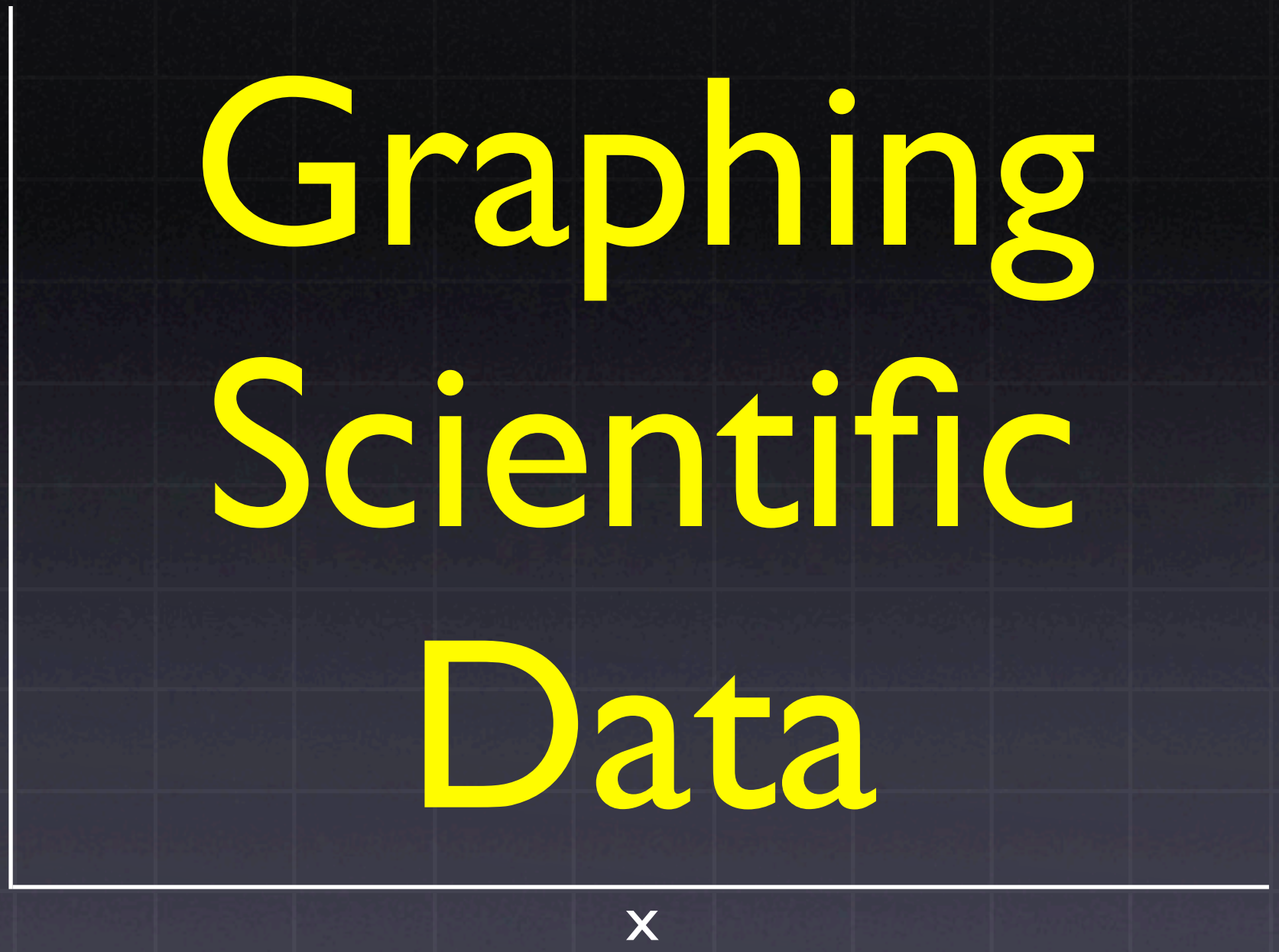
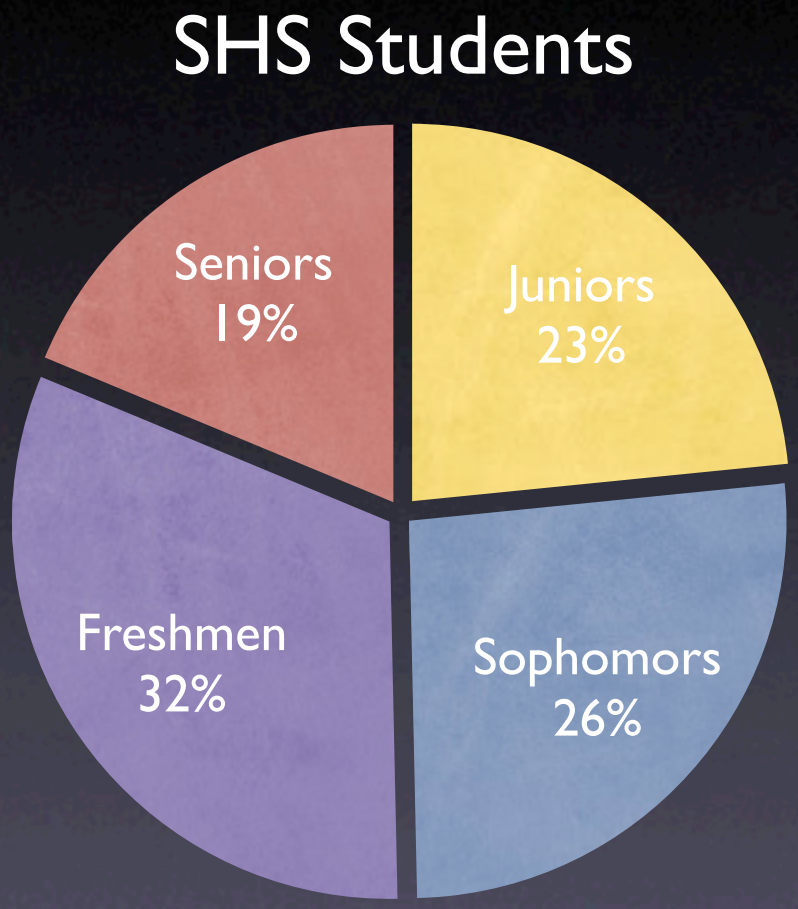


