

In this lab, you will be given sets of cups in which you will find a mixture of two types of objects along with some pennies. The two objects will be the *variables*, since the type of objects will *vary* from station to station.

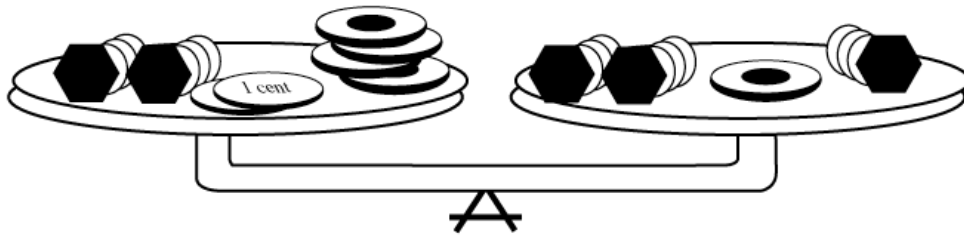
If you have 5 nails in one cup, you would write 5N, while 6 pencils would be represented as 6P. In these cases, the N and P's will be variables. In this lab your job, should you choose to accept, is to find out how much one of the objects weighs in terms of pennies and the other object.

Pennies will always act as *constants*. By that I mean, their value will *always be the same* in every station. So if you find 4 pennies in a container, just write + 4. Don't write + 4P because the pennies are constants and 4 is a constant, so it's always the same value. This next example should help make this clearer.

- 1) Objects, such as pencils, will be called _____ and the pennies are the _____.

You know how to attack these. To keep the cups balanced on the scale, you must always **remove the same amount of items from both cups**. Continue doing this until you end up with **all of the same kind of objects in one cup** and the **other objects and pennies in the second cup**.

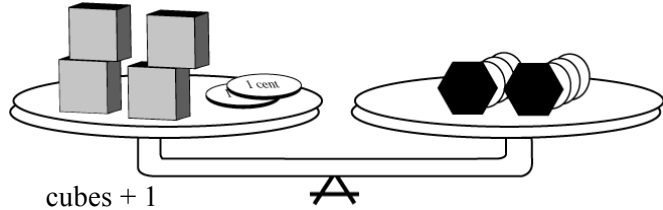
- 2) On the scale below, please make a few mental transfers and you will be able to see that **one bolt weighs the same as a certain number of washers and pennies**.



- a) What did you do first? *I took away _____ from each side.*
(Perhaps cross them out in the picture to help you keep organized.)
- b) Then, *I took away _____ from _____.*
- c) Now I could see that one bolt is the same weight as _____ washers plus _____ pennies.
- 3) As you go to each station in this lab, you will **tell me what you did** to find the weight. Here's how to describe your steps using **both words and algebra** for the one above.

- | <u>Words</u> | <u>Algebra</u> |
|---|--|
| $2 \text{ Bolts} + 4 \text{ Washers} + 2 = 3 \text{ Bolts} + 1 \text{ Washer}$ | $2\mathbf{B} + 4\mathbf{W} + 2 = 3\mathbf{B} + 1\mathbf{W}$ |
| a) <i>Now I took away 2 Bolts from each side.</i> | $2\mathbf{B} + 4\mathbf{W} + 2 - 2\mathbf{B} = 3\mathbf{B} + 1\mathbf{W} - \underline{\hspace{1cm}}$ |
| b) <i>I simplified it.</i> | $4\mathbf{W} + 2 = \underline{\hspace{1cm}} + 1\mathbf{W}$ |
| c) <i>Then I took away 1 Washer from each side.</i> | $4\mathbf{W} + 2 - 1\mathbf{W} = 1\mathbf{B} + 1\mathbf{W} - 1\mathbf{W}$ |
| d) <i>Here is what I get.</i> | $\underline{\hspace{1cm}} + 2 = 1\mathbf{B}$ |
| e) <i>This explains why 1 Bolt weighs the same as _____ Washers plus 2 pennies.</i> | |

- 4 a) You are pretty good at these puzzles already. Try this one. If two bolts weigh the same as four cubes + 2, what does **one bolt** weigh?



One bolt would weigh the same as ___ cubes + 1

- b) You would show this with algebra this way.

$$4C + 2 = 2B$$

- c) Then just divide both sides of the equation into 2 equal parts.

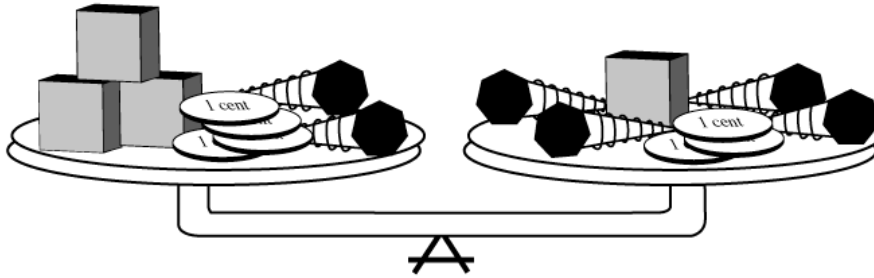
$$\frac{4C + 2}{2} = \frac{2B}{2}$$

- d) Now it's important that you remember to divide **both** the 4C **and** the 2 by the 2.

$$___ + ___ = 1B$$

This next one is not really that complicated, yet it will take organizational and communication skills to make sure you can tell any person reading it what you did to find the weight of one lag bolt.

- 5) Find the weight of one lag bolt *in terms of* cubes and pennies. Make sure you aren't just filling in blanks, but are focusing on learning. **Cross off the items in the picture as you go.**



In this lab, you will use your communication skills to show how to do it two ways.

Words

Algebra

- a) Here's the equation:

$$2L + ___ C + 4 = 4L + 1C + 3$$

- b) *I will take two Lag bolts from both sides.*

$$2L + 3C + 4 - 2L = 4L + 1C + 3 - ___$$

- c) *Here's what I get:*

$$___ + ___ = ___L + 1C + 3$$

- d) *Now I just need to take 1 cube from both sides.*

$$3C + 4 - 1C = 2L + 1C + 3 - ___$$

- e) *I get this:*

$$___ + 4 = 2L + 3$$

- f) *Now take 3 from both sides.*

$$2C + 4 - 3 = 2L + 3 - ___$$

- g) *I get....*

$$2C + 1 = ___$$

- h) *If 2 Lag bolts weigh 2 Cubes + 1, I'll divide both sides into 2 piles.*

$$\frac{2C + 1}{2} = \frac{2L}{*}$$

- i) *Finally, it's clear that 1 Lag bolt weighs 1C + 1/2*

$$___ + ___ = 1L$$

Wow, it takes a lot of steps to clearly show how to solve these, but as you run this lab they should become clear and very logical. After you and your partner finish one set of cups, then just come up and pick up another set.

To be successful, it is important you write down what you do immediately as you do it.

You'll find the "weight" of one of the objects (variables) in terms of the other two. Just follow the earlier examples. There will always be pennies at each station, and they represent the _____.

Cup # ____ Objects in the containers: _____, _____ and pennies.
On one of the cups I have written the name of the object I want you to find the weight of.

For you to really understand this lab, **it is important for you to write each step immediately after you move objects** from one container to another.

Words

Algebra

Here's the original equation: _____ = _____

I'll take _____ from both sides. _____ - _____ = _____ - _____

Here's what I get: _____ = _____

Now I need to take _____ from _____.

I get: _____ = _____

Now I'll take _____

I get: _____ = _____

If _____ weighs _____, + _____ I'll ÷ both sides into _____ piles. * _____ = * _____

So I _____ "weighs" the same as _____.

Before you move on, use your equation to **reset the containers for this cup-set** as they were when you got there. Then trade your containers for a new set.

Cup # ____ Objects in the containers: _____, _____ and pennies.
On one of the cups I have written the name of the object I want you to find the weight of.

Words

Algebra

Here's the original equation: _____ = _____

Take _____ from both sides. _____ - _____ = _____ - _____

Here's what I get: _____ = _____

Now I need to take _____ from _____.

Simplified, it is _____ = _____

Now take _____

I get: _____ = _____

_____ weighs _____, + _____, so ÷ both sides into _____ piles. * _____ = * _____

So I _____ "weighs" the same as _____.

Be kind, please reset the containers for this cup-set to the same way you found them.

On these last sets, you will only have to **explain each step** you did in the language of algebra. **Look at the example from page 2** to follow while you do these last stations.

Again, find the weight of the object whose name is on one of the cups.

Only list the two variables in the cups, all will have pennies. **Remember, the key to learning is to write what you did immediately after you do it.**

Cup # _____ and _____

Here's my equation:

$$\begin{aligned} & \underline{\hspace{2cm}} &= & \underline{\hspace{2cm}} \\ \underline{\hspace{2cm}} - \underline{\hspace{1cm}} &= & \underline{\hspace{2cm}} - \underline{\hspace{1cm}} \\ &= & & \\ \underline{\hspace{2cm}} - \underline{\hspace{1cm}} &= & \underline{\hspace{2cm}} - \underline{\hspace{1cm}} \\ &= & & \\ \underline{\hspace{2cm}} &= & \underline{\hspace{2cm}} \\ &= & & \\ \underline{\hspace{2cm}} &= & \underline{\hspace{2cm}} \\ &= & & \\ & \frac{*}{*} &= & \frac{*}{*} \\ & \underline{\hspace{1cm}} &= & \underline{\hspace{1cm}} \end{aligned}$$

So I _____ "weighs" _____.

Please reset the cups before moving on.

Cup # _____ and _____

$$\begin{aligned} & \underline{\hspace{2cm}} &= & \underline{\hspace{2cm}} \\ \underline{\hspace{2cm}} - \underline{\hspace{1cm}} &= & \underline{\hspace{2cm}} - \underline{\hspace{1cm}} \\ &= & & \\ &= & & \\ &= & & \\ &= & & \\ &= & & \\ &= & & \\ &= & & \\ & \frac{*}{*} &= & \frac{*}{*} \\ & \underline{\hspace{1cm}} &= & \underline{\hspace{1cm}} \end{aligned}$$

I know I _____ "weighs" _____.
You know what to do before you move on :-)

Cup # _____ and _____

Here's my equation:

$$\begin{aligned} & \underline{\hspace{2cm}} &= & \underline{\hspace{2cm}} \\ \underline{\hspace{2cm}} - \underline{\hspace{1cm}} &= & \underline{\hspace{2cm}} - \underline{\hspace{1cm}} \\ &= & & \\ \underline{\hspace{2cm}} - \underline{\hspace{1cm}} &= & \underline{\hspace{2cm}} - \underline{\hspace{1cm}} \\ &= & & \\ \underline{\hspace{2cm}} &= & \underline{\hspace{2cm}} \\ &= & & \\ \underline{\hspace{2cm}} &= & \underline{\hspace{2cm}} \\ &= & & \\ & \frac{*}{*} &= & \frac{*}{*} \\ & \underline{\hspace{1cm}} &= & \underline{\hspace{1cm}} \end{aligned}$$

So I _____ "weighs" _____.

Don't forget to be kind and reset the cups.

Cup # _____ and _____

I _____ "weighs" _____.