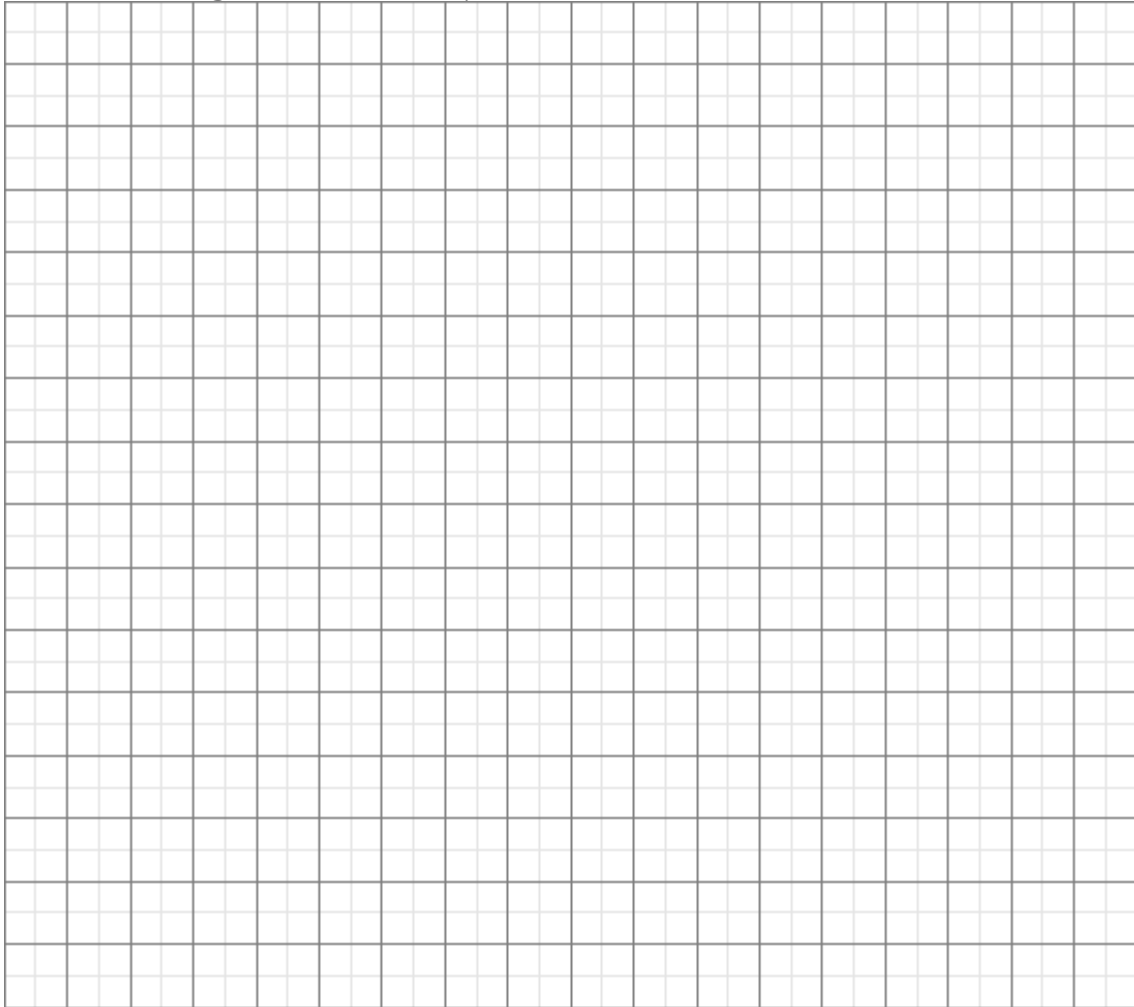
Without doing any more drawing yet, do you know what the depth of your popup will be? If so, state it, and explain how you know. If not, explain why you don't know. _____