Graphing Scientific Data

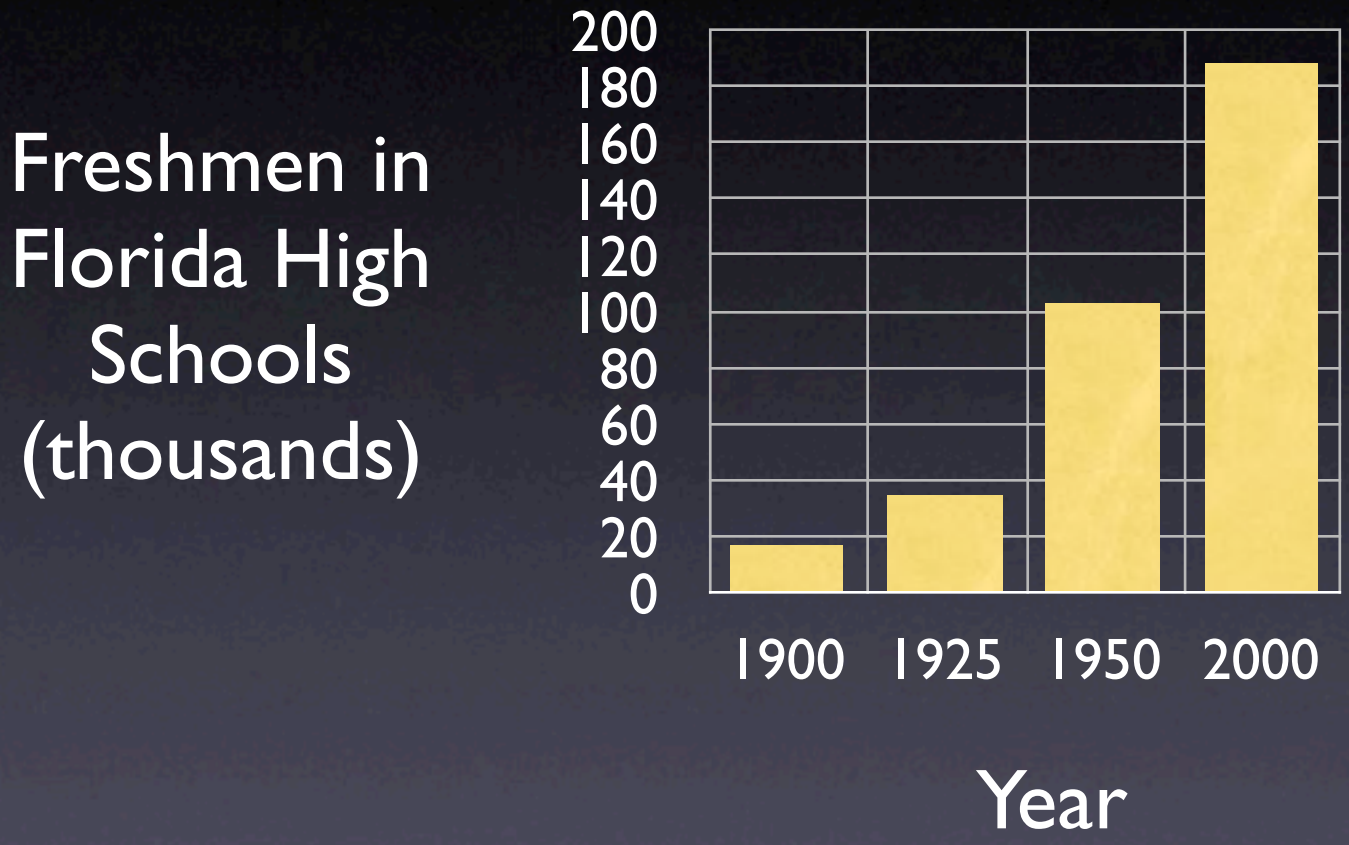
Mr. Gilliland
Honors Phy. Sci. @SHS

Pie Graphs



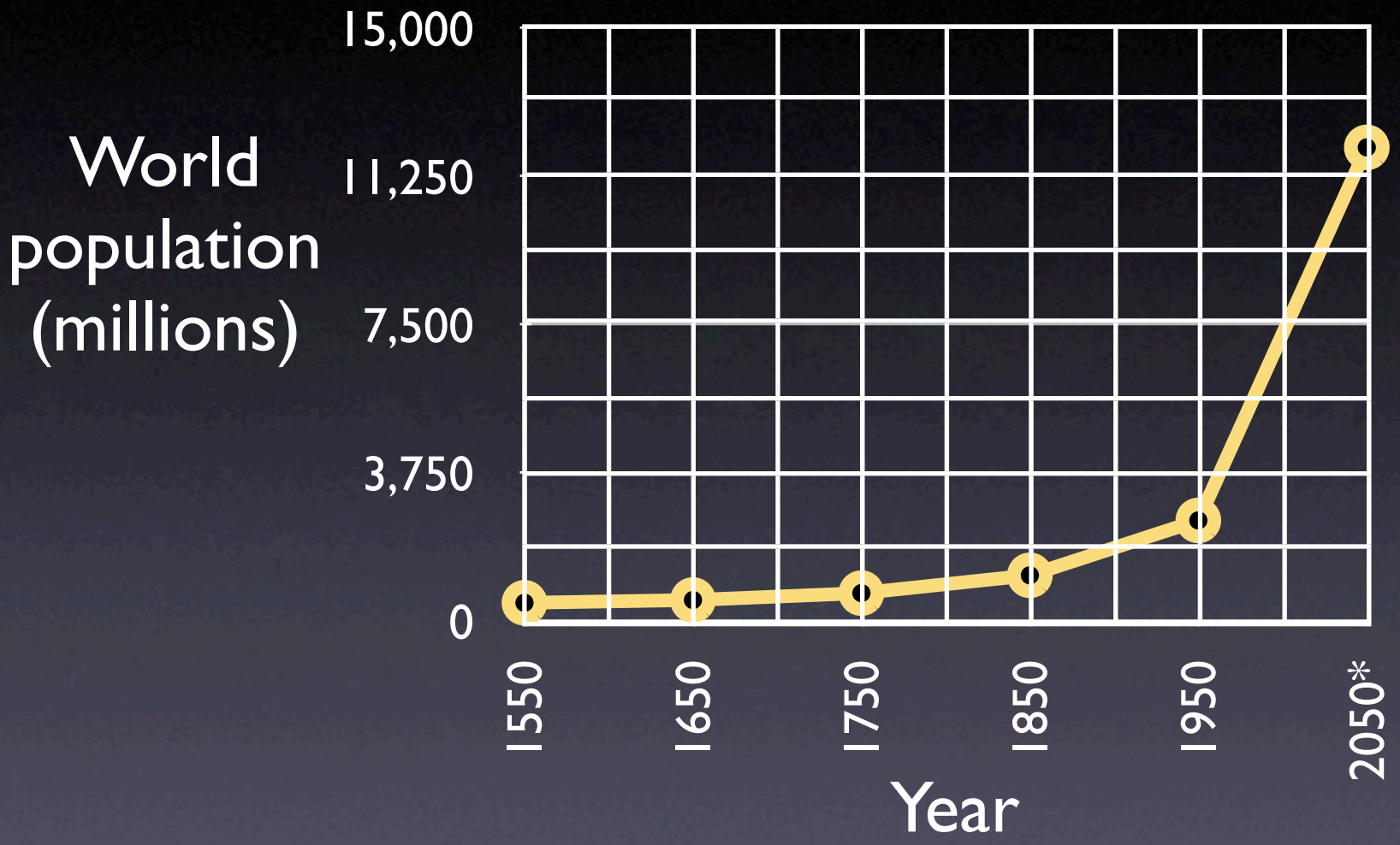
Pie graphs are useful to show parts of a whole.

Bar Graphs



Bar graphs are useful to show comparison.

Line Graphs



Lines graphs are used to show trends your data.

This is type used most often in science.

Scientific Graphing

In Science you are are graphing measurements while in Math you graph numbers.

Because of this difference *graphing in Science is done differently than in Math*.

Plotting Variables in Science

Graphs in Science always contain two variables:

- Independent Variable
- Dependent Variable

Independent & Dependent Variables

Most experiments involve two variables that change concurrently.

The variable you change directly (you control) is the independent variable.

The variable that responds is called the dependent variable.

Examples of Independent & Dependent Variables

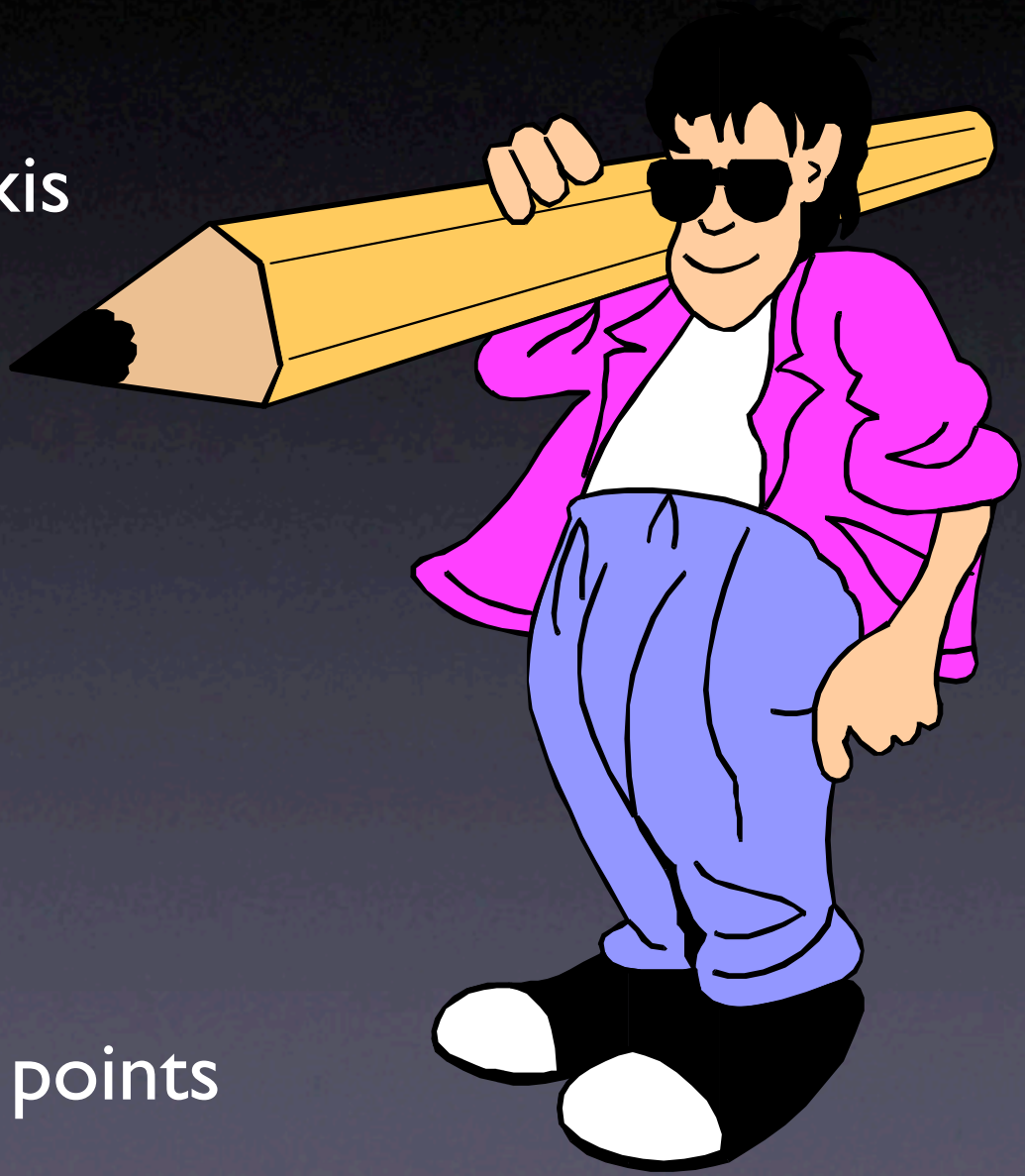
In the pendulum lab the mass, angle and length of the pendulum were independent variables.

