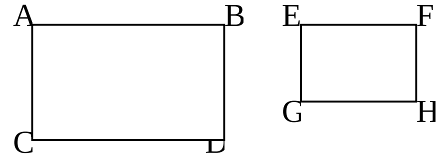
S & S - Problem 1.1 notes - "Enlarging Figures"

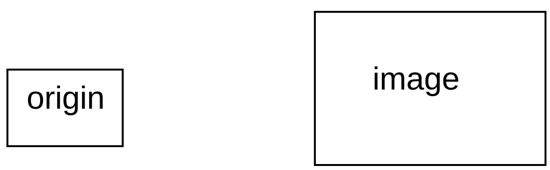


Definitions:
image - new figure created from the original
compare - to look at the similarities and differences
corresponding - parts of a figure relating to the parts of it's image

example: **∠A and ∠E are corresponding**
segments AB and EF are corresponding

A two-band stretcher can be used to enlarge a figure.

1. loop together 2 rubber bands
2. using your index finger, hold down one end of the two-band stretcher on the anchor point. ***Do not move this hand!***
3. put your pencil in the loop of the other end of the two-band stretcher
4. stretch the rubber band so that the knot is directly over your picture
5. watch the knot and move your pencil hand so that the knot outlines the picture
6. as you move the two-band stretcher, your pencil should be drawing an enlarged ***IMAGE*** at the side of your paper



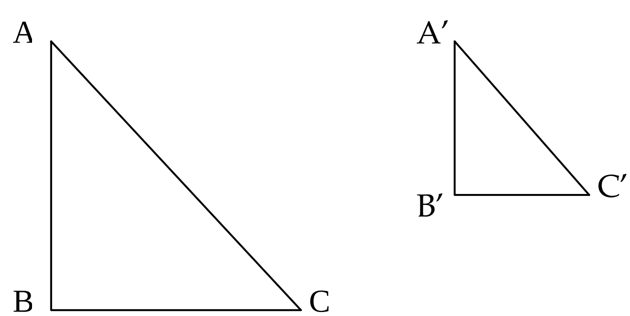
A. COMPARE the original figure and it's image.

similarities	differences
general shape is the same each set of angles are the same	side lengths have been doubled the area is 4 times as big

B. We use the word **corresponding** to describe how parts of a figure are related to the parts of it's image. Look at ΔABC and it's image ΔA'B'C'.

(ΔA'B'C' is read "triangle A prime, B prime, C prime)

angle A corresponds to angle A′
angle B corresponds to angle B′
angle C corresponds to angle C′
side AB corresponds to side A′B′
side AC corresponds to side A′C′
side BC corresponds to side B′C′



S & S - Problem 2.1 notes - "Drawing Wumps"

Definitions:
coordinate rule - when creating figures on a coordinate grid, a coordinate rule tells you how to use the coordinates of the original figure to find the coordinates of it's image

Similar to the "rules" we wrote in the book Variables & Patterns, a coordinate rule uses symbols.

Example:
The coordinate rule (3x, 4y) tells you to multiply the original set of x-values by 3, and to multiply the original set of y-values by 4. Connecting each set of coordinates will make two triangles (the image larger than the original).

original figure	image
rule: (x,y)	rule: (3x,4y)
(1,5)	(3•1 , 4•5) = (3,20)
(0,1)	(3•0 , 4•1) = (0,4)
(2,2)	(3•2 , 4•2) = (6,8)

Each figure can then be graphed on a coordinate grid so we can compare them.

- In class, we were given a set of coordinates that we used to draw "Mug Wump".
- We were given 4 sets of coordinate rules that we then used to draw Zug, Lug, Bug, and Thug (see back side of this sheet).
- we compared the pictures of Zug, Lug, Bug and Thug to the picture of Mug and tried to determine which were true Wumps and which were impostors.