_____

_____

STOP! Have a teacher check your work.
Teacher's initials: _____

Time to draw. Copy your drawing which includes risers. Draw an appropriate border around it to form the base. Draw the main fold line that goes across the whole base. In your drawing, indicate for all lines which should be cut and which should be folded. Include all relevant measurements. If you need to make any modifications, you may do so, but indicate them clearly. Color in the face that pops out yellow, and the pop-out riser blue.
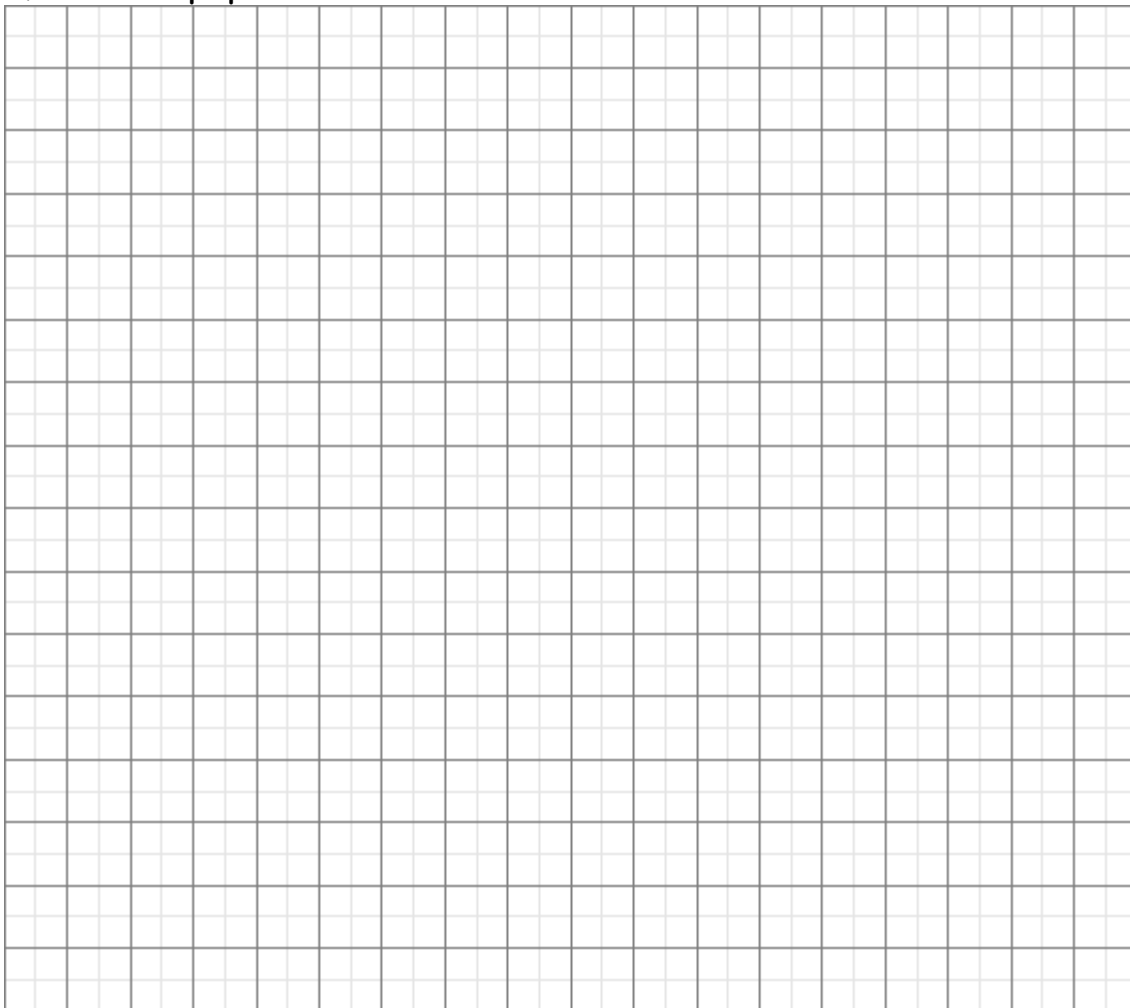
STOP! Have a teacher check your work.
Teacher's initials: _____

How has your design changed from the first drawing to the last? Why? If it has not changed, what aspects of the design allowed you to keep it the same? _____

_____

_____

_____

Could you put more than one of this plant on one piece of printer paper? Why or why not? Why would you want to? _____

_____

_____

STOP! Have a teacher check your work.

Teacher's signature: _____

Pop-Ups for Your Garden

Now that you know how to make pop-ups, it's time to actually sketch and then make your plants. Make each kind of plant a different shape. In the space below, sketch your idea for each plant, including risers, fold lines, and measurements (cm). This will assist you when making them in Silhouette Studio. Write on the lines which plant you are sketching, and how tall you have calculated the face to be. (Ignore the non-plant area when considering height.)