The period of the pendulum was the dependent variable.

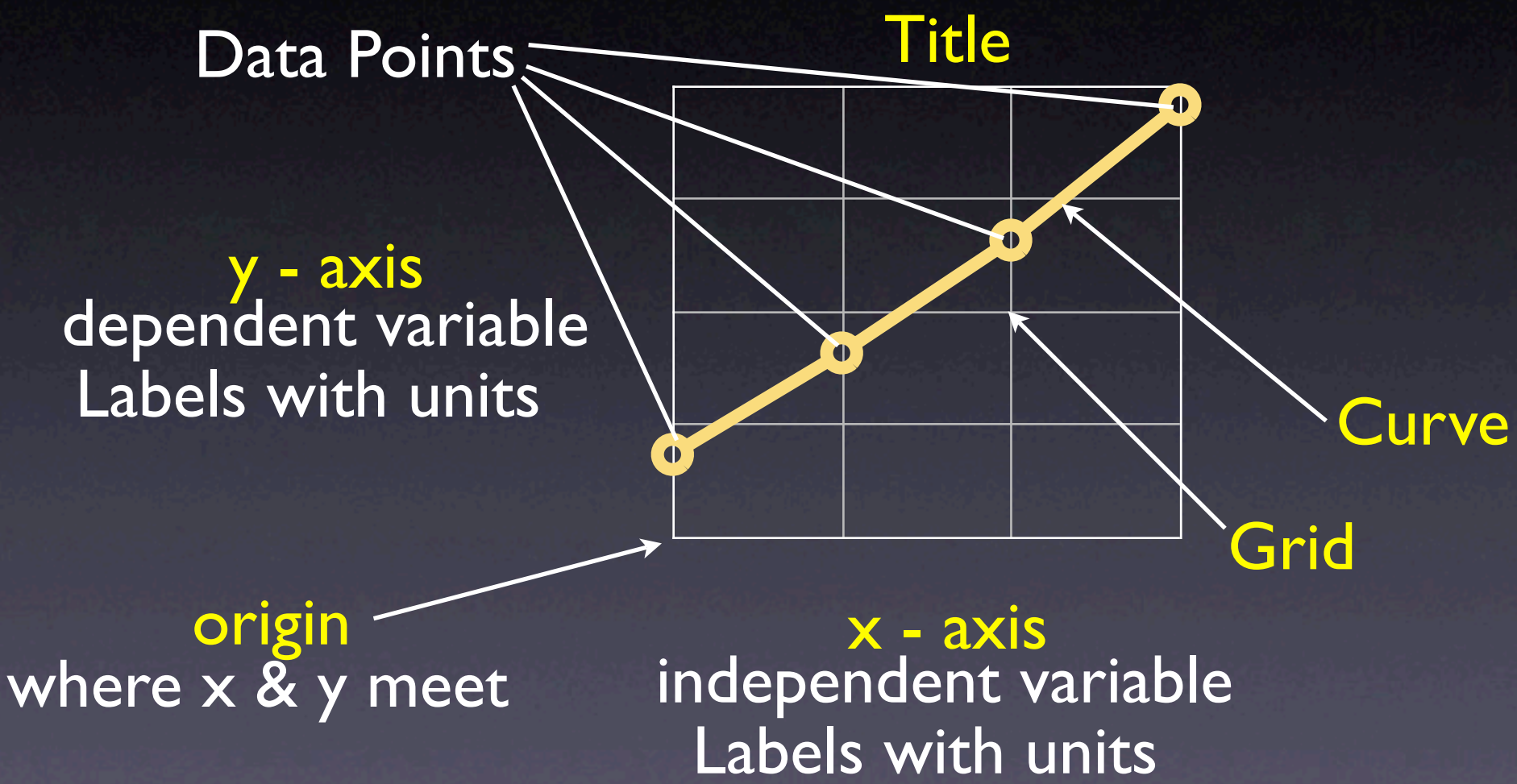
The dependent variable always depends on the independent variable - that is why it is called the dependent variable.

Parts of a Graph

- grid
- x & y axis
- variable
- origin
- curve
- title
- labels
- plotted points



Parts of a Graph



The Scale

Just as every instrument has a calibration, every graph has a scale.

The scale of a graph tells you the value each line on the graph. Before you can make a graph you must create a scale for both axes.

Guidelines for your scale:

- Chose a scale that is easy to read. Use 1, 2, 5, 10 or multiples of 10. Never use "odd" numbers like 3.25 or 11.6. For numbers less than 1, use 0.1, 0.2 or 0.5.
- Select a scale that nearly fills the page with your curve.
- Scales on your x-axis and y-axis are usually not the same.
- Always label your axes with both title and units. Example: Speed (m/s)

Formula for Best Scale

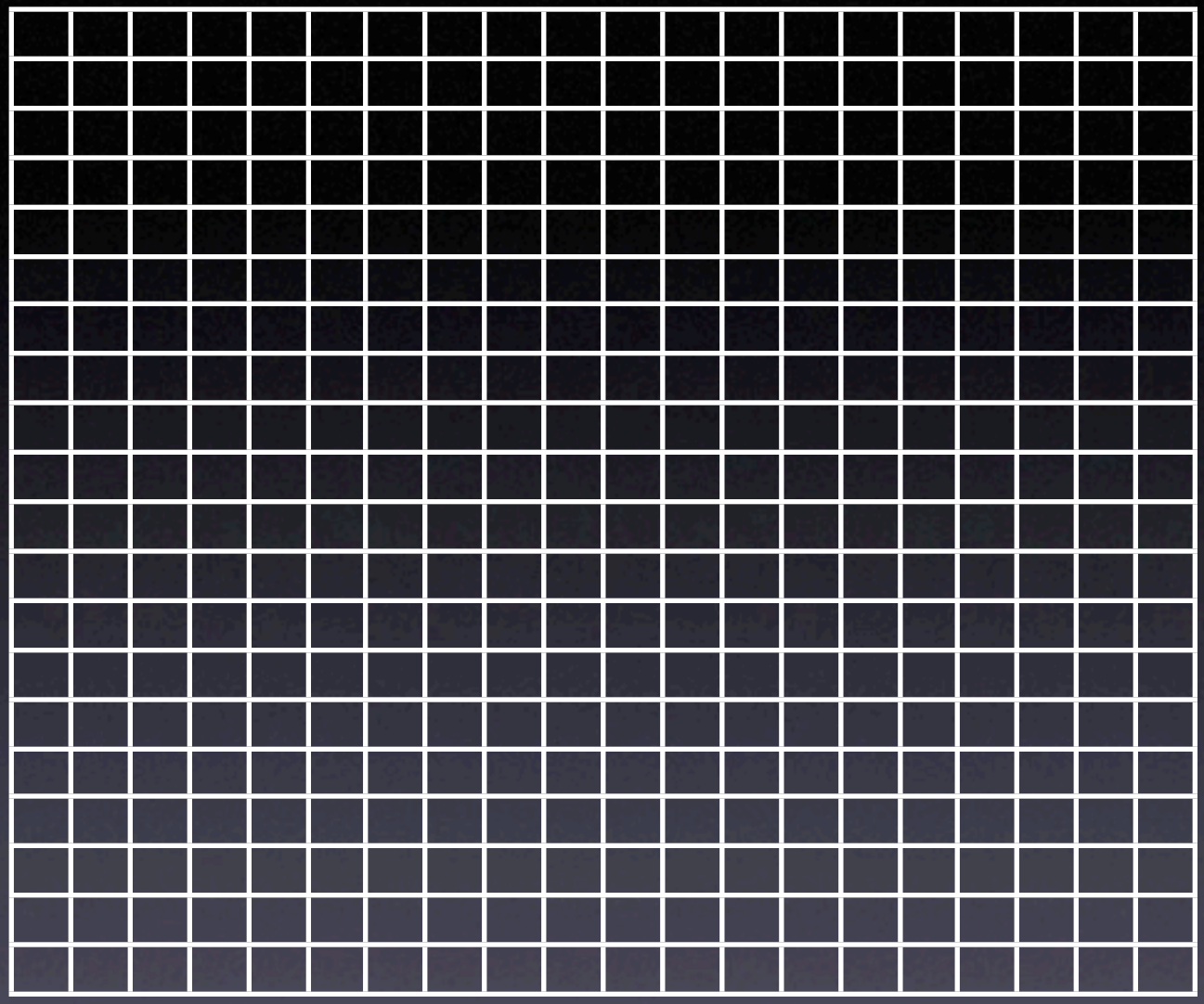
- Subtract the highest and lowest data you wish to plot on your graph. Look at questions as well as data.
- Count the number of spaces on the axis. (Count the spaces - not the lines.)
- Divide the data spread you wish to plot by the number of spaces on the axis. Include units!
- Pick a value HIGHER than you get that is easy to use.
- Scales less than one: 0.1, 0.2, 0.5
- Scales more than one: 1, 2, 5 and multiples of 5 or 10.
- DO NOT USE YOUR DATA AS A SCALE!!!!!!