Mug and Zug	same general shape, angles look the same, sides are twice as long
Mug and Lug	shape is different, height is the same, Lug is much wider
Mug and Bug	same general shape, angles look the same, sides are three times as long
Mug and Thug	shape is different, width is the same, Thug is much taller

WILL THE REAL WUMPS PLEASE STAND UP!
we decided the real wumps were Mug, Zug, and Bug because they were <u>similar</u>

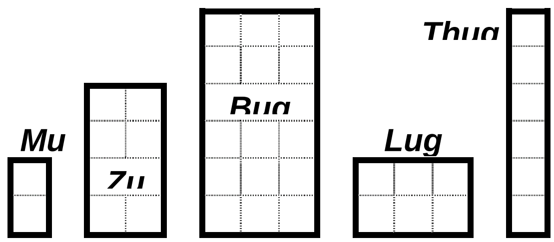
WHAT DO YOU THINK IT MEANS WHEN WE SAY THAT TWO THINGS ARE MATHEMATICALLY <u>SIMILAR</u>????????

S & S - Problem 2.2 notes - "Nosing Around"

<u>Definitions</u>:
similar - corresponding angles are congruent, corresponding sides are proportional, and the general shape is the same
ratio - a comparison of two quantities
scale factor - the number that is multiplied by the dimensions of an original figure to get the dimensions of a similar figure

We are going to compare the noses of the Wumps!

- ***wump 1 - Mug - was made from the rule (x,y)***
- ***wump 2 - Zug - was made from the rule (2x, 2y)***
- ***wump 3 - Bug - was made from the rule (3x, 3y)***
- ***wump 4 was made from the rule (4x, 4y)*** **and so on . . .**



Wump	Rule	Width of Nose (cm)	Lenth of Nose (cm)	$\frac{\text{width}}{\text{length}}$	Perimeter
Wump 1 (Mug)	***(x, y)***	***1***	***2***	$\frac{1}{2}$	***6 cm***
Wump 2 (Zug)	***(2x, 2y)***	***2***	***4***	$\frac{2}{4}$	***12 cm***
Wump 3 (Bug)	***(3x, 3y)***	***3***	***6***	$\frac{3}{6}$	***18 cm***
Wump 4	***(4x, 4y)***	***4***	***8***	$\frac{4}{8}$	***24 cm***
Wump 5	***(5x, 5y)***	***5***	***10***	$\frac{5}{10}$	***30 cm***
Wump 10	***(10x, 10y)***	***10***	***20***	$\frac{10}{20}$	***60 cm***
Wump 20	***(20x, 20y)***	***20***	***40***	$\frac{20}{40}$	***120 cm***
Wump 100	***(100x, 100y)***	***100***	***200***	$\frac{100}{200}$	***600 cm***
Lug	***(3x,y)***	***3***	***2***	$\frac{3}{2}$	***10 cm***
Thug	***(x, 3y)***	***1***	***6***	$\frac{1}{6}$	***14 cm***

- for each Wump, the width is twice the length (this is not true for Lug and Thug)
- for each Wump, the ratio of width to length is $\frac{1}{2}$ (not true for Lug and Thug)
- for each Wump, the perimeter is 6 times the Wump's number

OVER

S & S - Problem 2.3 notes - "Making Wump Hats"

What happens when you add or subtract a number from the rule?
EXAMPLE: What would (3x + 4, 3x + 2) do to the image?

A. Each wump has a hat. Draw `Mug's` hat using the given coordinates.

	Hat 1	*Hat 2*	*Hat 3*	*Hat 4*	*Hat 5*	*Hat 6*
Point	(x,y)	(x+2, y+2)	(x+3, Y-1)	(2x, y+2)	(2x, 3y)	(0.5x, 0.5y)
A	(0,4)	(2,6)	(3,3)	(0,6)	(0,12)	(0,2)
B	(0,1)	(2,3)	(3,0)	(0,3)	(0,3)	(0, 0.5)
C	(6,1)	(8,3)	(9,0)	(12,3)	(12,3)	(3,0.5)
D	(4,2)	(6,4)	(7,1)	(8,4)	(8,6)	(2,1)
E	(4,4)	(6,6)	(7,3)	(8,6)	(8,12)	(2,2)
F	(3,5)	(5,7)	(6,4)	(6,7)	(6,15)	(1.5,2.5)
G	(1,5)	(3,7)	(4,4)	(2,7)	(2,15)	(0.5,2.5)
H	(0,4)	(2,6)	(3,3)	(0,6)	(0,12)	(0,2)