Corn   **Tomato**

Zucchini   **Carrots**

Squash

Circle your best plant design, and write on the back why it should be included in your group's garden.

Plant __Corn__

Plant __Tomato_

Plant _Zucchini_

Plant __Carrots_

. Plant _Squash_

KSB 4: Unit Price

Whenever you are buying a number of items that is greater than one, it is always a good idea to know how much you are paying for each item. This way, you can know if you are getting a good deal or not.

Take the following example:

You buy 12 pieces of gum from the corner store for a total of $5.40. How much are you paying for each piece of gum?

How do you think we can find out the price per piece of gum?

_____

_____

_____

Experiment with your idea in the space below:

Did you get an answer of $0.45?

Dividing the **Total Cost** by the **number of items** purchased will give you the price per _one_ item purchased, or **UNIT PRICE**.

$$\frac{\$5.40}{12} = \$0.45 \text{ per piece of gum} \qquad \$0.45 \text{ is the Unit Price}$$

Let's try some practice problems.

1) Kate needed some school supplies from the stationary store. She purchased 16 pencils for a total cost of $3.20. How much did Kate pay per pencil?

2) Ben is baking a cake and needs some ingredients for his recipe. The grocery store sells a 5-pound bag of flour for $3.89. How much will Ben be paying for each pound of flour? Round your answer to the <u>nearest cent</u>.

3) Macy's is having a sale on t-shirts. If Jack buys 4 t-shirts, he will pay $36. If he buys 6 t-shirts, he will pay $48. Which deal is better? Show all work and explain your answer on the lines provided.

_____
_____
_____

Corn Pricing Chart – 3 Plants/Flat, Yields 10 ears of corn per Plant

Use the workspace on the next page to help perform the calculations needed to fill in the table below.

# of Flats	Total Plants	Total Yield	Vendor A Cost	Vendor A Cost/Plant	Vendor A Cost/Yield	Vendor B Cost	Vendor B Cost/Plant	Vendor B Cost/Yield
1	3	30	$15.00	$5.00	$0.50	$16.00		
2	6		$30.00			$28.00	$4.67	$0.47
3	9	90	$45.00	$15.00	$0.50	$40.00	$4.44	$0.44
4	12		$60.00			$50.00		
5	15		$75.00			$58.00		

Using the information in the table above, construct a graph of the total cost vs. the number of flats purchased for each vendor. Label your X and Y axes, and title the graph.

If you wanted to plant 7 corn plants, which vendor would you choose, and how much would you save by choosing the right vendor?

_____

_____

_____

Corn Calculations Worksheet   Name: _____

# of flats	Vendor A Cost/Plant	Vendor A Cost/Yield	Vendor B Cost/Plant	Vendor B Cost/Yield
1	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
2	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
3	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
4	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
5	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield

Tomato Pricing Chart – 2 Plants/Flat, Yields 8 tomatoes per Plant

Use the workspace on the next page to help perform the calculations needed to fill in the table below.

# of Flats	Total Plants	Total Veg Yield	Vendor A Cost	Vendor A Cost/Plant	Vendor A Cost/Yield	Vendor B Cost	Vendor B Cost/Plant	Vendor B Cost/Yield
1	2		$9.75			$11.00		
2	4	32	$19.50	$4.88	$0.61	$20.00	$5.00	$0.63
3	6	48	$29.25	$4.88	$0.61	$28.00	$4.67	$0.53
4	8		$39.00			$35.00		
5	10		$48.75			$41.00		

Using the information in the table above, construct a graph of the cost/plant vs. the number of flats purchased for each vendor. Label your X and Y axes, and title the graph.

Based on the graph you constructed, how many flats must you purchase from Vendor B to get a better deal than Vendor A?

_____

_____

_____

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Tomato Calculations Worksheet

Name: _____

# of flats	Vendor A Cost/Plant	Vendor A Cost/Yield	Vendor B Cost/Plant	Vendor B Cost/Yield
1	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
2	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
3	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
4	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
5	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield

Squash Pricing Chart – 3 Plants/Flat, Yields 2 squash per Plant

Use the workspace on the next page to help perform the calculations needed to fill in the table below.