Calculating a Scale

Data

fertilizer	growth
0 g	37 cm
2.0 g	38 cm
5.0 g	40 cm
8.0 g	42 cm
12.0 g	44 cm
16.0 g	46 cm

fertilizer's effect on plant growth



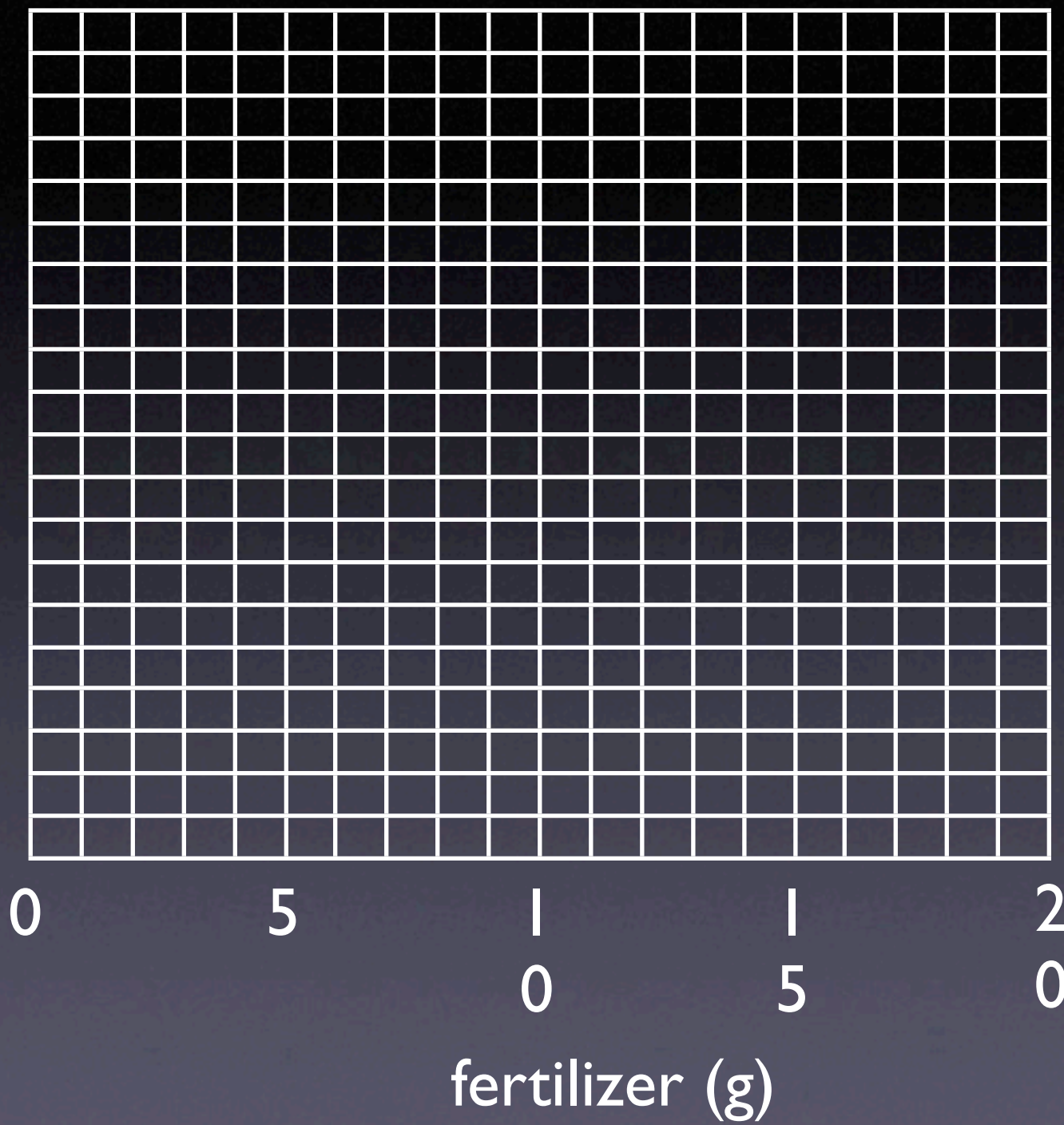
$$\frac{16.0\text{ g}}{20\text{ spaces}} = \frac{0.8\text{ g}}{\text{space}} = \frac{1.0\text{ g}}{\text{space}}$$

Calculating a Scale

Data

fertilizer	growth
0 g	37 cm
2.0 g	38 cm
5.0 g	40 cm
8.0 g	42 cm
12.0 g	44 cm
16.0 g	46 cm

What is the best scale for the y-axis?



Calculating a Scale

Data

fertilizer	growth
0 g	37 cm
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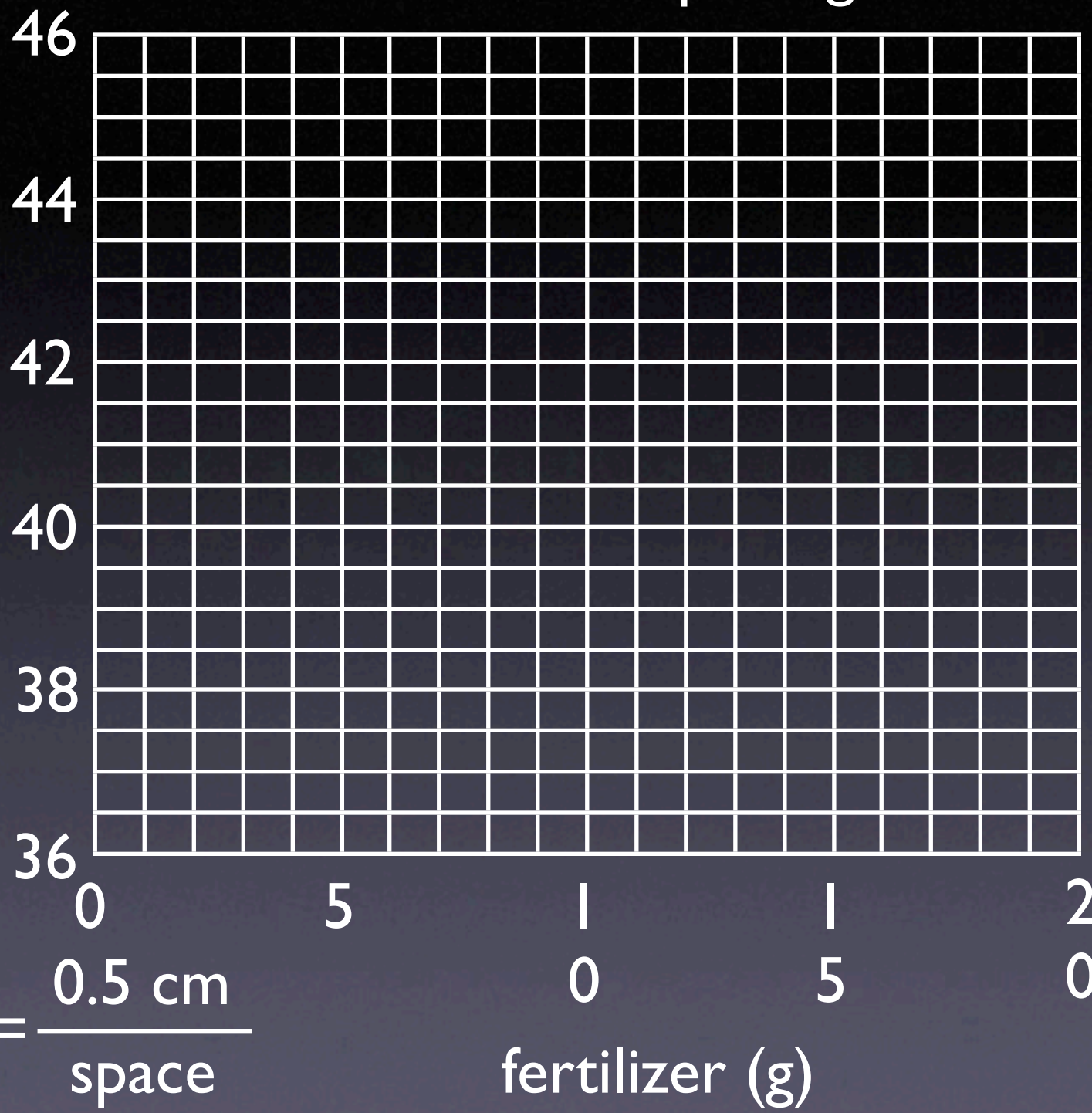
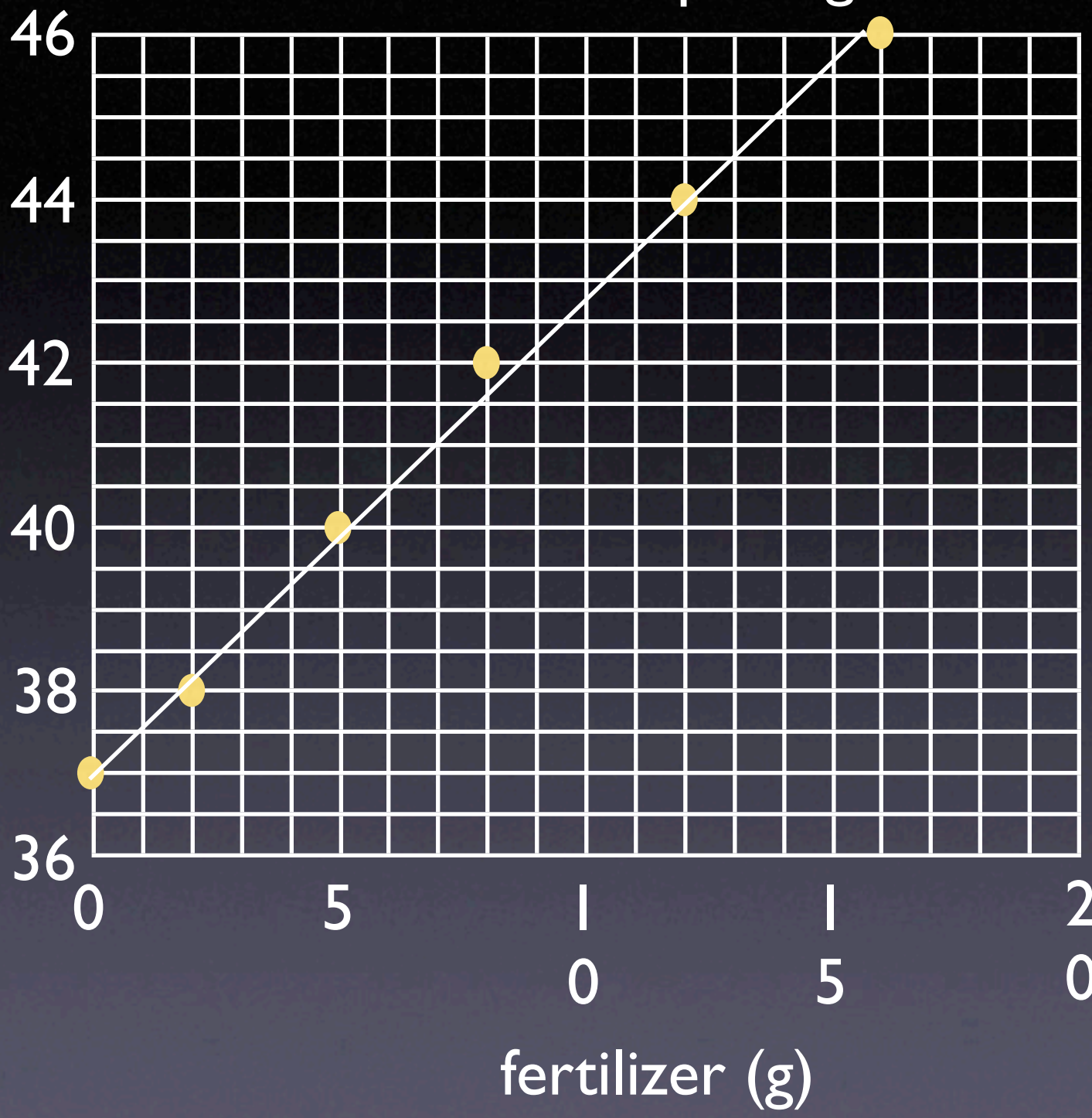