B. Using the rules, find the coordinates for Hats 2, 3, 4, 5, and 6.
C. Graph all of the wump hats. (see other side)

how was each hat different from Mug's hat?

rule	how did the <u>*shape*</u> change?	how did the <u>*location*</u> change?
(x+2, y+2)	same size	moved right 2, up 2
(x+3, y-1)	same size	moved right 3, down 1
(2x, y+2)	2 times wider, same height	moved up 2
(2x, 3y)	2 times wider, 3 times taller	same location
(0.5x, 0.5y)	half as wide, half as tall	same location

<u>Problem 2.3 Follow-Up:</u>

1. What rule would make the hat <u>3 times taller</u> and <u>3 times wider</u>? **(3x, 3y)**

2. What rule would move the hat <u>4 places right</u> and <u>7 places up</u>? **(x+4 , y+7)**

3. What happened when you add/subtract in the rule? *it changes the location*
   add a # to x - moves the figure right
   subtract from x - moves the figure left
   add a # to y - moves the figure up
   subtract from y - moves the figure down

S & S - Problem 3.1 notes - "Similar Figures"

- For each of the sets of polygons on Labsheet 3.1, two of the shapes are similar and the other is an impostor.
- Which polygons are similar? Why?

rectangle set	A and C	A has just been turned on its side
parallelogram set	B and C	the angles on A are different
decagon set	A and C	the angles on B are different
star set	A and B	the angles on C are different

Problem 3.1 Follow-Up:

1. For each pair of similar figure, tell what number the side lengths of the small figure must be multiplied by to get the side lengths of the large figure.

(the small to large scale factor)

rectangles - scale factor from A to C is 4
parallelograms - scale factor from B to C is 2
decagons - scale factor from A to C is 3
stars - scale factor from A to B is 3

2. For each pair of similar figure, tell what number the side lengths of the large figure must be multiplied by to get the side lengths of the small figure.

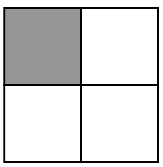
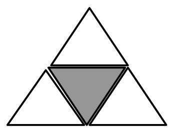
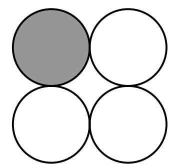
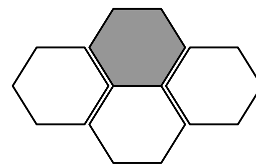
(the large to small scale factor)

rectangles - scale factor from C to A is $\frac{1}{4}$
parallelograms - scale factor from C to B is $\frac{1}{2}$
decagons - scale factor from C to A is $\frac{1}{3}$
stars - scale factor from B to A is $\frac{1}{3}$

3. How are the scale factors in parts 1 and 2 related? *they are reciprocals*

S & S - Problem 3.2 notes - "Reptiles"

Definitions:
rep-tile - a shape that can be copied and put together to form a larger, similar version of the same shape.

rep-tiles	not rep-tiles
 	  

- look at the shapes on Labsheet 3.2
- which could be made into rep-tiles? Cut them out.
- for each rep-tile, find the scale factor from the original to the larger shape
- next find the scale factor from the larger shape back to the original
- how many copies of the original rep-tile shape does it take to make the enlargement?

☞ IMPORTANT IDEAS FROM PROBLEM 3.2 ☜

- **to make a rep-tile, you will need 4 copies, 9 copies, 16 copies, 25 copies, 36 copies… etc of the original shape**

- **to find the number of shapes that will fit into the rep-tile, multiply the scale factor times itself (scale factor ^{2})**

- **area of the new figure = (area of the old figure) x (scale factor ^{2})**

- **for triangles, if the corresponding angles are congruent , then the shapes are automatically similar**

S & S - Problem 4.1 notes - "Using Similarity"

DID YOU KNOW?
Measurement is used in investigations and police work all the time. Some stores that have surveillance cameras will mark a spot on the wall that is 6 feet from the floor so that when a person is filmed, it is easier to estimate that person's height.

In the picture below, a teacher is holding the teacher's edition of your CMP book. The book measures 8.5 x 11 inches. How could we use this information to find the true height of the teacher?

(look on pg 42)

- **The picture of the book and the actual book are similar.**
- **Let's find a scale factor from the picture of the book to the real-life book!**
- **First we need to measure (with a ruler) the height of the book in the picture.**
  the picture of the book is about 0.5 in tall
- **Then we need to measure the height of the teacher in the picture.**
  the picture of the teacher is about 3.5 in tall
- **Next we need to organize the info we know and the info we need to know.**

	picture	actual size
book height	0.5 in	11 in
teacher	3.25 in	?

the scale factor for the book height: **0.5 x __22__ = 11**

so to find the true height of the teacher: **3.25 x __22__ = 71.5 inches**

(71.5 inches = about 6 feet)

the teacher is about 6 feet tall!

S & S - Problem 4.2 notes - "Scaling Up"

What kind of models are smaller or larger than the real object?

SMALLER THAN THE ACTUAL SIZE	LARGER THAN THE ACTUAL SIZE
maps	model of an ear at the doctor's office
blue prints	newspaper advertisements
model cars	billboards
pictures (photographs)	image through a microscope

- When you use a copy machine, you can either enlarge or reduce the size of the original picture.
- Raphael is closing his bookstore and wants to place a full-page advertisement in the newspaper. A full-page ad is 13 in. x 22 in., which allows for a white border all the way around the page.
- Raphael used the computer to make an 8.5 in. x 11 in. model of the ad.

Is it possible to enlarge his copy of the ad, without distorting the picture?
(is a 8.5 x 11 sheet of paper similar to a 13 x22 sheet?)

	model	actual ad	scale factor (small to large)
width	8.5	13	8.5 x <u>1.5</u> = 13
length	11	22	11 x <u>2</u> = 22

Since the actual ad would be <u>1.5 times wider</u> and <u>2 times longer</u>, there is no common scale factor, so the <u>model and the ad would not be similar</u>. This means that the picture would be distorted, or some might be cut off.

S & S - Problem 4.3 notes - "Making Copies"

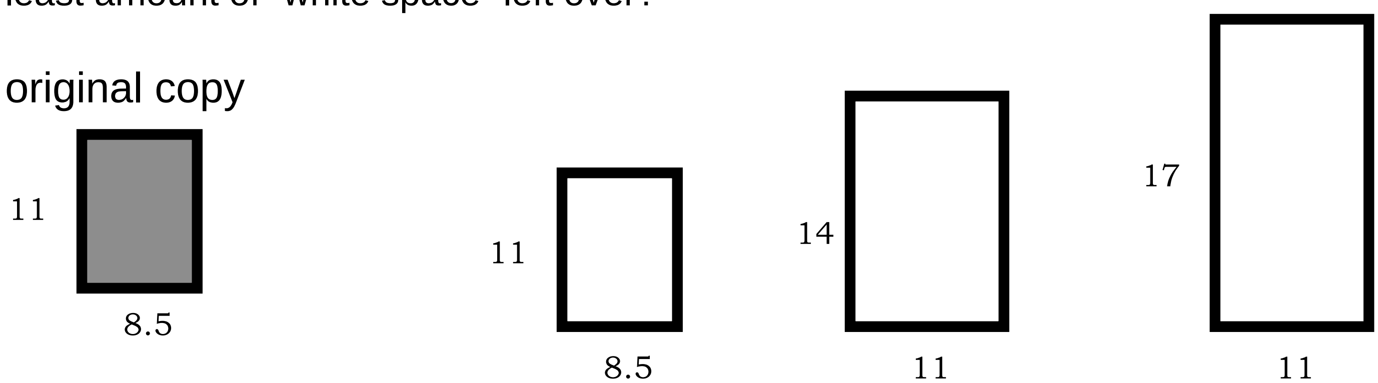
When you use a copy machine to make a similar picture, your scale factor is usually written as a percent.

Example: entering 100% means using a scale factor of 1
entering 200% means using a scale factor of 2
entering 50% means using a scale factor of 0.5

Suppose you make a design on the computer (on normal 8.5x11 paper) and you want to make a copy of it on the copy machine, The machine can hold 3 paper sizes:

8.5x11 11x14 11x17.

On which sheet of paper could you make the biggest poster of your original, with the least amount of "white space" left over?



	original copy	small poster	medium poster	large poster
short side	**8.5**	8.5	11	11
long side	**11**	11	14	17

The small poster would be similar, but would stay the same size.

The medium poster size is almost similar to the original poster:

8.5 x 1.29 **= 11**
11 x 1.27 **= 14**

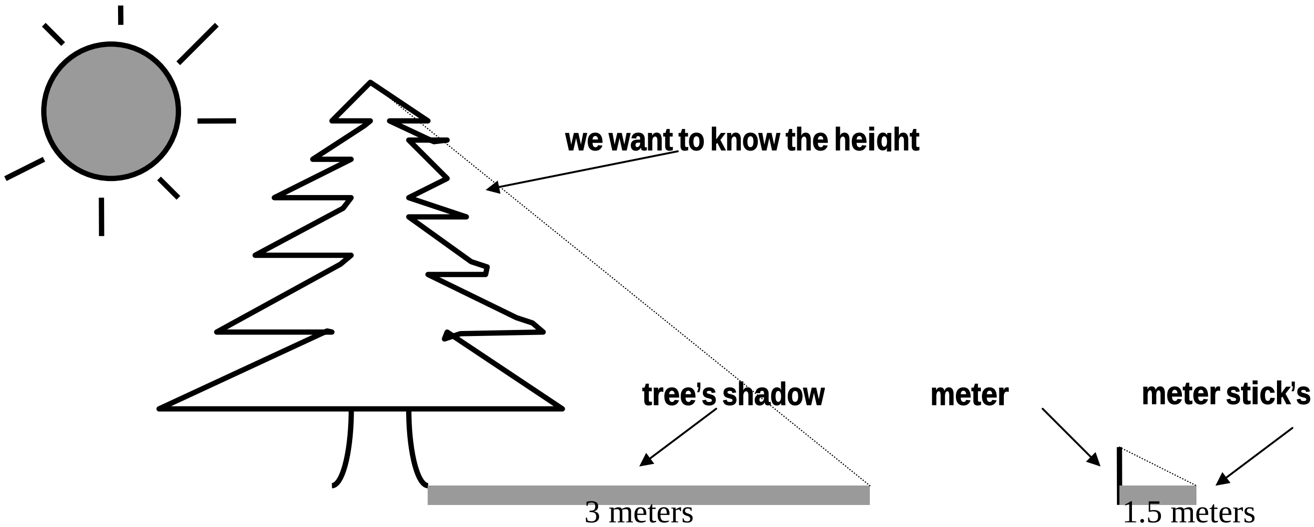
The large poster size is not similar, and would leave lots of white space:

8.5 x 1.29 **= 11**
11 x 1.55 **= 17**

S & S - Problem 5.1 notes - "Shadow Method"

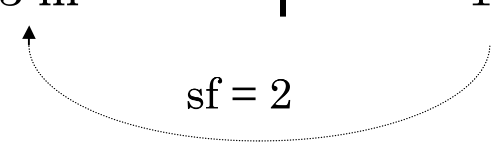
<u>Definitions</u>:
none

Using shadows, we can find the heights of really tall figures that would otherwise be hard to measure. The figure, the shadow, and the line from the top of the figure to the end of the shadow form a triangle. This triangle is similar to the one created by a meter stick.