# of Flats	Total Plants	Total Veg Yield	Vendor A Cost	Vendor A Cost/Plant	Vendor A Cost/Yield	Vendor B Cost	Vendor B Cost/Plant	Vendor B Cost/Yield
1	3		$2.25			$3.00		
2	6	12		$0.75	$0.38	$6.00	$1.00	$0.50
3	9	18		$0.75	$0.38	$8.00	$0.89	$0.45
4	12					$10.00		
5	15					$11.00		

Vendor A forgot to include pricing for buying from 2 to 5 flats. Luckily, Vendor A charges the same price for every flat they sell. Using this information, complete the "**Vendor A Cost**" column. Then, use the workspace on the next page to perform the calculations needed to fill in the rest of the table.

Using the information in the table above, construct a graph of the cost/Yield vs. the number of flats purchased for each vendor. Label your X and Y axes, and title the graph.

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Squash Calculations Worksheet

Name: _____

# of flats	Vendor A Cost/Plant	Vendor A Cost/Yield	Vendor B Cost/Plant	Vendor B Cost/Yield
1	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
2	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
3	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
4	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
5	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield

Zucchini Pricing Chart – 5 Plants/Flat, Yields 3 zucchinis per Plant

Use the workspace on the next page to help perform the calculations needed to fill in the table below.

# of Flats	Total Plants	Total Veg Yield	Vendor A Cost	Vendor A Cost/Plant	Vendor A Cost/Yield	Vendor B Cost	Vendor B Cost/Plant	Vendor B Cost/Yield
1	5		$6.75			$8.00		
2	10	30	$13.50	$1.35	$0.45	$12.25	$1.23	$0.41
3	15	45	$20.25	$1.35	$0.45	$22.50	$1.50	$0.50
4	20		$27.00			$27.00		
5	25		$33.75			$30.00		

Using the information in the table above, construct a graph of the cost/Yield vs. the number of flats purchased for each vendor. Label your X and Y axes, and title the graph.

Based on the graph you constructed and the table above, how many flats would you buy, and from which vendor, if you wanted to yield:

15 zucchinis?   _____ Flats from Vendor _____

45 zucchinis?   _____ Flats from Vendor _____

55 zucchinis?   _____ Flats from Vendor _____

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Zucchini Calculations Worksheet   Name: _____

# of flats	Vendor A Cost/Plant	Vendor A Cost/Yield	Vendor B Cost/Plant	Vendor B Cost/Yield
1	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
2	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
3	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
4	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
5	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield

Carrot Pricing Chart – 6 Plants/Flat, Yields 1 carrot per Plant

Use the workspace on the next page to help perform the calculations needed to fill in the table below.

# of Flats	Total Plants	Total Veg Yield	Vendor A Cost	Vendor A Cost/Plant	Vendor A Cost/Yield	Vendor B Cost	Vendor B Cost/Plant	Vendor B Cost/Yield
1	6		$1.50			$1.75		
2	12	12	$3.00	$0.25	$0.25	$3.00	$0.25	$0.25
3	18	18	$4.50	$0.25	$0.25	$4.25	$0.24	$0.24
4	24		$6.00			$5.50		
5	30		$7.50			$6.75		

Using the information in the table above, construct a graph of the cost/Yield vs. the number of flats purchased for each vendor. Label your X and Y axes, and title the graph.

Based on the graph you constructed and the table above, which vendor would you recommend to a friend, and why?

_____
_____
_____
_____
_____

35

Carrot Calculations Worksheet   Name: _____

# of flats	Vendor A Cost/Plant	Vendor A Cost/Yield	Vendor B Cost/Plant	Vendor B Cost/Yield
1	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
2	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
3	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
4	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield
5	$_____/Plant	$_____/Yield	$_____/Plant	$_____/Yield

STOP! Get your teacher's signature before continuing: _____

Draw a sketch of a possible garden. Label each vegetable, and make sure you add detail to your sketch as to which plants are in the front, middle and back of the garden, and the height measurements as well. Below your sketch, write one reason as to how your sketch fulfills the proportion height specifications. Fill in the measurements at the bottom of the page. Do your mathematics on the back of

My Individual Sketch   Date:

My Reason :

<u>Vegetable Names and Height Measurements</u>

Veggie 1: _____   Veggie 2:_____

Veggie 3:_____   Veggie 4:_____

Veggie 5:_____

Share each team individual sketch. Decide on one group sketch. You can choose one person's sketch, or combine sketches to create a new garden design idea. Each group member should draw the group team sketch below, with all labels and detail as stated in your previous individual sketch requirements. All mathematics should be recorded on the back of this sheet.

