Notes

Relationships and Patterns

Course Long Goal

Nature behaves in very predictable ways. There are patterns of behavior in the physical world.

Our goal is to discover, describe, and explain these patterns.

Experiments

Typical Goal: to determine the effect of one quantity upon another quantity.

Example: How does the **mass** of an object affect its **acceleration**? That is, to determine the effect of **mass** upon **acceleration**.

Variable - a quantity that changes or varies.

Independent Variable: the variable that the scientist intentionally changes each trial.

Dependent Variable: the variable that changes in response to the changes that are made to the independent variable.

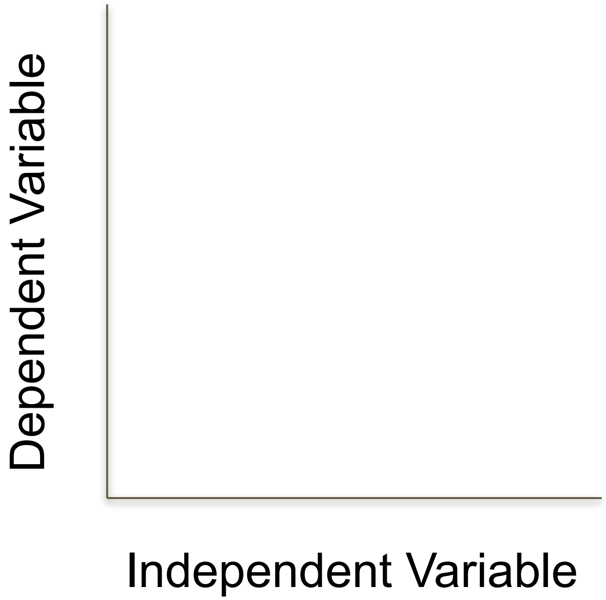
Dependent vs Independent Variable

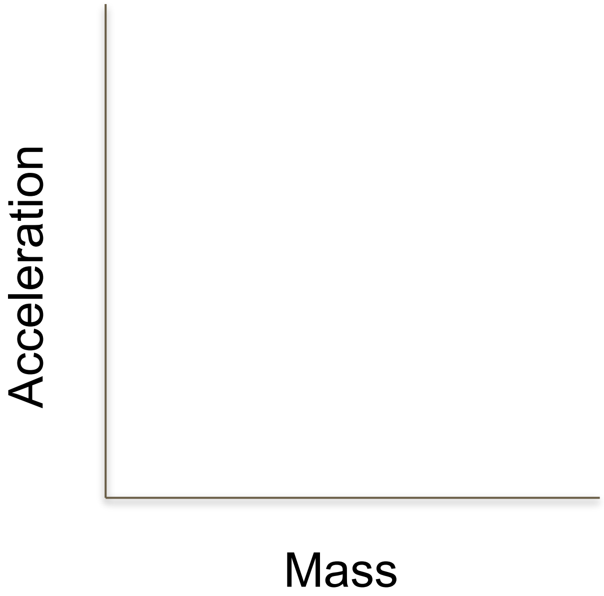
Purpose: to determine the effect of mass upon the acceleration of an object.

Independent Variable: mass (it is varied by the scientist from trial to trial)

Dependent Variable: acceleration (it varies in response to changes in the mass)

Dependent vs Independent Variable





DRY MIX

Dependent - Responding - Y-axis

The dependent variable changes in response to the other variable; its values are plotted on the y-axis.

Manipulated - Independent - X-axis

The independent variable is the one that is manipulated or changed by the scientist; values are plotted on the x-axis.

What types of patterns are possible?

1. Linear Relationship
2. Non- or Constant Relationship
3. Quadratic Relationship
4. Inverse Relationship

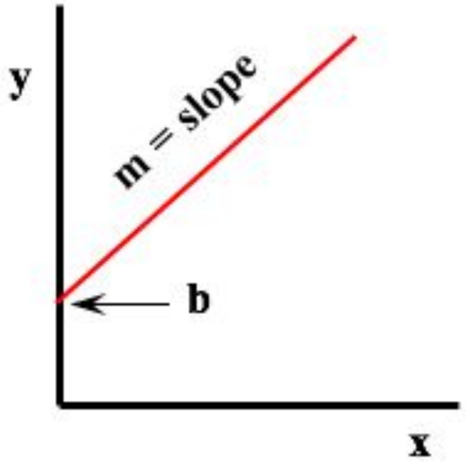
Linear Relationship

Any given change in the independent variable (x) will always produce the same change in the dependent variable (y).

x	y
0	4
1	6
2	8
3	10
4	12
5	14

When x changes by a certain amount (1 unit), the value of y always changes by the same amount (e.g., 2 units).

$$y = m \cdot x + b$$



Directly Proportional Relationship

A special type of linear relationship - shows an x-y plot that is linear and has a y-intercept of zero.

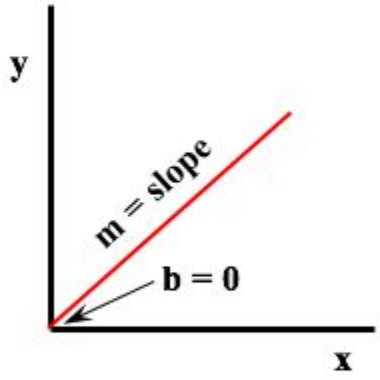
Whatever change is made to one variable is made to the other variable.

y = m•x

Double x … double y

Triple x … triple y

Halve x … halve y



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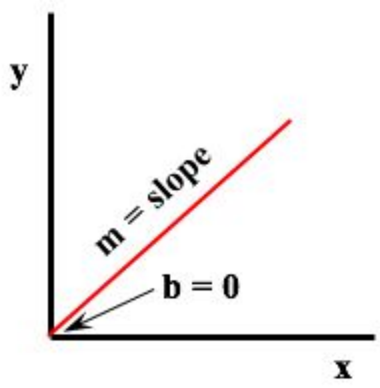

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1	2
2	**4**
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5	10

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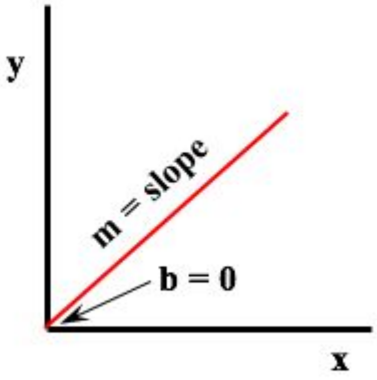

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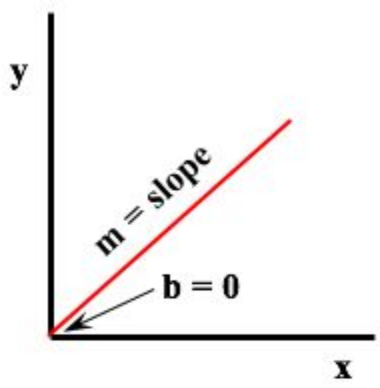

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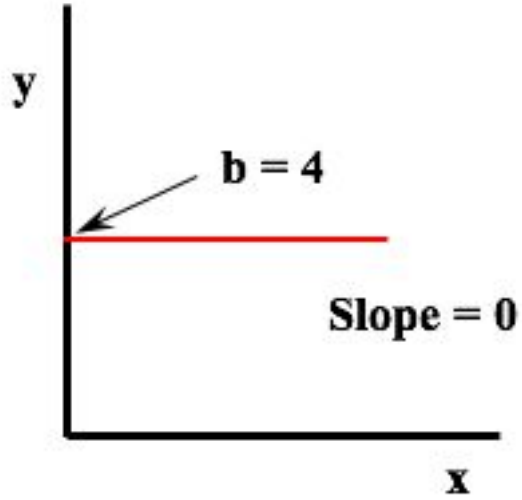
Non-Relationship (or Constant Relationship)

A change in one variable will have no effect upon the value of the other variable.

As the value of x changes, the value of y remains constant.

X has NO effect upon Y.

y = 4



x	y
0	4
1	4
2	4
3	4
4	4
5	4

Quadratic Relationship

Most commonly, a quadratic will show an exponent of 2, indicating that the y value depends on the square of x.

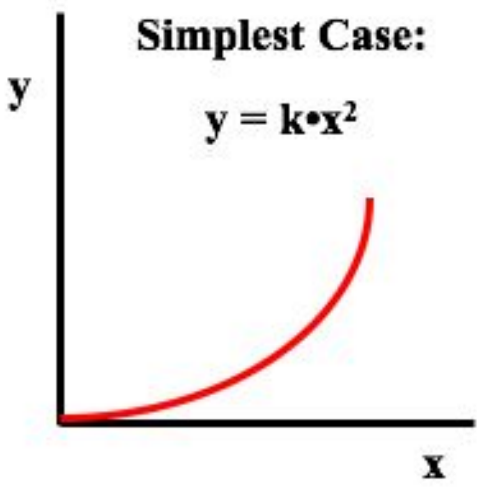
Whatever change is made to x, the square of that change is made to y.

Double x … Quadruple y

Triple x … Nine times y

Halve x … One-quarter y

$y = A \cdot x^2$



x	y
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1	2
2	8
3	18
4	32
5	50

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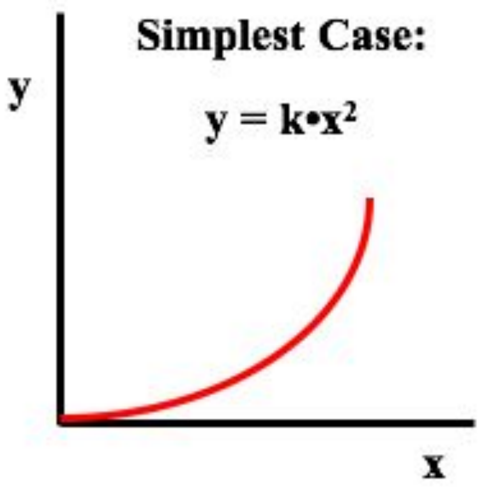

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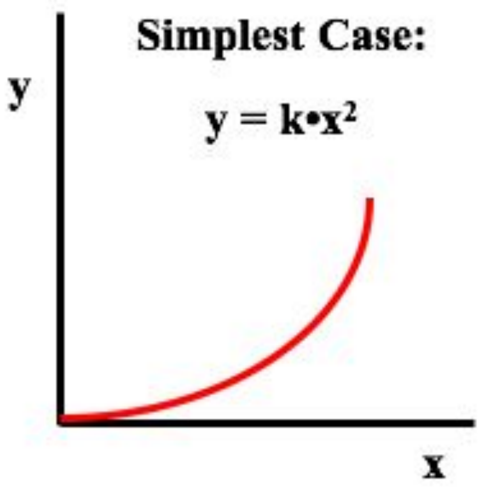

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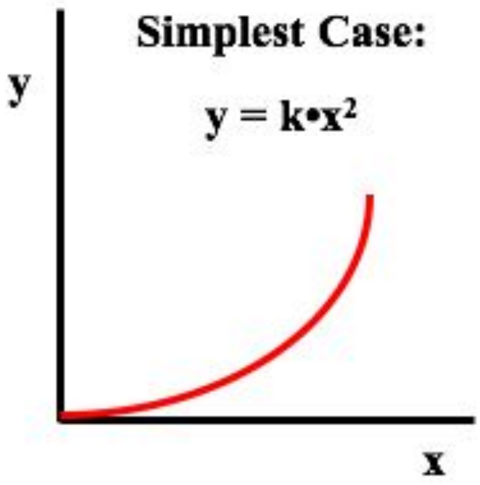

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Inverse Relationship

An increase in one variable causes a decrease in the other variable.

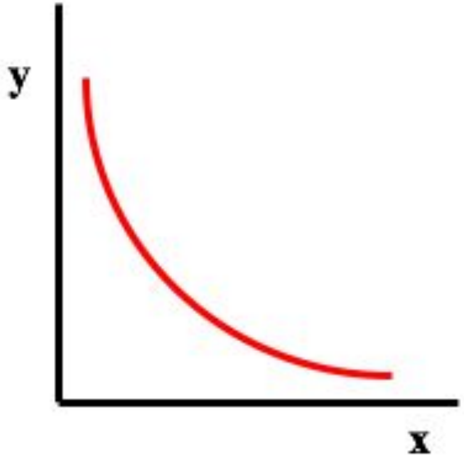
Whatever change is made to x, the reciprocal change is made to y.

Double x … Halve y

Quadruple x … One-fourth y

Halve x … Double y

x•y = 12
or
y = 12/x



x	y
1	12
2	6
3	4
4	3
5	2.4
6	2

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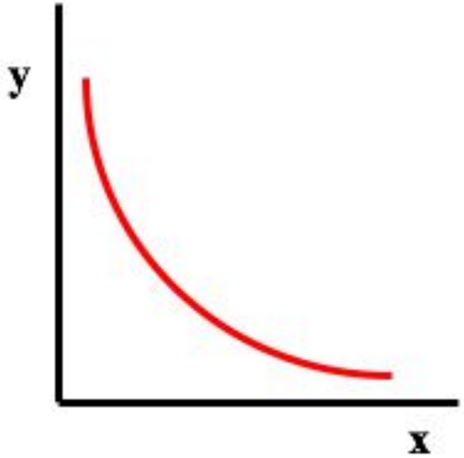

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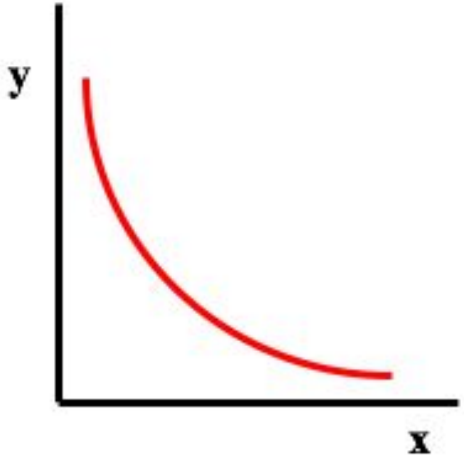

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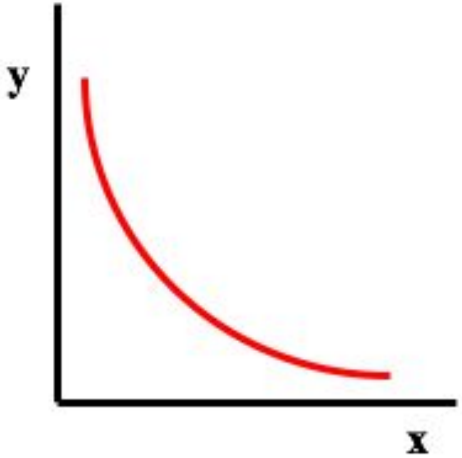

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The Big Idea on Relationships

Throughout the year we will do experiments and collect data for the dependent and independent variables.

Then we will need to identify the type of relationship from the patterns that we observe in the data.