<u>STEPS:</u>
1. hold a meter stick perpendicular to the ground (since the tree is perpendicular to the ground, we are forming congruent angles)
2. the meter stick and it's shadow will form a triangle similar to the tree it's shadow (there's an imaginary line made by the sun)
3. measure the length of the tree's shadow (in meters)
4. measure the length of the meter stick's shadow (in meters)
5. use the measurements to find the scale factor between the two triangles
(tree's shadow length ÷ meter stick's shadow length)
6. multiply the scale factor by the meter stick's height (1 m)

	tree	**meter stick**
height	?	1 m
shadow length	3 m	1.5 m

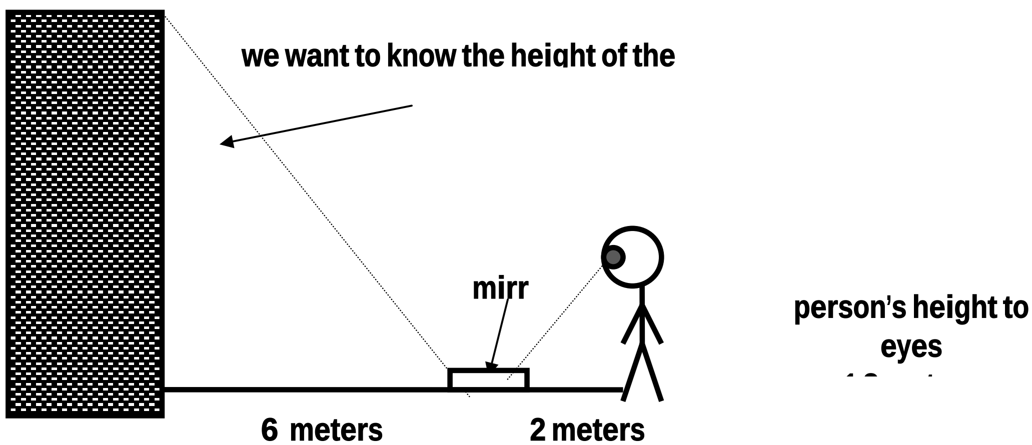


the tree's height is 2m

S & S - Problem 5.2 notes - "Mirror Method"

<u>Definitions</u>:
none

The shadow method we used in problem 5.1 can only be used outside on sunny days. The mirror methods works indoors and outdoors.



<u>STEPS:</u>
1. set mirror on level ground in front of the object you are trying to find the height of
2. step back until you can see the reflection of the top of the object in the middle of the mirror
3. person 2 needs to measure the distance from the middle of the mirror to the object's base
4. person 2 also needs to measure the distance from the middle of the mirror to person 1 's feet
5. the last measurement we need is the distance from person 1 's feet to their eyes

	object (wall)	**person 1**
height	?	1.2 m
distance to mirror	6 m	2 m

sf = 3

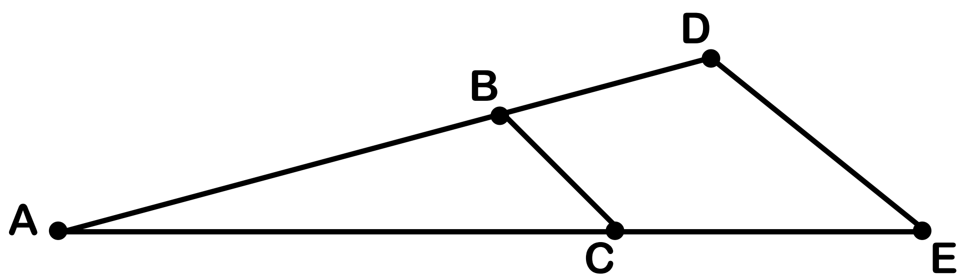
wall's height is 3.6 m

S & S - Problem 5.3 notes - "Stacked Triangles"

Definitions:
none

Sometimes we need to know the distance ACROSS something, but perhaps it is too difficult to measure, like a canyon or a deep lake. We can use imaginary lines forming "stacked" triangles to find this distance.

Here is an example of 2 stacked triangles, $\triangle ABC$ and $\triangle ADE$:



Corresponding Sides		Corresponding Angles	
AB	AD	∠ A	∠ A
AC	AE	∠ B	∠ D
BC	DE	∠ C	∠ E

Now, say we were trying to measure the distance across Bevort Pond.

insert picture pg 63

	$\triangle ABC$	$\triangle ADE$
base	120 ft	(120+40 =) 160 ft
right side	?	70 ft

the distance BC = 52.5 ft