Our Group Sketch   Date:

Vegetable Names and Height Measurements

Veggie 1: _____   Veggie 2:_____

Veggie 3:_____   Veggie 4:_____

Veggie 5:_____

STOP! Your teacher must approve your Community Garden Design.

Teacher's Signature _____

Fill out your order form based on your calculations from the pricing charts.

Vendor A Order Form

Vegetable	Flats	Price per Flat	Total
Corn			
Tomato			
Squash			
Zucchini			
Carrots			
		Total:	

Vendor B Order Form

Vegetable	Flats	Price per Flat	Total
Corn			
Tomato			
Squash			
Zucchini			
Carrots			
		Total:	

STOP! Your teacher must approve your Vendor Order Forms.

Teacher's Signature _____

Draw a fully labeled group sketch of a finished garden. Incorporate what you now have learned about price per plant into your sketch of how many of each specific vegetable will be in your garden. Use your previous group sketch of height of plants to help complete this sketch. List two reasons why your garden is the optimal design. . **Remember that you have a constraint of a 60 cm by 90 cm foam core board to fit your vegetables onto.**

<div align="center">Our Group Sketch   Date:</div>

Reason 1:

Reason 2:

Cost of Garden _____ (See filled in Vegetable Chart)

Productivity of Garden_____ (Vegetables grown)

Silhouette Studio Design Time!

Now that you have drawn your final sketch for the Community Garden Design Challenge, use the Silhouette Studio to create your final pop-up vegetables. Decide who will be working on which vegetable, or you may choose to break the work up differently. You have two class periods to design, print out, color and glue your Silhouette vegetables onto your foam core board. **Remember that you have a constraint of a 60 cm by 90 cm foam core board to fit your vegetables onto.** Keep this in mind as you think about how many vegetables you have in each row, and how wide the base of each plant should be.

Job Responsibilities:

Name _____

Responsibility: _____

Name _____

Responsibility:

Name _____

Responsibility: _____

Name _____

Responsibility: _____

Community Garden Design Balance Sheet

Item	Cost	Work Shown	Total

Trade-Off Reflection

Name three pricing trade-offs your group made when deciding which vegetables to include in your garden. Then state your reasoning.

Trade-Off 1: _____

_____

_____

Reasoning: _____

_____

_____

Trade-Off 2:

_____

_____

_____

Reasoning: _____

_____

_____

Trade-Off 3:

_____

_____

_____

Reasoning: _____

_____

_____

As young engineers, it is important to always reflect on new constraints or specifications that may have been added to the design challenge. Look through your Design Portfolio at the past few math challenges you have solved. Decide whether to add additional specs/constraints to the original problem. First re-write the original specs and constraints in pencil, and any additional ones you find in pen. Below, explain your rationale for your newly recorded specifications/constraints.

Specifications	Constraints

Rationale:_____

_____

_____

Constraints/Specifications Reflection

What constraint was the most difficult one in this challenge to overcome? _____

How did you meet this challenge?

_____

_____

_____

_____

What specification(s) presented the biggest challenge to your group?

_____

_____

_____

How did you meet this challenge?

_____

_____

_____

_____

Silhouette Reflection

What were two of your biggest modifications when designing vegetables on Silhouette Studio?

Modification1:_____

_____

_____

Why did you find it necessary to make these modifications?

_____

_____

_____

Modification2:_____

_____

_____

Why did you find it necessary to make these modifications?

_____

_____

_____

What would you change, if given more time, to your design?

_____

_____

Why? _____

_____

_____

_____

_____

What change, if any, have you made with amount of rows in your garden from your original sketch/plan?

_____

_____

_____

What made you change your idea?

_____

_____

_____

As you collaborated on how many of each type of vegetable to purchase, what did you find was one of your biggest idea changes?

_____

_____

_____

_____

Mathematics Reflection

What did you learn about ratio/proportion by completing this design challenge?   What is a proportion?

I learned

_____

_____

_____

An example of this in my design challenge work is:

What did you learn about finding unit prices by completing this design challenge? Explain how to find a unit price.