$$\frac{9\text{ cm}}{20\text{ spaces}} = \frac{0.45\text{ cm}}{\text{space}} = \frac{0.5\text{ cm}}{\text{space}}$$

Calculating a Scale

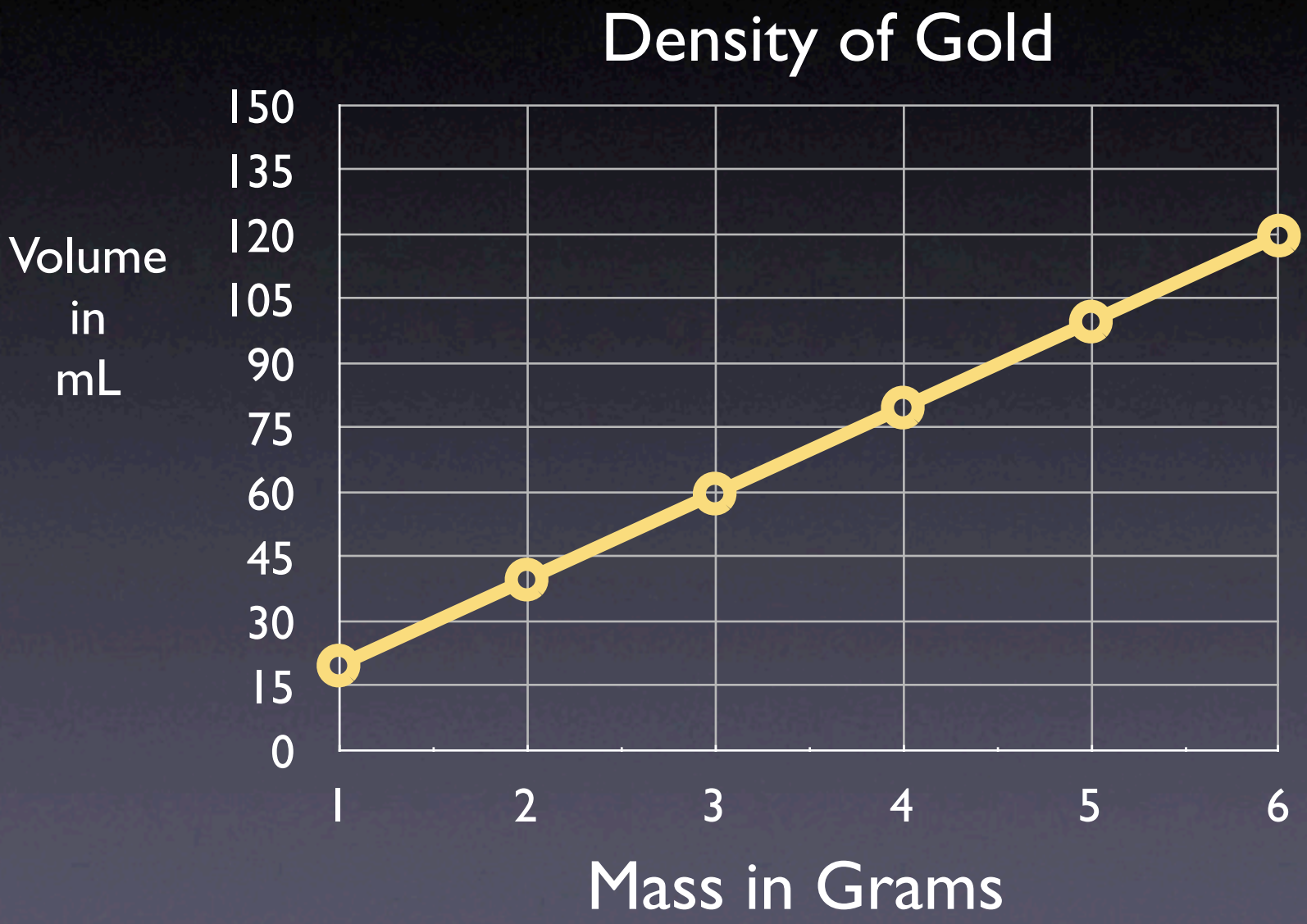
Data

fertilizer	growth
0 g	37 cm
2.0 g	38 cm
5.0 g	40 cm
8.0 g	42 cm
12.0 g	44 cm
16.0 g	46 cm



Which axis is incorrect?

A Good scale uses most of your grid.



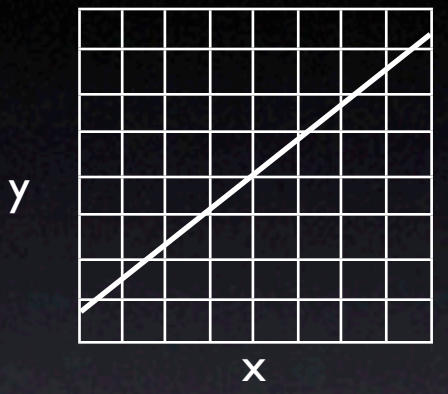
Drawing your Curve

On any line graph, the line is called the curve.

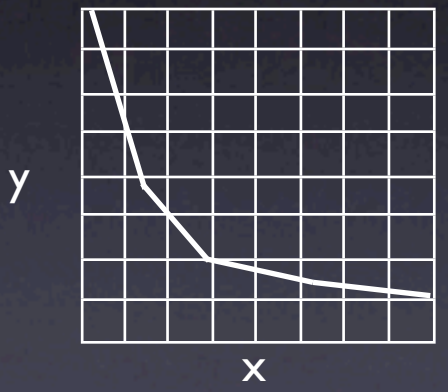
The curve shows the relationship between the independent variable and the dependent variable.

3 Types of Line Curves

Linear - Straight line going up or down.
As x increases, so does y.
As x decreases, so does y.



Hyperbola - curves as it falls.
As x increases, y decreases quickly.

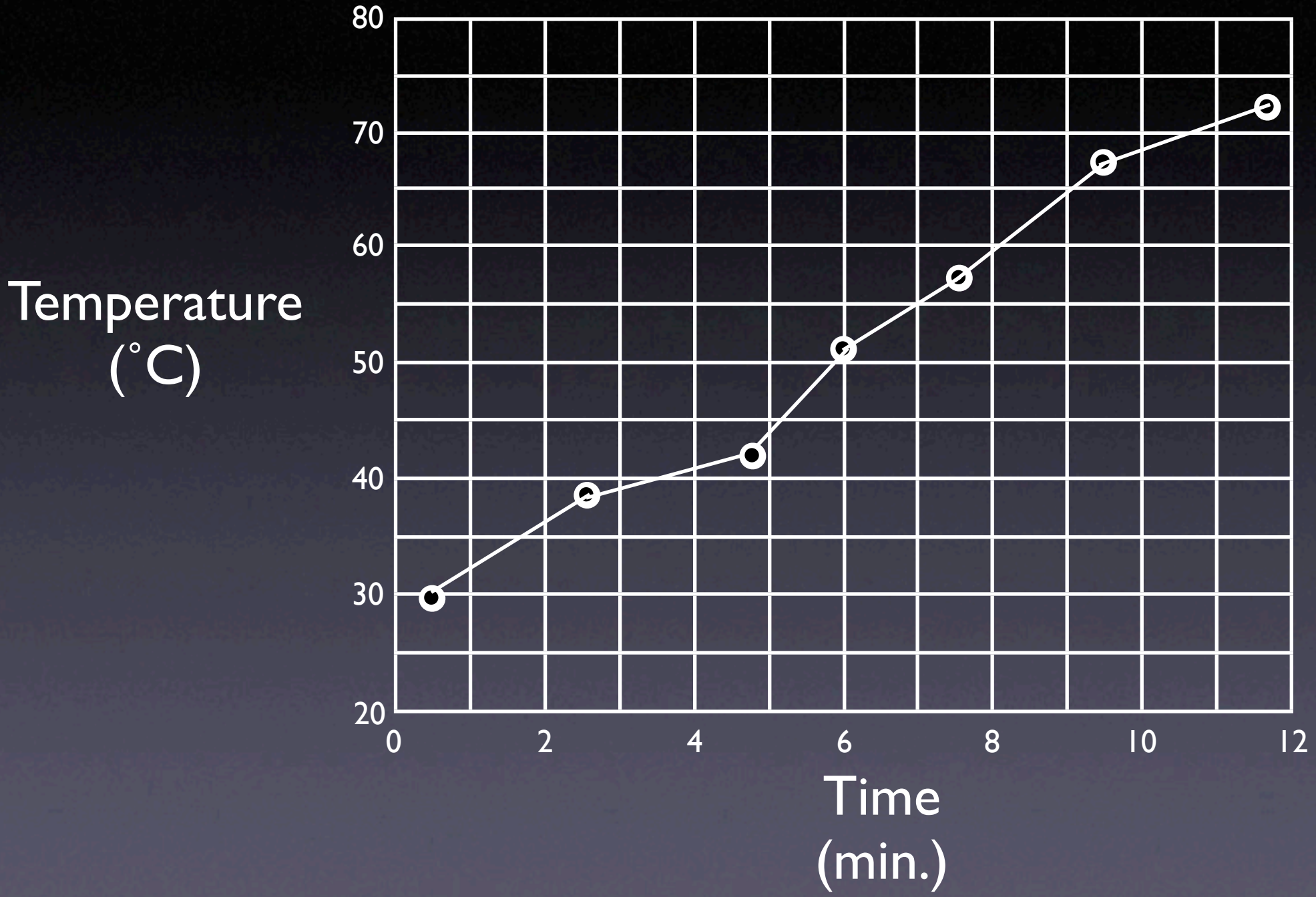


Parabola - curves as it rises.
As x increases, y increases quickly.

When drawing a curve:

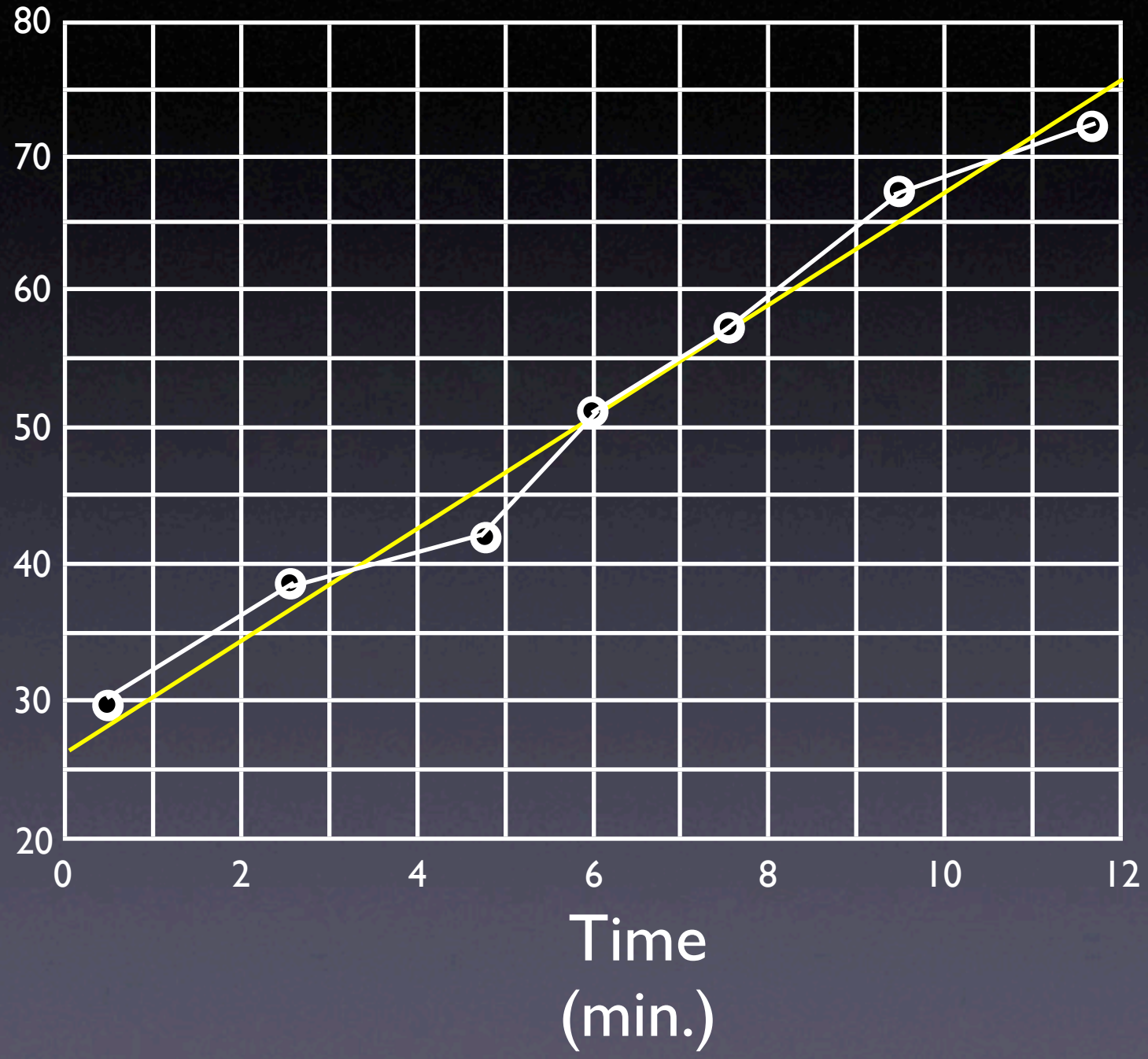
- Look at your data to determine if your curve is linear, a hyperbola or parabola.
- Circle your plotted points so they stand out.
- Do not connect your points - draw a line of best fit.
- Extend your curve all the way across the grid - don't stop at your first or last point.
- Draw a linear curve with a ruler. For a hyperbola & parabola draw a smooth curve.

DO NOT CONNECT THE POINTS IN SCIENCE.



DO NOT CONNECT THE POINTS.

DRAW A LINE OF BEST FIT.

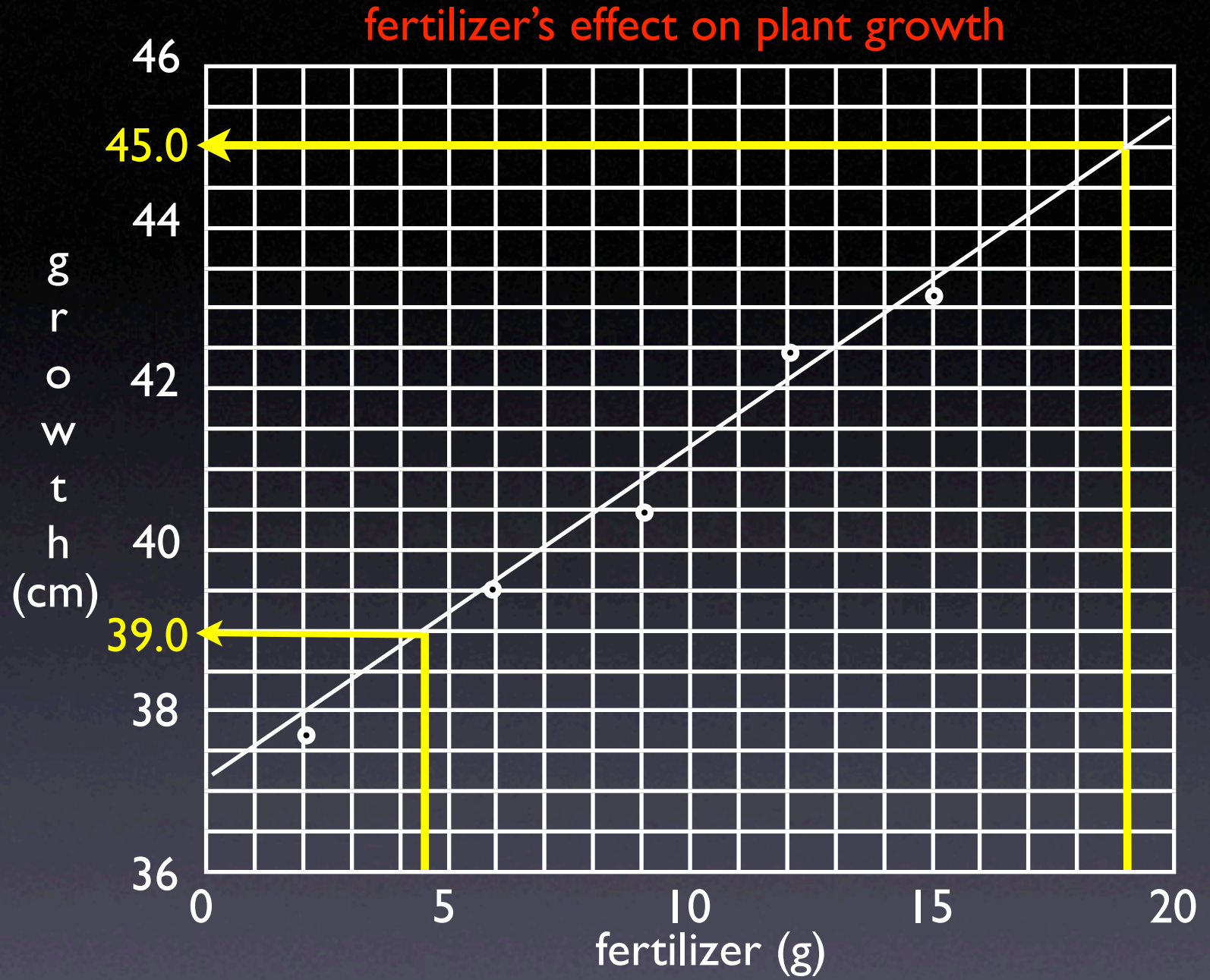


Important! The curve does not begin at the origin. Rarely does it.

Interpolation
&
Extrapolation

Interpolate: To find the value of a point inside your data points.

Extrapolate: To find the value of a point outside of your data points.



How much growth would you get with 4.5 grams of fertilizer? interpolated

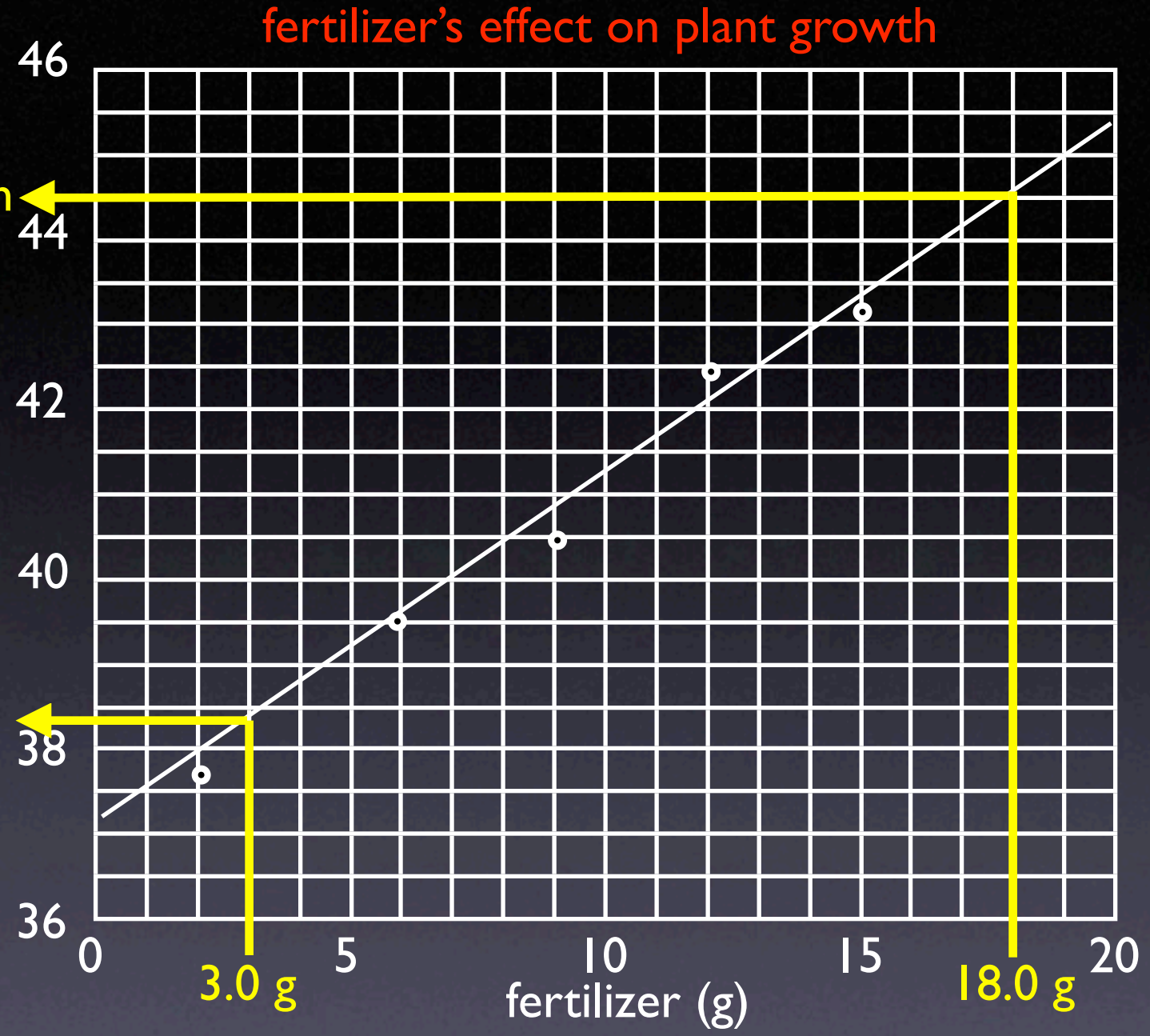
How much growth would you get with 19 grams of fertilizer? extrapolated

Calculating The Slope of a Linear Curve

$\Delta y/\Delta x$

Slope of a curve:

To determine how much the y-axis changed per one change in your x-axis.



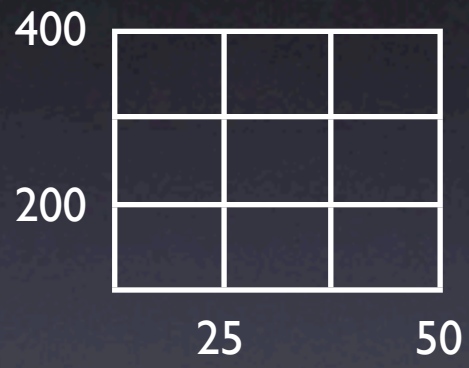
Slope of the curve tells you that for every gram of fertilizer the plants grew 0.41 cm.

1. Select two points on your x-axis. Subtract them. (Δx) 15.0 g
2. Find the two corresponding values on the y-axis. Subtract them. (Δy) 6.1 cm
3. Divide $\Delta y/\Delta x$. Be sure to include units! 6.1 cm/15.0 g = 0.41cm/g

Common mistake #1

Label the first line on the x and y axis. Don't skip the first line (origin).

INCORRECT

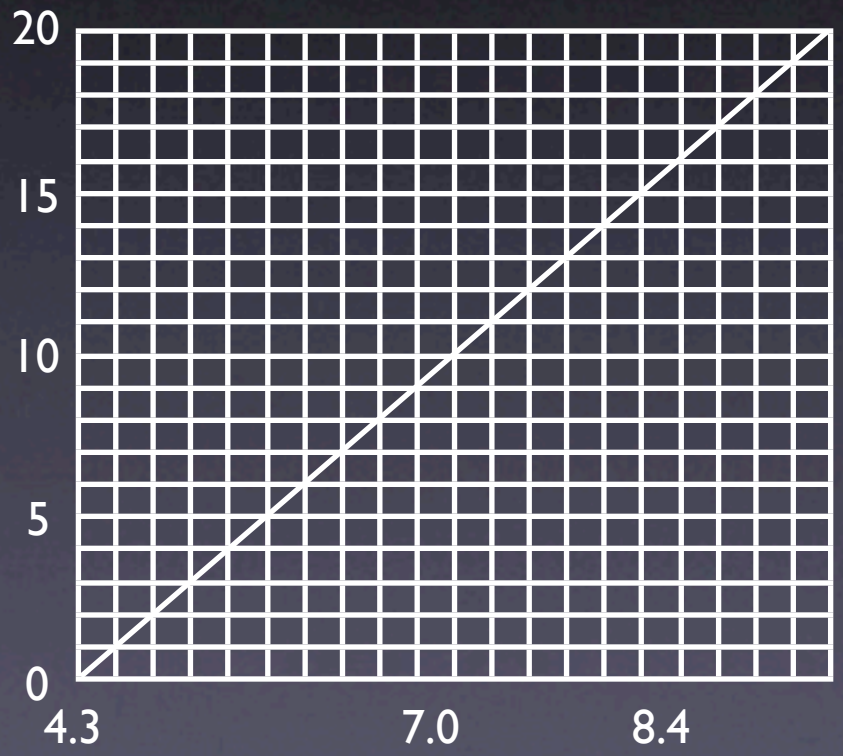


CORRECT

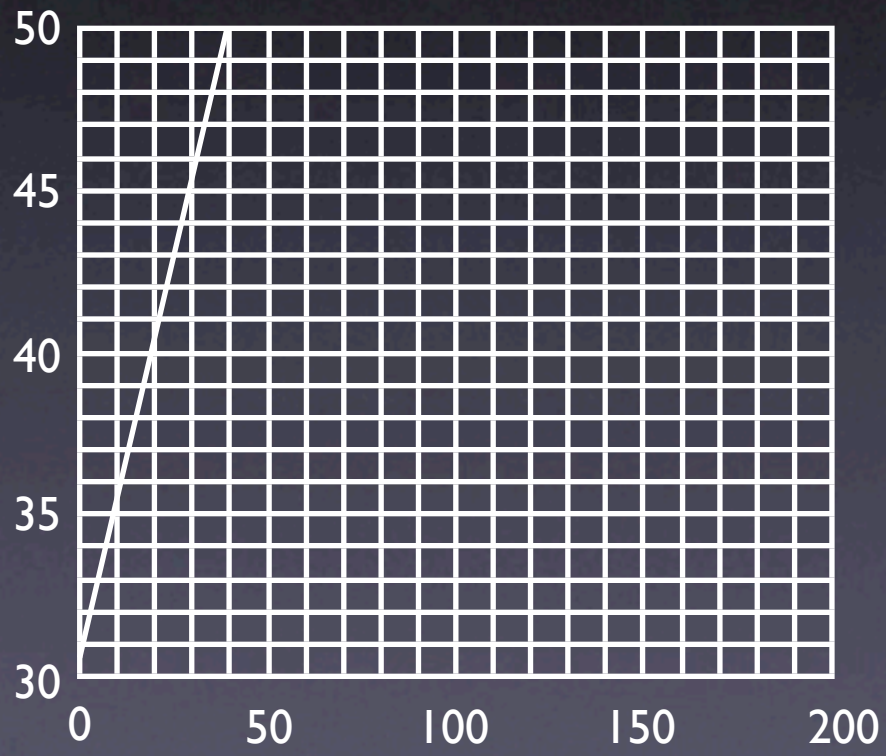
Common mistake #2

Scale is too small, too large or the student used their data as a scale.

Used data for scale in X axis.



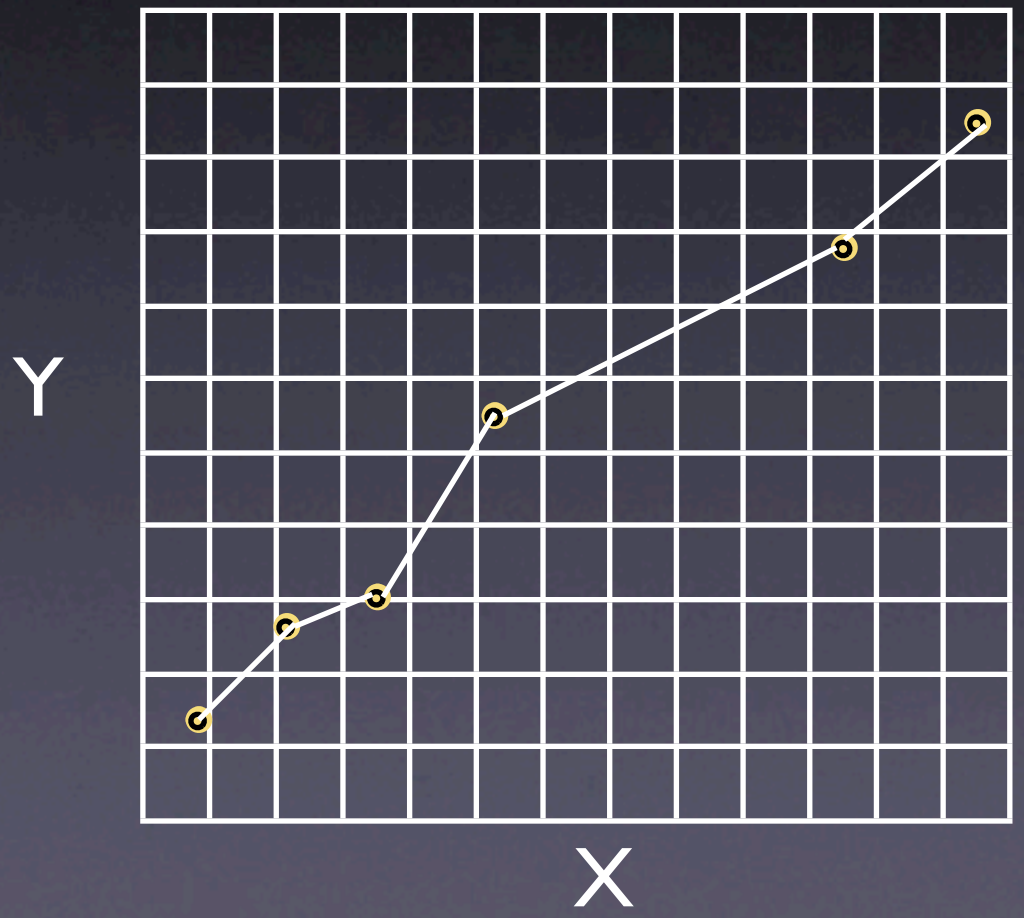
X scale too large



Common mistake #3

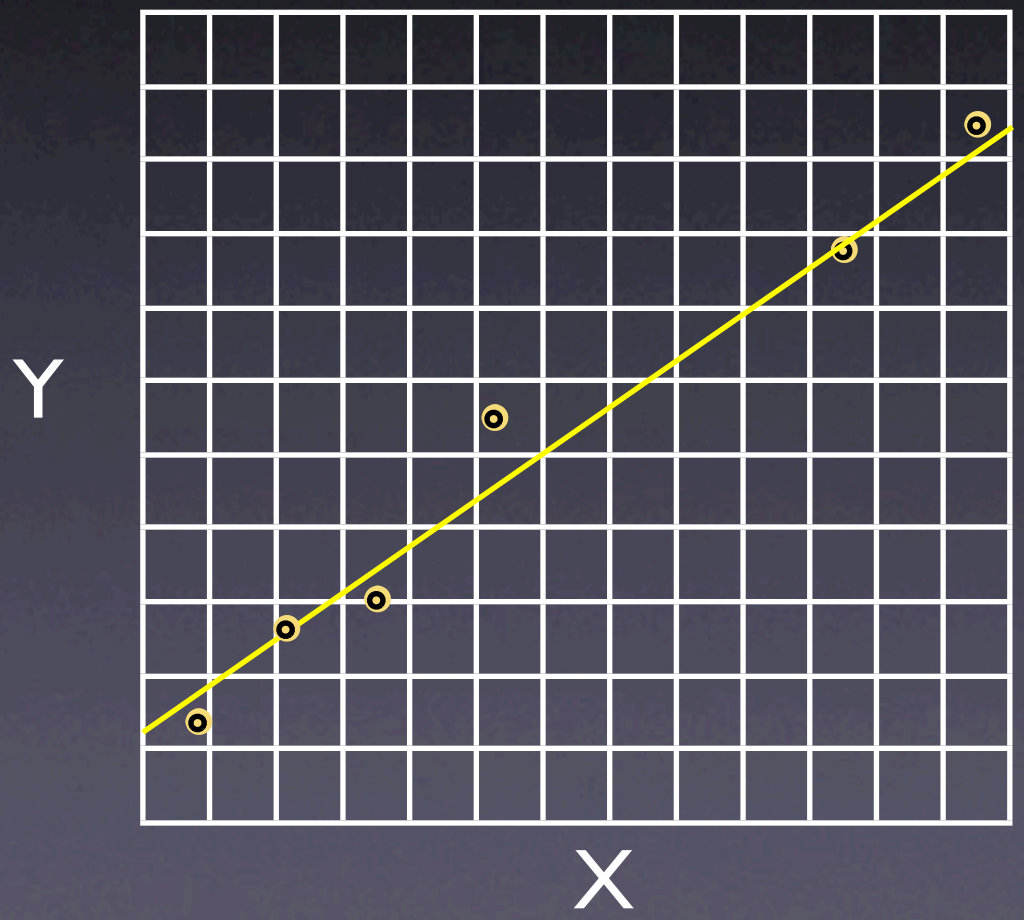
Students connect their points. Since science deals with measurements and all measurements have some error, you draw a line of best fit.

Do not simply connect points.



Common mistake #3

The line of best fit extends all the way across the grid showing best average of the points. Some points are above the curve, some are below and some points are on the curve.



More help on graphing and a copy of this presentation can be found on NetTutor, Chapter 2 on our website.