I learned

_____

_____

_____

An example of this in my design challenge work is:

What did you learn about graphing/ charting costs by completing this design challenge?   Why are graphs useful?
I learned

_____

_____

_____

An example of this in my design challenge work is:

An example of this in my design challenge work is:

Using the Community Design Garden model, what are two examples where engineering design and mathematics are inter-connected.

Example 1: _____

_____

_____

_____

Example 2:

_____

_____

_____

_____

Peer Review Rubric

Visit another team's Community Garden Design and review their Design Portfolio along with their design model. After you have reviewed and evaluated their work, and they have done the same for you, fill in the rubric on the next page. Then tear out and exchange rubrics and attach (glue) their rubric review for your team in the space below.

Peer Review Rubric

Topic	3	2	1	Points Given
Specifications and Constraints	All specifications and constraints are correctly identified and listed in the appropriate columns.	Some specifications and constraints are correctly identified and listed in the appropriate columns.	Very few specifications and constraints are correctly identified and listed in the appropriate columns.	
Meeting the Specifications	The design that was created met all of the specifications and constraints that were given.	The design that was created met some of the specifications and constraints that were given.	The design that was created met very few of the specifications and constraints that were given.	
Trade-offs and Modifications	All trade-offs and modifications were justified and explained appropriately.	Some trade-offs and modifications were justified and explained appropriately.	Very few trade-offs and modifications were justified and explained appropriately.	

Reviewer Names _____

Community Garden Design Extension Problem 1

Now that your community garden design is complete, take one class period on the internet to research the actual plant characteristics of your garden model.

I found out that:

Use this new information on the growth and needs of your vegetables to help you decide how you would modify your garden model in one way to be more representative of the real world model of your chosen vegetables.

My one modification would be: _____

_____

The reason I chose this as my modification is:_____

_____
_____
_____

This would make my garden community model more like the real world model because:_____

_____
_____

Community Garden Design Extension Problem 2

You have been hired to create a Garden Design Challenge for another seventh grade class. Based on your new knowledge about the real world plants you just researched on the internet and using the design challenge you were given as a model (see first page of the Design Portfolio), consider the following to make your design challenge as realistic as possible:

- ✓ Ratios of the five different vegetable plants, as compared to their real-world heights
- ✓ Yield per plant as compared to their real-world yields
- ✓ Real world nutritional value of each plant as it applies to the impact it has on the people who will consume them.
- ✓ Real world sunlight/shade requirements of each vegetable as it relates to placement in the garden

Write the design challenge on the back of this page, and in the chart below, insert the specifications and constraints of your challenge

Specifications	Constraints

Community Garden Design Extension Problem 3

Part A: Percent/ Percentage

A **percentage** is a way expressing a number as a fraction out of 100.

For example, let's say you are in charge of figuring out the percentage of boys in the auditorium at a given time. If there are 100 students in the auditorium and 64 of them are boys, that would mean that 64% of the students in the auditorium are boys. ($\frac{64}{100}$)

Unfortunately, students don't always travel in groups of 100!

Let's say there are 72 students in the auditorium and 47 of them are boys. How can we figure out the percentage now?
To do so, we use the following formula:

$$\frac{Part}{Whole} = \frac{Percent}{100}$$

From our example we know that our Whole is 72, our Part 47, and our Percent is our unknown x. Try plugging these values into our formula using the fraction lines below.

$$\underline{\hspace{3cm}} = \underline{\hspace{3cm}}$$

Now cross multiply:

Now solve for x:

Did you get 65.28%? Great!

There are other ways to find percentage that you might like better.
Let's keep using the same example as before:

There are 72 students in the auditorium and 47 of them are boys. What is the percentage of boys in the auditorium?

Try dividing the part by the whole and then multiplying by 100.

$$\frac{Part}{Whole} \times 100$$

Do you get the same answer?

What if you are asked to find the **percent of a number?**
EX: Find 62% of 300?

- You can multiply 300 by .62

- Set up a proportion: $\frac{x}{300} = \frac{62}{100}$

- Work with "friendly percents" like 6 ten percents = 30 six times (180)
  And then add 2 one percents = 3 two times (6)
  180 + 6 = 186

When buying items at a discount, you find what percent off you receive in savings, and then subtract that amount from the original price.

For example: A flat of flowers originally priced at $15.00 was 20% off. Here, you would first find what 20% of $15.00 is by using any of the above bulleted methods(your savings), and then subtract that amount from $15.00 to find out the total amount that you pay with the discount.

Savings = $3.00   **Total amount paid**: $12.00

Part B: Sales Tax

There are different ways to calculate the **sales tax** on an item.
Let's start with an example.

EX: Suppose a bicycle costs $179.00 and the sales tax is 8.5%. How much would you pay for the bicycle after tax?

By Proportion	By Rate	By Friendly Percent
$$\frac{percent}{100} = \frac{x}{cost}$$ $$\frac{8.5}{100} = \frac{x}{\$179.00}$$ Cross-multiply, to obtain: $$\$179.00 * 8.5 = 100x$$ Now, solve for x: $$\frac{\$1521.50}{100} = \frac{100x}{100}$$ $$x = \frac{\$1521.50}{100}$$ $$x = \$15.22$$ Finally, add the sales tax to the original cost, to determine the final cost: $$\$179.00 + \$15.22 = \mathbf{\$194.22}$$	First, you must change the percent to a decimal, by dividing it by 100 or moving the decimal point two places to the left. $$8.5\% = \frac{8.5}{100} = 0.085$$ Now multiply the decimal by your original cost: $$\$179.00 * 0.085 = \$15.22$$ Finally, add the sales tax to the original cost, to determine the final cost: $$\$179.00 + \$15.22 = \mathbf{\$194.22}$$	10% = $17.90 1% = $1.79 } 1.5% .5% = $0.89 (10% -1.5% = 8.5%) $17.90 -$1.79 = $16.11 $16.11 -$0.89 = $15.22 $179.00 + $15.22=$194.22

Notice that all methods arrive at the same solution.

Try these tax and percentage problems on your own:

1. Using the proportion method, determine the **sales tax** of an iPod that costs $250, with a 7.45% tax rate.

2. Using the rate method, determine the **final cost** of a pair of jeans that costs $49.99, taxed at a rate of 4.9%.

3. Joe goes shopping, and buys four shirts at $17.00 each, and a pair of shoes for $31. He is charged 5.25% sales tax. Using whichever method you prefer, determine the **total cost** of Joe's purchase.

4. Jane buys a shirt on sale for 30% off of the original price. The price of the shirt was $48.00. What was the amount she saved? What was the final cost?

5. Using the "friendly percent" method, calculate the savings you get when you buy a $64.00 item that is 25% off and 40% off another item priced at $86.00

Challenge Question: Emily is going through her receipts, and finds one for when she bought a new laptop. She can't make out the cost of the laptop, but the receipt says she paid a total of $1818.60, and was taxed at 8.25%. Help Emily calculate the cost of the laptop *before* tax.

Work Space:

Solution: _____

How was the above problem different than the others?

_____

_____

_____

In the space below, create a problem similar to Emily's problem and write the solution on the back of this page. Then give the problem to one of your teammates to solve.

My Problem:

The community garden design vendors decided to offer the following discounts. You may choose **ONE** coupon from this sheet to use on your order.

Vendor A

$$

12% off your **entire order**!

$$

Vendor A

Buy 1 flat of **squash** or **corn**, get 1 flat of the same vegetable free!

Vendor B

Buy 1 flat of **squash** or **corn**, get 1 flat of the same vegetable free!

Vendor B

13% off all **squash** orders

&

16% off all **zucchini** orders

Vendor A

10% off all **carrot** orders

Vendor B

14% off all **tomato** orders

In the spaces provided, calculate the savings for each coupon, based on your **current** order.

Vendor A	Vendor A
$$ 12% off your **entire order**! $$	Buy 1 flat of **squash** or **corn**, get 1 flat of the same vegetable free!

Vendor B

13% off all **squash** orders

&

16% off all **zucchini** orders

Vendor A	Vendor B
10% off all **carrot** orders	14% off all **tomato** orders

Now that you have calculated the savings for each coupon, which one will you use on your order? Why? _____

_____

_____

Cut out the coupon and place it at the bottom of your order Vendor form (found after the upcoming Sales Tax Activity)

KSB 6: Percent Increase and Decrease

When a quantity grows, we can calculate the **percent** by which it has **increase**d. Likewise, when it shrinks, we can calculate the **percent** by which it has **decrease**d. Either way, we use the same formula:

$$\text{Percent Increase/Decrease} = \frac{Change\ in\ Amount}{Original\ Amount} * 100$$

Why do you think we multiply by 100?

_____

Follow along with this example:

EX 1)   The price of a sandwich at your favorite deli went from $5 to $7.

Do you think it will be an increase or decrease?

_____

Calculate the percent of change in the price.

$$\text{Percent Increase/Decrease} = \frac{Change\ in\ Amount}{Original\ Amount} * 100$$

$$\text{Percent Increase/Decrease} = \frac{(7-5)}{5}$$

$$\text{Percent Increase/Decrease} = \frac{2}{5}$$

Convert fraction to decimal by dividing numerator by denominator

Percent INCREASE = .4 x 100   .40 x 100 = 40

Since we are looking for **percent i**ncrease/decrease, your solution will always be in terms of a %. Therefore: Percent Increase = 40%
 Now that you have the idea, try the practice problems on the following page. Be sure to show all steps and write your solution on the line provided.

1)   Tickets to a concert were $125, but they are now on sale for $95. What is   the percent decrease in ticket price as a result of the sale?

Solution: _____

2)   Last week, 68 students attended the school football game. This week, 86   students attended the game. What is the percent increase in attendance   from last week to this week? Round your answer to the nearest <u>tenth</u> of a   percent.

Solution: _____

3)   The chef at Vinny's Pizza noticed that last night he made 47 pizzas, but   tonight he made only 33. Calculate the percent change in pizzas made and   determine if it is a percent increase or decrease. Round your answer to the   nearest <u>tenth</u> of a percent.

Solution: _____

Coupon Savings

Now that you have decided which coupon you want to use, the Community Garden Design Vendors wish to know exactly how much you will be saving on your order. Please calculate the percent decrease on your **Pre-Tax** order total.

Your chosen coupon was _____

Work Space for Percent Decrease:

Percent Decrease Solution: _____

Sales Tax on the Community Garden

The community Garden Committee has informed us that all plant purchases will be taxed at a rate of 4.75%. You may also choose to order from either vendor out-of-state, in which case you will pay 2.35% tax, and an additional $0.65 shipping. Decide which is best, and calculate the amount of sales tax you will pay on your order after applying your coupon. Justify your ordering choice. Use the method you are most comfortable with to do the calculations.

Vendor A	Vendor B
Order cost: $_____	Order cost: $_____
Coupon savings: —$_____	Coupon savings: —$_____
Total before tax: $_____	Total before tax: $_____

Tax (+Shipping): $_____   Tax (+Shipping): $_____

Final Total: $_____   Final Total: $_____

Grand total: $ _____

Fill out your order form based on your calculations from the pricing charts, coupon worksheets, and sales tax worksheet.

Vendor A Order Form

Vegetable	Flats	Price per Flat	Total
Corn			
Tomato			
Squash			
Zucchini			
Carrots			
		Subtotal:	
		Coupon Savings:	—
		Total Before Tax:	
		Tax:	+
		Shipping (if applicable):	+
		Total:	

Use the space below for any final calculations, and paste coupon if applicable:

Vendor B Order Form

Vegetable	Flats	Cost
Corn		
Tomato		
Squash		
Zucchini		
Carrots		
Subtotal:		
Coupon Savings:	—	
Total Before Tax:		
Tax:	+	
Shipping (if applicable):	+	
Total:		

Use the space below for any final calculations, and paste coupon if applicable:

STOP! Your teacher must approve your Vendor Order Forms.

Teacher's Signature

_____

Daily Learning Log

Day_____

This is what I did

today:_____

_____

_____

_____

_____

_____

_____

_____

This is what I

learned:_____

_____

_____

_____

_____

This is a sample of what I learned:

This was my best math for today:

Daily Learning Log

Day_____

This is what I did

today:_____

_____

_____

_____

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_____

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_____

This is what I

learned:_____

_____

_____

_____

_____

This is a sample of what I learned:

This was my best math for today:

Daily Learning Log

Day_____

This is what I did
today:_____

_____

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_____

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_____

This is what I
learned:_____

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_____

_____

_____

This is a sample of what I learned:

This was my best math for today:

Daily Learning Log

Day_____
This is what I did
today:_____

_____

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_____

_____

This is what I
learned:_____

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_____

_____

_____

This is a sample of what I learned:

This was my best math for today:

Daily Learning Log

Day_____

This is what I did

today:_____

_____

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This is what I

learned:_____

_____

_____

_____

_____

This is a sample of what I learned:

This was my best math for today: