Introduction to FX Draw

The Mathematics Teacher's Drawing Program

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Introduction to FX Draw

User's Guide

by Efofex Software

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Introduction to FX Draw

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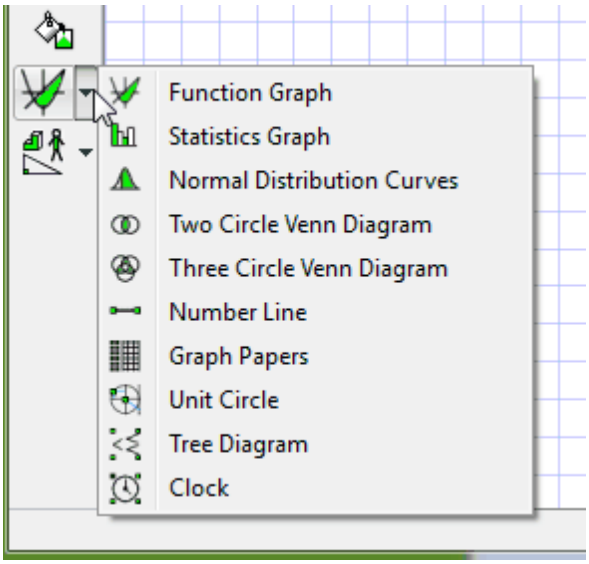
1 Introduction & Dropdown Toolbars

Welcome to the Introduction to FX Draw Email Tutorial lessons. These lessons are designed to get you started with FX Draw as quickly as possible rather than discuss every possible setting. Lots more information is available from the Help menu of FX Draw.
Now to the lesson...

FX Draw has dozens of tools - so many that if we had all of them visible at one time they would be overwhelming. To overcome this congestion, FX Draw 4 uses dropdown toolbars.

Most of the main toolbar buttons have buttons hidden underneath. To access them, just click on the small triangle on the right side of the button. A dropdown menu of further options will then appear.

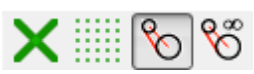


Select a new tool - then release the mouse button. The main toolbar will now show the new tool. The dropdown toolbars contain logically grouped tools. Take a little bit of time to look at all of the tools available to you.

2 Getting Started With GAD

GAD stands for Geometrically Aware Drawing. The GAD system makes drawing most geometric diagrams quick and easy.

Before we start, we need to make sure that GAD is turned on. Check the toolbars at the top of the FX Draw 3 window and make sure that this button is pushed.



We will discuss this toolbar in a later lesson.

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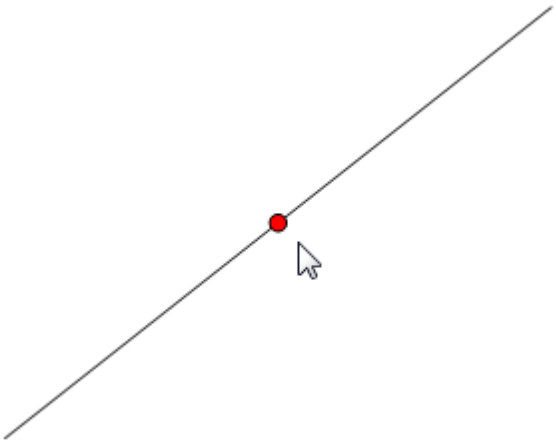
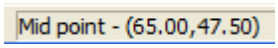
Now that GAD is turned on - lets start using it...

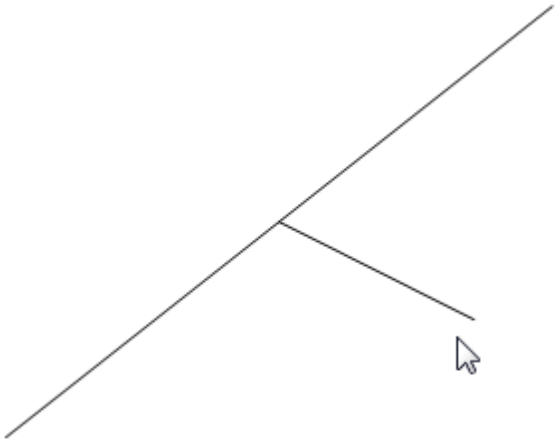
Select the line tool and draw a line on FX Draw's canvas. Now move the pointer around near the line. You should see something like this.



FX Draw has sensed the midpoint of line and marked it with a red dot. Down the bottom of the screen, in the status line, FX Draw will tell you what it has found - although it is usually obvious.



If you start drawing a second line while that red dot is showing, it will begin exactly on the midpoint of the line.



Even better, when the new line is perpendicular to the first, FX Draw will show you that as well.

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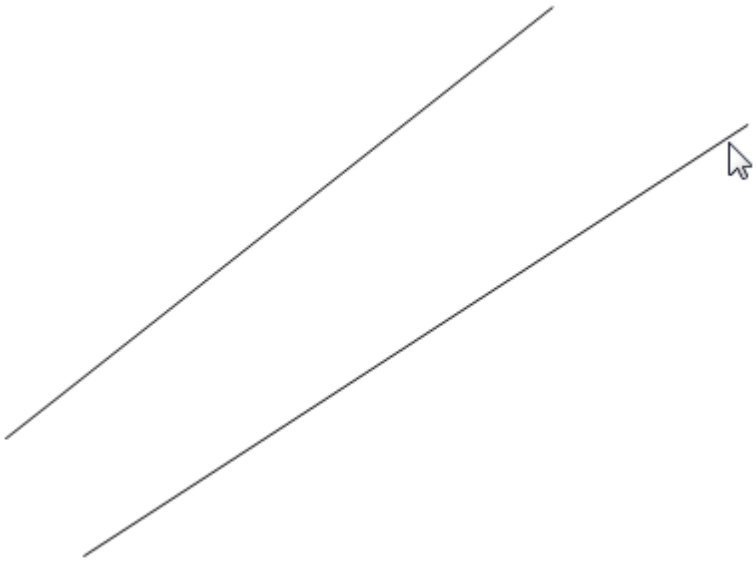
Now a couple of parallel lines. First I will draw a line, then start drawing a second line.



When the second line is parallel, FX Draw shows me visually.

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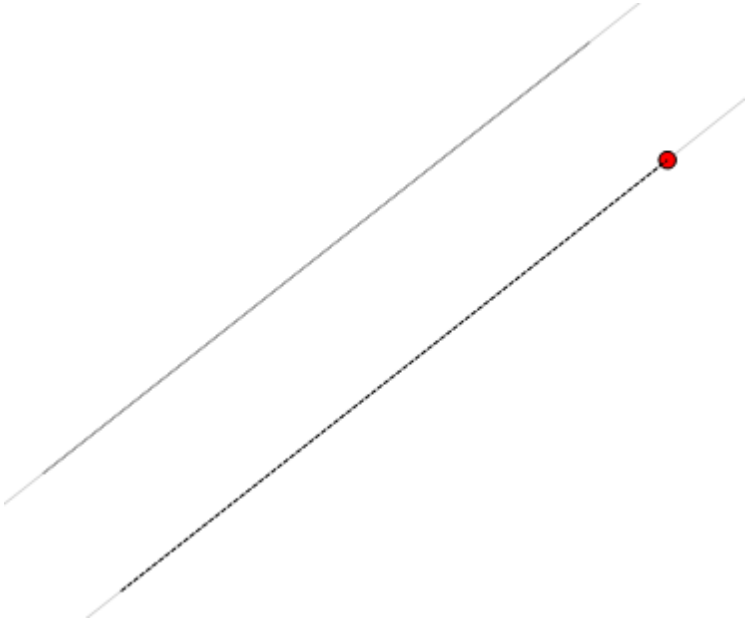
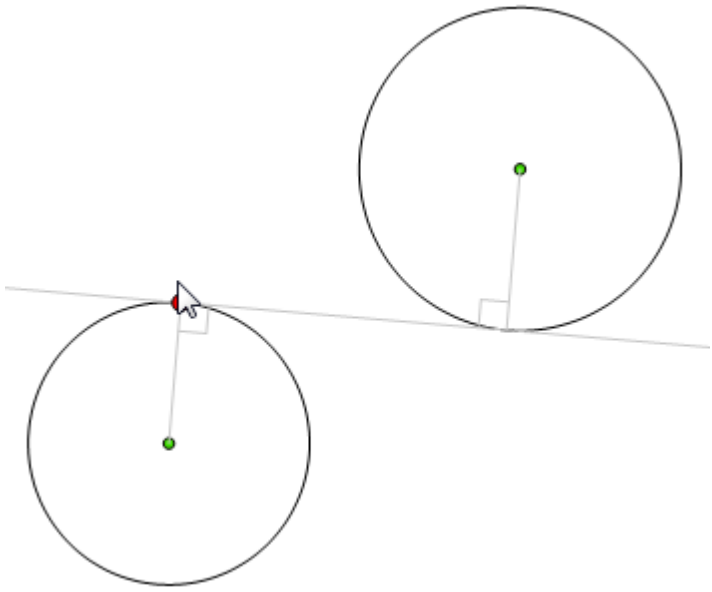


The GAD system has lots of tricks up its sleeve. It can find points of intersection, end points, vertices, centres of circles, points on figures, tangents, common tangents, angle bisectors and equal length lines to name a few. All of these situations are show visually on the screen and explained in the status bar. In the next image, FX Draw has found a common tangent of two circles.



Experiment a little. There is a lot to find.

3 Changing a Figure's Properties

We thought we would have an easy lesson after the last one. All figures (lines, circles, arcs, graphs…) have properties that can be changed. To change a figure's properties, RIGHT CLICK on it.

Draw a line and right click on it. You will be able to change lots of things about the

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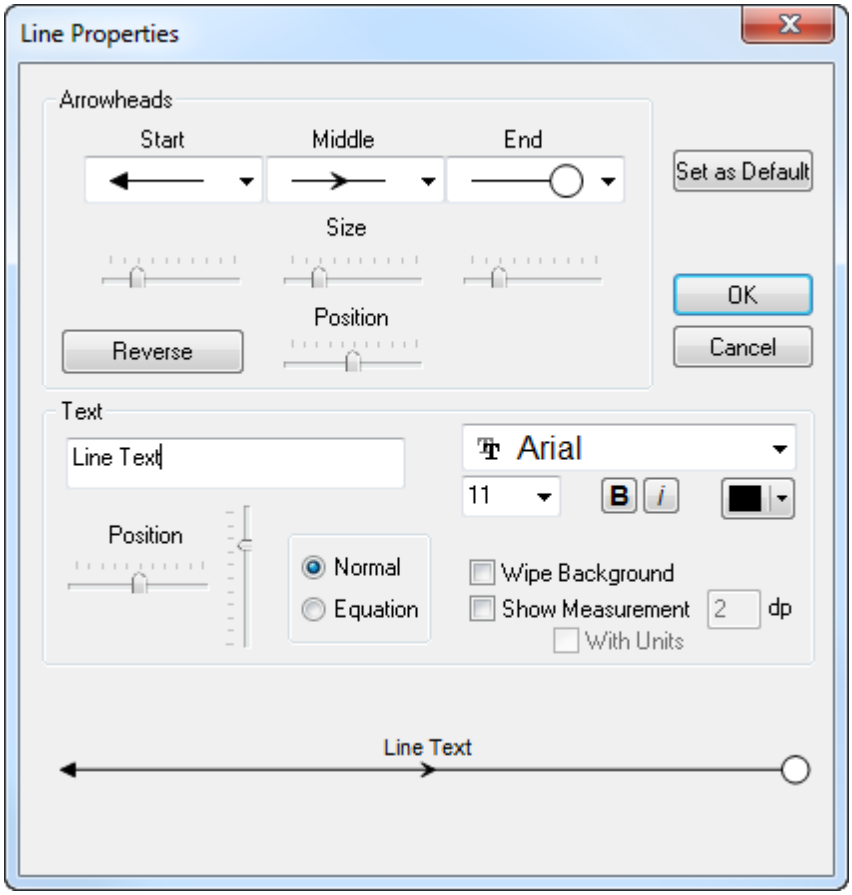
line:



- You can select an "arrow" type for the start, middle and end of the line.
- You can set the size for each of the arrows
- You can attach text to the line – and a number of other options

You should experiment changing the various properties of the line and see how they appear on your diagram.

4 Selecting Figures

You will often need to select a figure in order to modify it in some way. To select a figure you need to use the select tool – the white arrow on the top left of the toolbar.

There are two common ways of selecting:

- Clicking ON a figure. You normally need to click on a line that makes a figure rather than the centre of the figure.
- Sweeping out a rectangle that encloses the figure or figures.

Selected figures are shown with green, amber, red or grey rectangles at the control points – points that control the shape of the figure.

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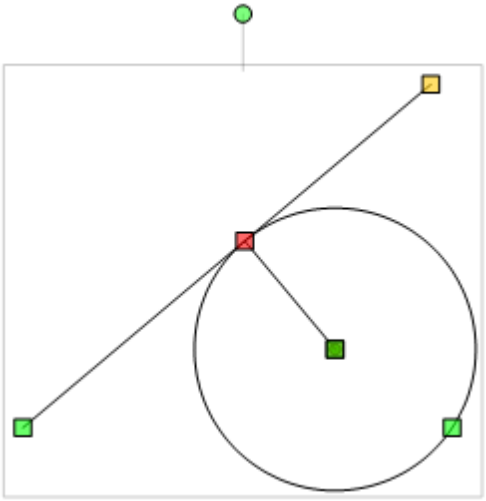

We will discuss the different colour squares in a later lesson.

The control (Ctrl) key allows you to select or unselect one figure at a time. If you hold down the Ctrl key while you click on a figure, you can add that figure to the selection or – if it is already selected – you can remove that figure from the selection. The Ctrl key allows you select exactly the figures you need.

There is a final way of selecting figures. Holding down Ctrl and pressing A will select ALL the figures in the diagram.

You will need to select figures to copy, move, delete or group them.

5 Changing Figures

To start this lesson, draw a figure and then select it.

To MOVE the figure, click on one of the LINES that makes up the figure; hold down the left mouse button and move the mouse. The figure will move with the mouse pointer.

To RESIZE the figure, click on one of the green, amber or red squares (control points); hold down the left mouse button and move the mouse. The figure will resize to allow for the new location.

To ROTATE the figure, grab the rotate handle and move the selected objects. If you hold down the SHIFT key, the rotation will be locked to 15 degree intervals.

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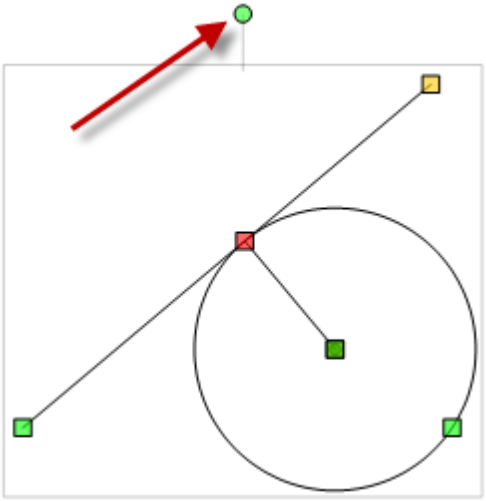
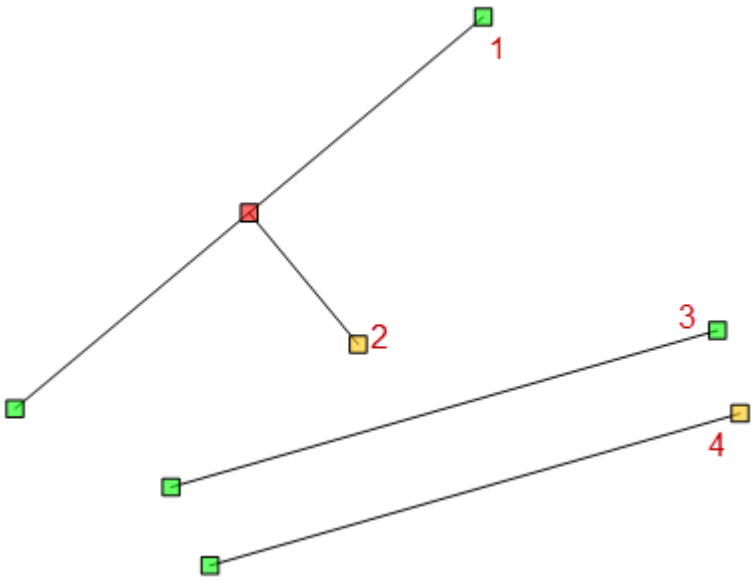


You can MOVE and ROTATE multiple figures at the same time. Try drawing a few figures and selecting all of them. Then move them and rotate them using the instructions above.

6 GAD Links

Your first contact with GAD Links will occur when you select some figures and the selection squares will be different colours. What is going on? In short, GAD Links give GAD a memory.



The colours represent relationships that the user has used when creating the diagram.

Line 1 was drawn first. Neither end was linked to anything else - so both ends are green, free to move.

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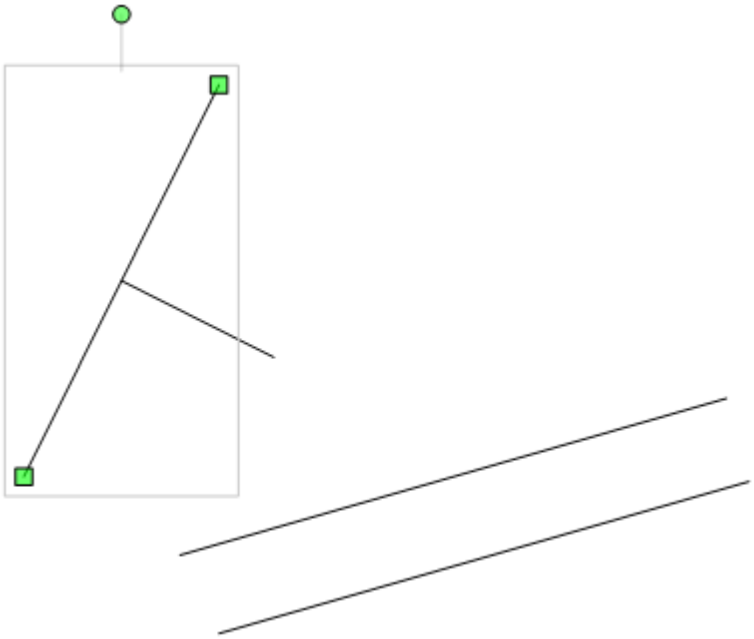
Line 2 was drawn second. We started on the mid-point of line one and moved out to a point on the perpendicular. Line 2 is locked onto the midpoint - a fixed point at one end (red = locked to a point) and locked onto a relationship - the perpendicular (amber = restricted to a relationship).

In Line 4, the right hand point is restricted to being parallel to line 3.

The colours give you some indication of what is going on - but what's the point?

The FX Draw 2 GAD system let you build geometric diagrams but once a figure was drawn, the relationship was forgotten. With GAD Links, the relationship is remembered.

When you move the first line, the second line moves too - to maintain the relationship.



We have moved Line 1 and Line 2 has remained attached to the midpoint and on the perpendicular.

GAD Links make FX Draw much "smarter" but also allow you to construct complicated geometric relationships that changed dynamically. Combine this with dynamic annotations (oops, haven't mentioned those yet) and you have a powerful geometry canvas that takes almost no training to use.

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7 Marking Angles

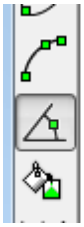
Marking an angle in FX Draw takes just one click.

Before we start, we need to make sure that GAD is turned on. Check the toolbars at the top of the FX Draw window and make sure that this button is pushed.

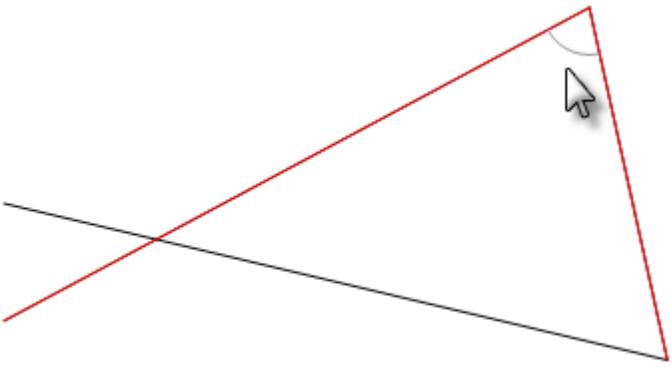
If this GAD button is not pushed, the angle tool will be grey and you will not be able to use it.

One common misconception is that the angle tool will draw a complete angle including the two rays that define the angle. It will not. It will only add an angle mark to an EXISTING angle.

First, draw a diagram that includes some angles. Second, make sure that you have picked the one-click angle tool.



As you move your mouse pointer around, FX Draw will automatically sense close angles and show you where it would mark it.



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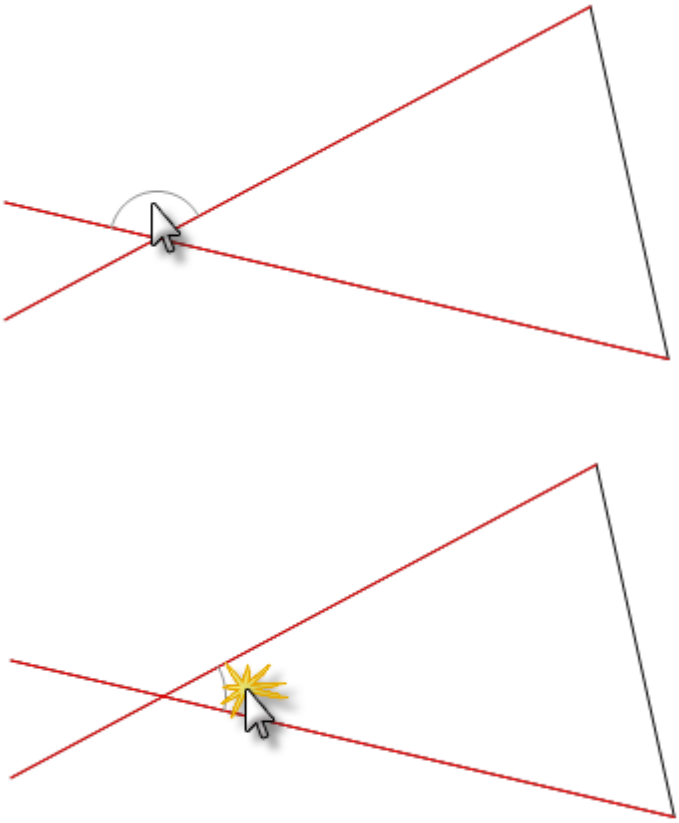
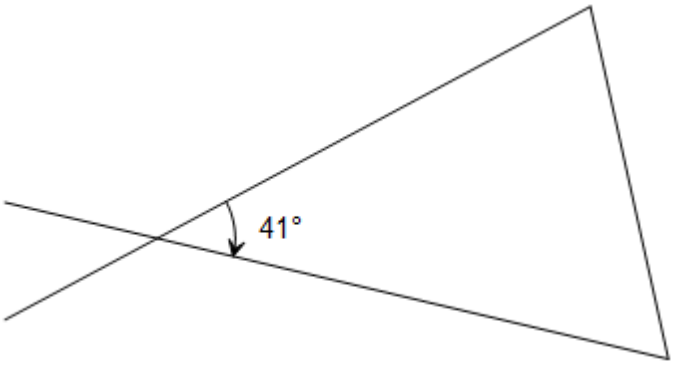


One click and the angle will be marked using the current defaults.



Note that FX Draw lets you mark an angle with an arc and a measurement in one step (and lots of other options).

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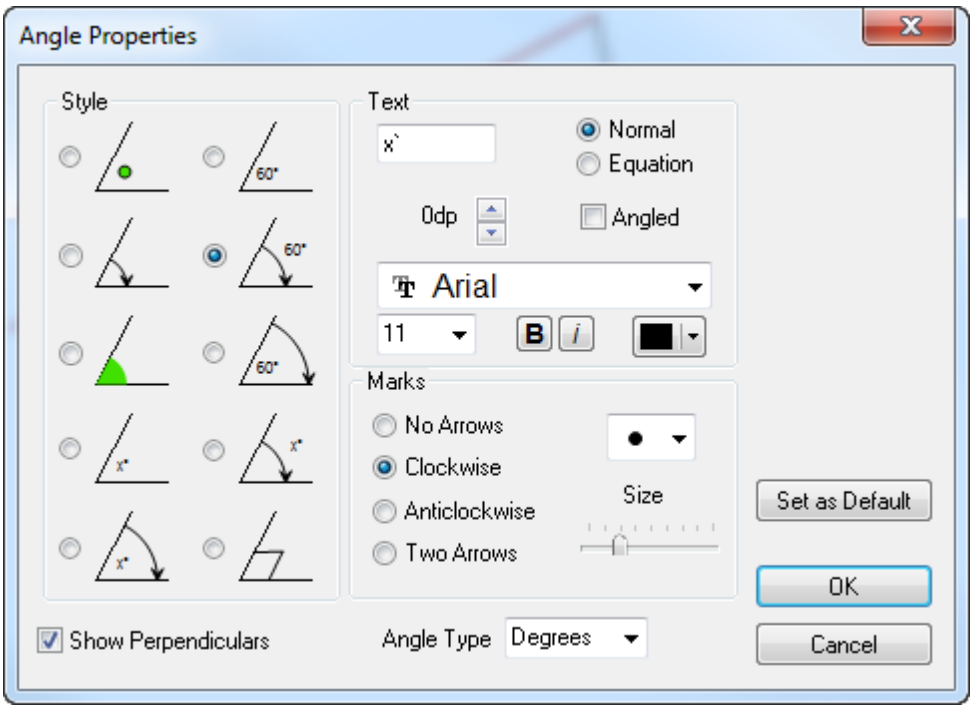
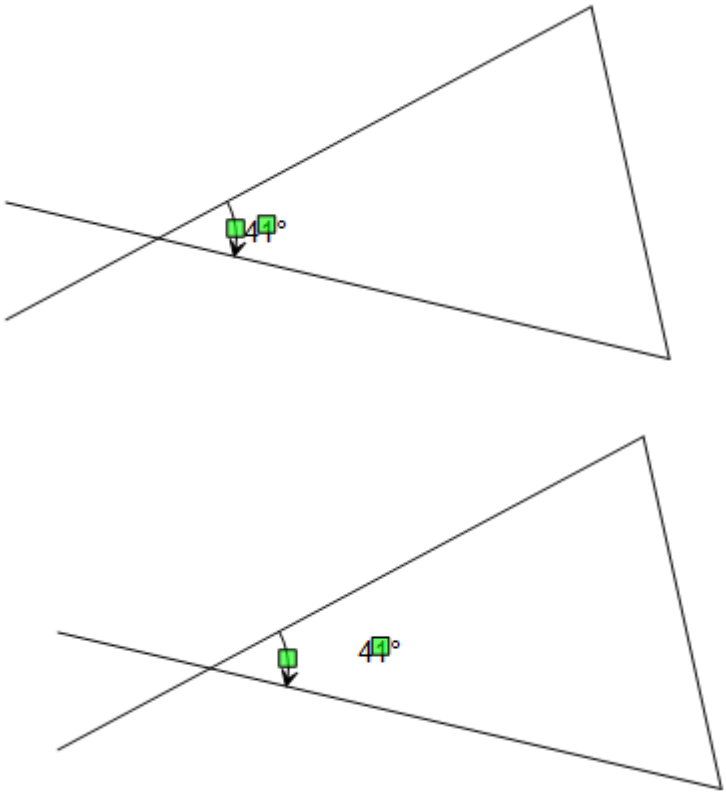


The last angle option lets you mark angles as perpendicular, even when they are not. This is useful in 3D drawings.

Setting the size of the angle mark is much easy. Just click on the angle and move the green square marks.



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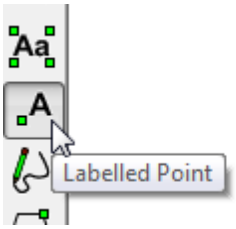
There is another angle tool that is useful in some situations - but that will be discussed in another lesson.

8 Marking Points



FX Draw has a tool that allows you to mark and label points in one step.

There are two ways of using the labelled point tool.

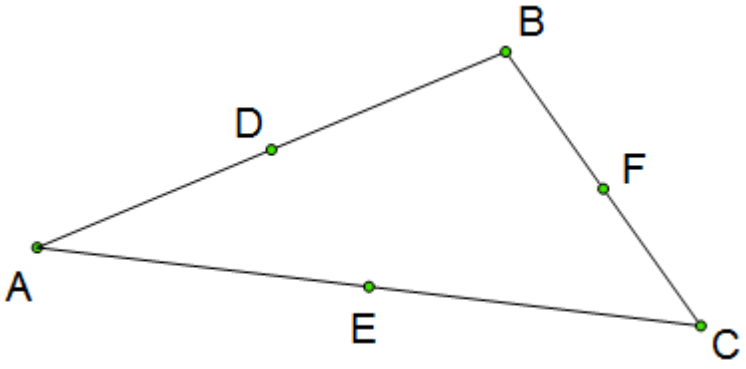
Mark a Point Without Using a Label.

Clicking the left mouse button anywhere on the drawing canvas will mark a point without adding a label.

Mark a Point and Attach a Label

Click and **hold** the left mouse button on the point you wish to mark and then move the mouse to the location you wish the label to appear.

If you add more than one labelled point, the labels will automatically increment.



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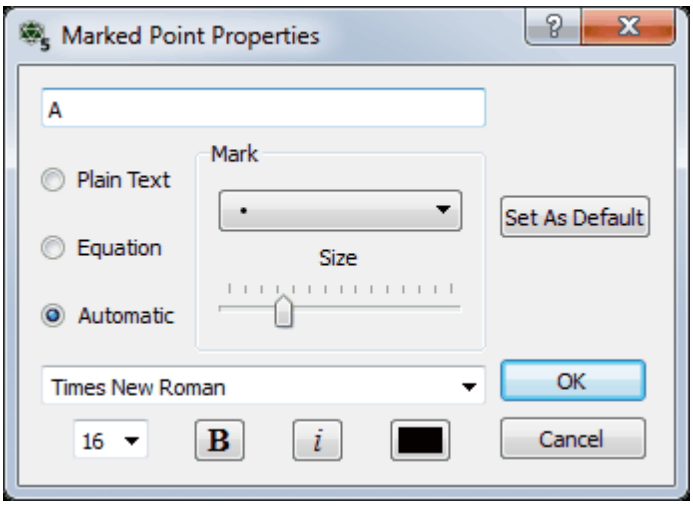
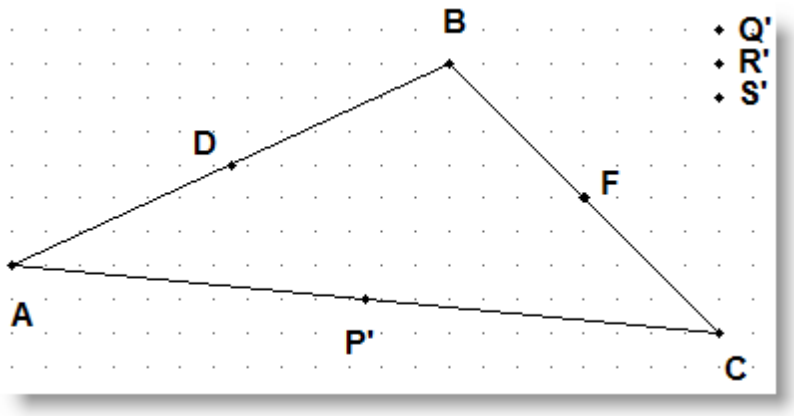
Editing the Properties of a Labelled Point

Right clicking on a labelled point allows you to edit a point's properties.



Here you can change the style and size of the point mark, as well as changing label and font. If you change any label, the automatic increment will start from your new text.

For example, if we change the label from E to P', the next automatically generated labels will automatically be Q', R' and so on.



Labelled points are GAD aware and will automatically move with any underlying geometry.

Greek Letters

If you enter a point label of al and make the label an equation (select the Equation option on the properties screen), FX Draw will mark the points as Greek letters.

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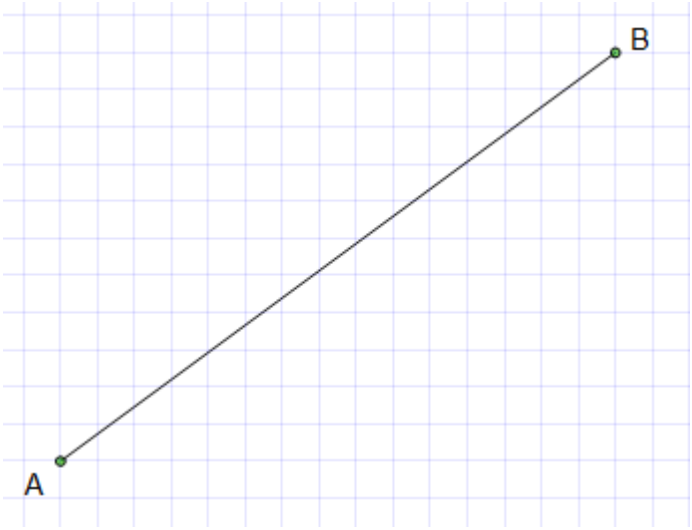
9 Autopoints

FX Draw can automatically add annotated points to geometric diagrams. First ensure that the Autopoint feature is turned on...

When the autopoint feature is on, FX Draw will add points to ends of lines, vertices, centres of circles as well as points of intersection.



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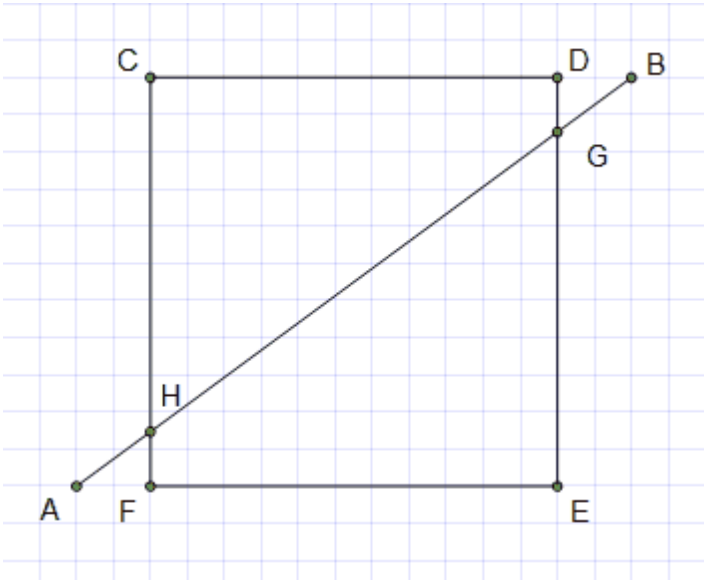
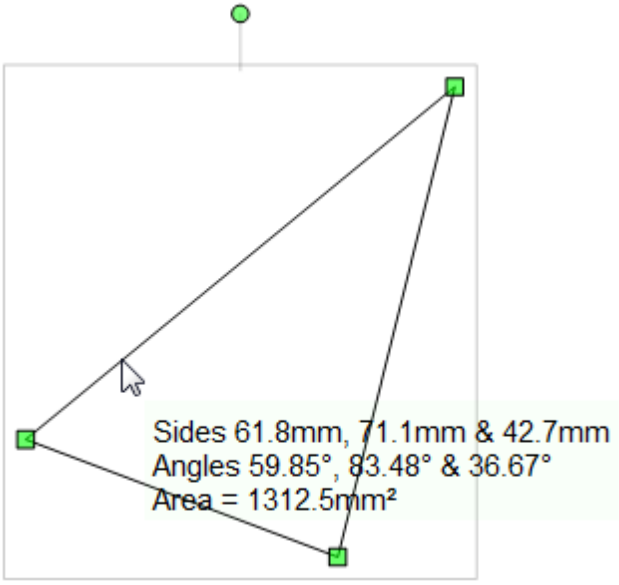


FX Draw automatically increments the point labels. The autopoint feature only operates as new figures are created. If you later **move** a line so that it intersects with another line, an autopoint will not be added.

10 Figure Information

FX Draw can provide lots of information about the figures you are drawing. To view this information: draw the figure; click on it to select it and then let your mouse cursor sit near the figure for half a second. Most figures will display a yellow box with relevant information.

For example: Below I have drawn a triangle using the triangle tool.



The information presented depends on the figure selected.

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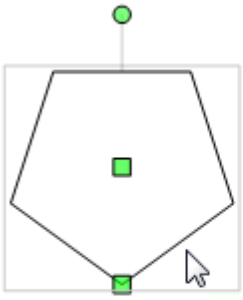
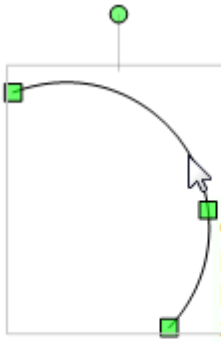
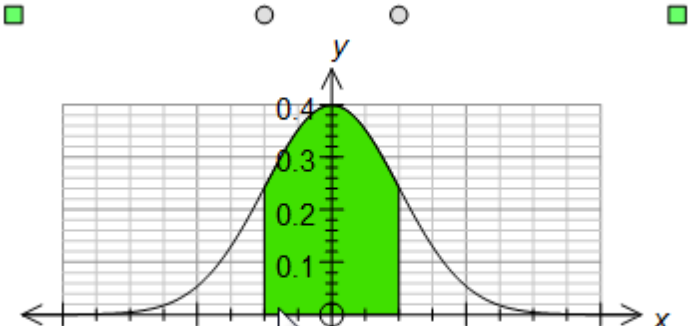


Perimeter = 88.2mm
Area = 534.97mm²



Centre (71.67,47.22)
Radius 18.5mm
Length = 49.9mm
Start (65.00,30.00)
Stop (85.00,60.00)
Central Angle = 154.94°
Sector = 46.1mm²
Segment = 38.9mm²



P(-1 < z < 1) = 0.6827

11 Creating Annotations

An annotation is a text box that is attached to a figure and is dynamically updated with the information about that figure.

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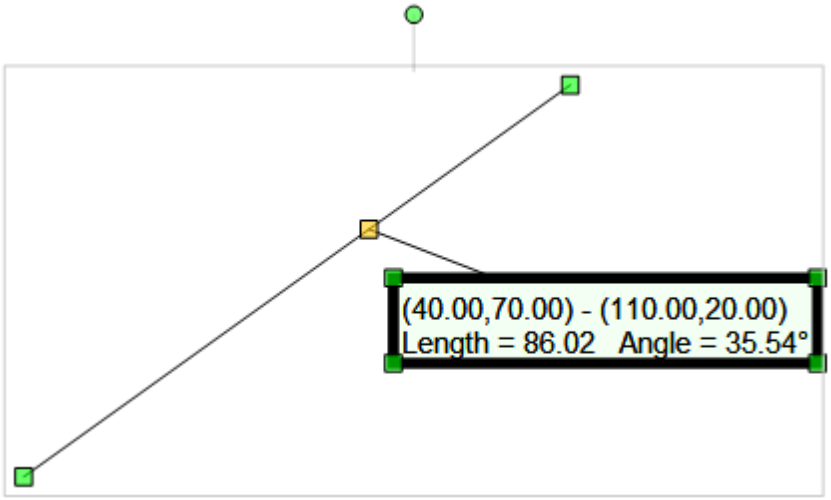
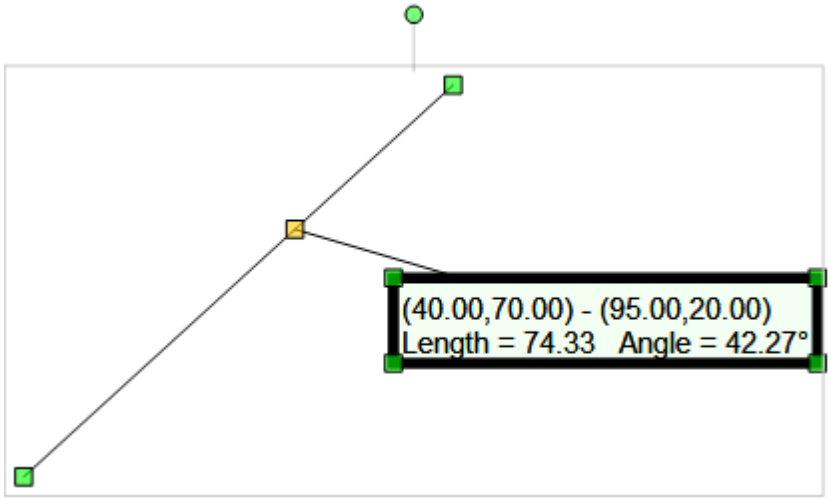


When you change the figure, the annotation automatically updates.



Annotations are based on the figure information we discussed in the previous lesson. Whatever is displayed as figure information will be added as an annotation.

Creating an annotation is easy.

1. Draw the figure
2. Select just the figure you wish to annotate.
3. Let the mouse hover over the figure until figure information is displayed.
4. Right click.

Normally, when you right click you will edit the properties of the currently selected figure. If the figure is displaying its information, you will instead be offered the choice of either adding an annotation or editing the properties.

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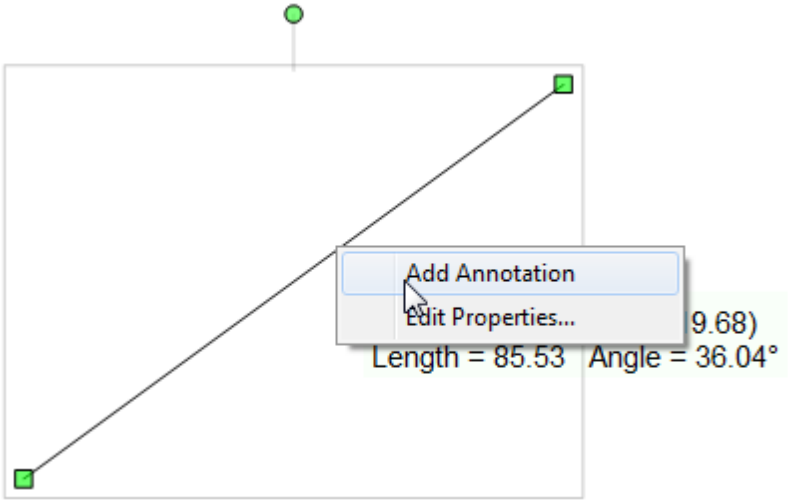
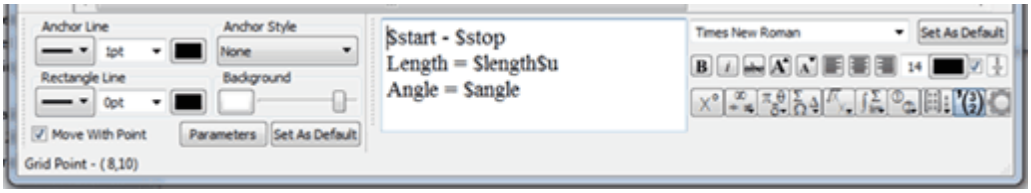


Choose Add Annotation and an annotation will automatically be attached to the figure.

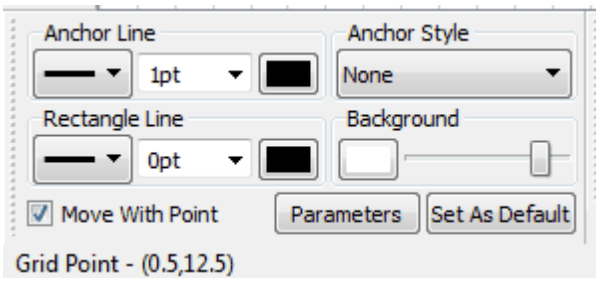
Efofex introduced the idea of annotations in FX Graph 3. FX Draw makes them more powerful and allows you to use them with most types of figures.

12 Editing Annotations

Editing annotations is just like editing any other figure in FX Draw - you right click on them. The Annotation editing area will appear at the bottom of the FX Draw screen.



There are three sections to this screen.



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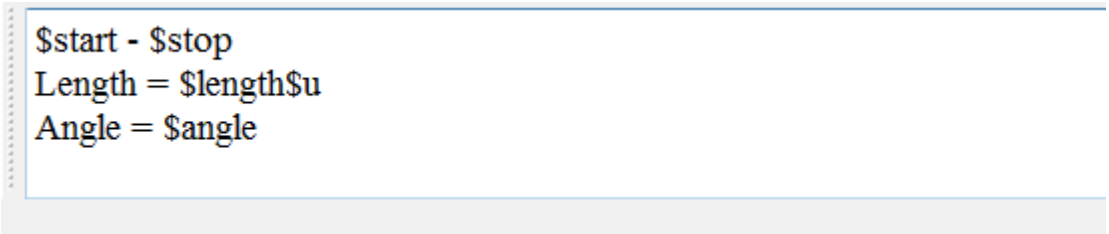
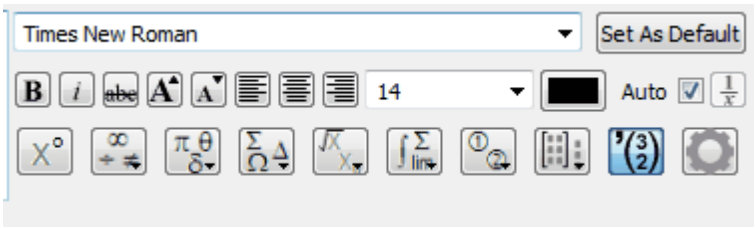
In this section, you control the style of the lines and anchors of the annotation. You can also select if the annotation will move with the point it is marking. Finally, you can push the Parameters button to access the parameters for this annotation. Parameters are things like $length which FX Draw will replace with the current length of the annotated line.

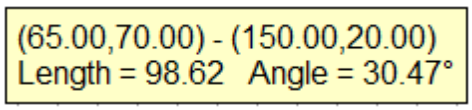


In this section you enter the text of your annotation using any parameters you require.



The final section allows you to format the annotation. If Auto is selected, FX Draw will use its FX Autoquate system to automatically determine which parts of the annotation should be interpreted as equations. If Auto is switched off, you can manually select the sections which should be equations using the 1/x button.

The bottom row of buttons allows you to create equations using our FX Equation technology. This is discussed in later lessons.



Annotations are dynamic so FX Draw uses parameters rather than just raw text. All parameters start with a $ sign and each figure has its own parameters which can be accessed with the Parameters button. There are often more parameters than are displayed in the figure information.

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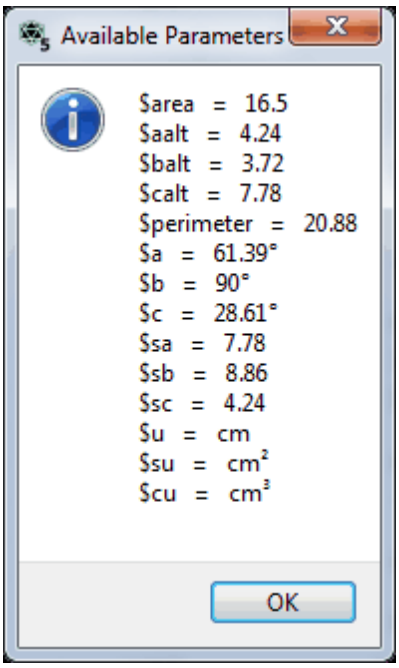


Even though the standard figure information shows side lengths, angles and area, triangles can also show altitudes and perimeter.

$u, $su and $cu are standard parameters available for all figures. They allow you to add linear units, square units and cubic units to any annotation.

13 Setting a Default - Network Diagrams

Many tools have a "Set As Default" button. This tells FX Draw 3 to remember the current settings for that figure and use them whenever you create a new one of the same type.

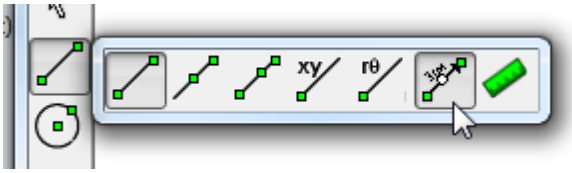
For example, if you prefer all of your text boxes to be in Garamond 10pt font.

- Draw a text box.
- Right click on it and change the font to Garamond 10pt.
- Push the Set As Default button.

Any text boxes you create from now on will use this font.

One great use for Set As Default is to draw Network Diagrams.

Firstly, we need to choose the "Arrow Line" tool. This is the only line tool that uses defaults.



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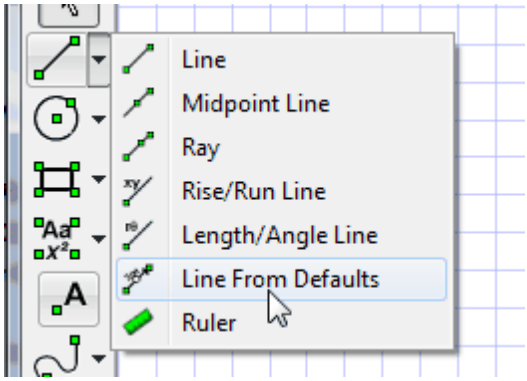
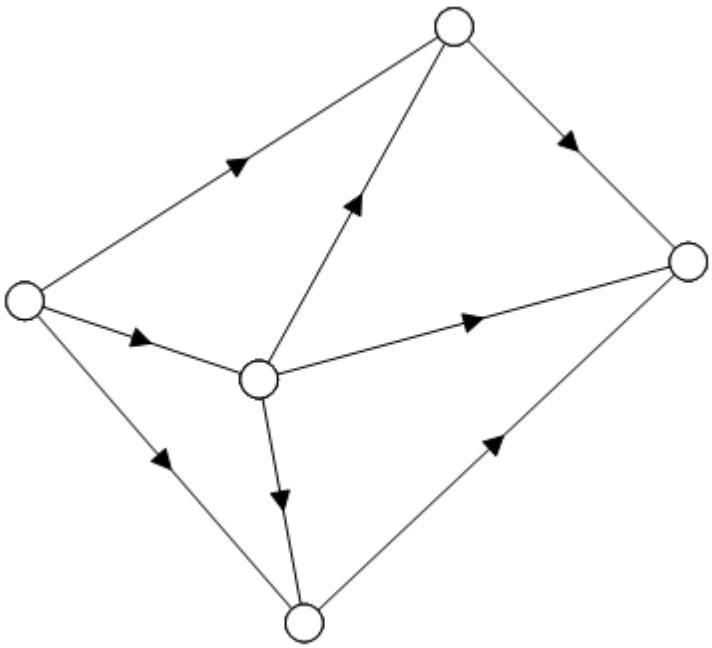
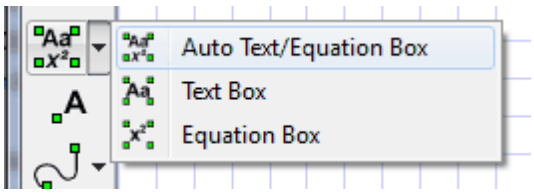
Now draw an arrow line and right-click on it. Set the line to have an open white circle at both ends and an arrow head in the middle - then press Set as Default.



Your arrow line button will now draw, by default, a line with an open white circle at each end and an arrowhead in the middle – PERFECT for drawing network diagrams. Try it



14 Text Boxes



Text can be added to your diagram using any of the text tools. The only difference

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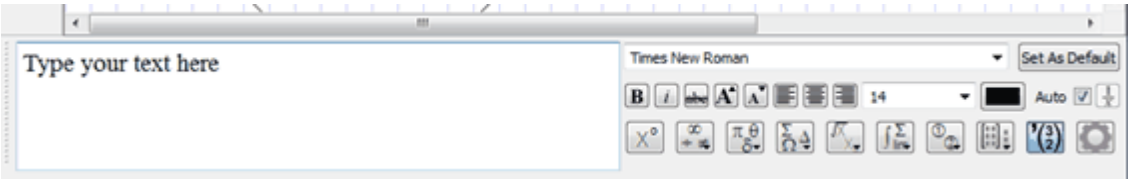
between the three tools is that the mode that the text tool starts in.

On most occasions, you will leave it set to Auto Text/Equation Box. This options uses our FX AutoQuate technology which automatically determines which parts of the text box should be formatted as an equation.

Select the tool and click in the drawing area. The Text entry screen will appear at the bottom of the FX Draw window.



The right hand side of the text entry screen contains standard formatting buttons and a few new buttons.

If Auto is switched on, FX Draw will use the FX AutoQuate technology to automatically format. If Auto is switched off you can manually control which sections are interpreted as equations using the 1/x button. We will be introducing equations in the next lesson so for the moment you can ignore this option.

Degree Sign

Mathematics teachers often need to type a degrees sign - so much so that we have allocated a key on the keyboard to the job. FX Draw (and FX Equation) uses the ` key to indicate degrees (the text entry screen also has a degrees button if you cannot remember this).

You could even get a sharp permanent pen and put a degree sign on the key! Whenever you want a degree sign - just use the key. FX Draw will automatically replace it with a degree sign when it renders the text box.

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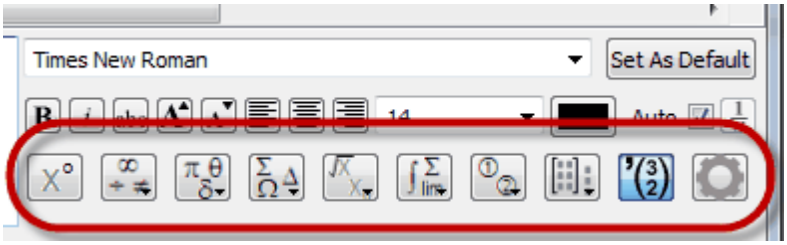
32` 32°

15 Introduction to Equations

Efofex's equation technology allows for extremely fast entry of equations. There is no way we can cover all of the equation features in one small lesson but we can make a small start.

Our equation technology can be used almost totally with the keyboard – there are no mouse clicks or menu selections required. The text entry screen does contain buttons to help you construct equations but these are not required.



Using the equation tool is usually as simple as typing. In this example we are assuming that Auto is switched on.

Type

The equation of the function is y=((x-4)2)/(x+1)

FX Draw will AUTOMATICALLY turn this into

$$\text{The equation of the cubic is } y = \frac{(x-4)^2}{x+1}$$

That is all there is to it!

Try these:

(x2-4)/(x-2)

45` (the ` key is next to the 1 key on the keyboard)

lim(x->0) (x2+4)/x

The equation tool borrows its functionality from FX Equation – our equation writer. What you learn here is totally transferable to FX Equation.

The quick reference card for FX Draw contains a summary of how to enter equations using this system. If you have not printed the quick reference card yet, now is a good

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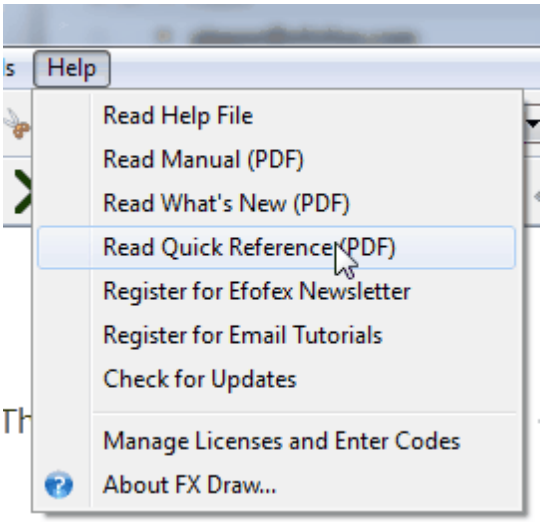
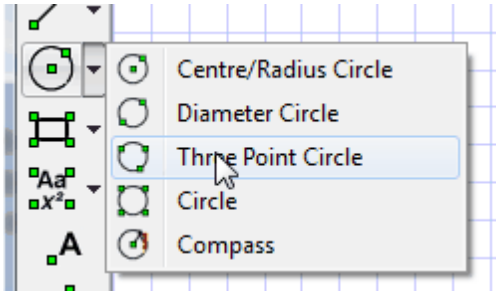
time.



You will require Adobe Acrobat to view the quick reference card. A copy of Adobe Acrobat is freely available for download from Adobe (www.adobe.com).

16 Drawing a Circumcircle - The Three Point Circle

A number of the FX Draw figures require "three-clicks" to define them. The three point circle is a good example.



The three-point circle defines a circle by three points on its circumference. You might use it to draw the circum-circle of a triangle.

Three point tools, like the three-point circle, can be a little odd to use so it is a good idea to have a practice.

First, draw a triangle and select the three-point circle tool.

To draw the circle, we have to mark three points. Click, click, click.

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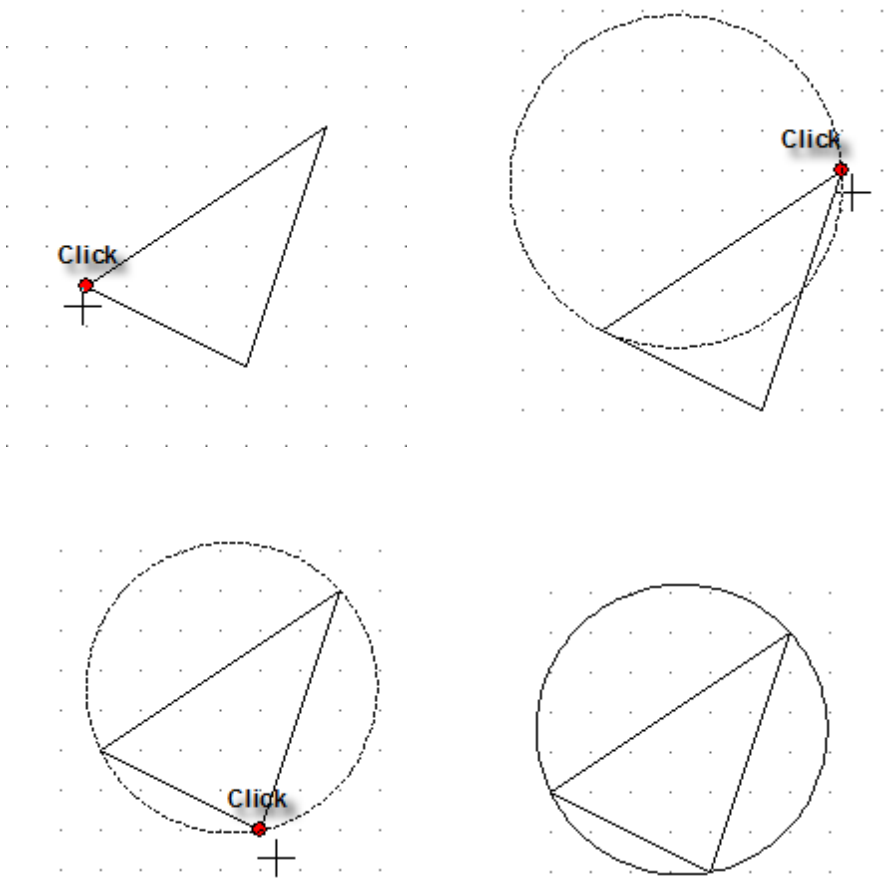
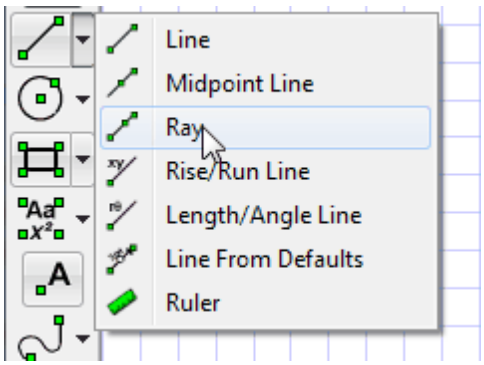


While you are creating the circle, you are probably saying “I can see a circle but it is just NOT the one I want!” True – but this is because you have not marked all of the points. In order to show something on screen, FX Draw is "inventing" some of the points. As you mark more of the points (and FX Draw has less to "invent") the circle will start looking better.

We recommend that you try this a number of times so you get the “feel” of the tool. It is not that hard to use!

Quite a few of the tools use a similar method to define the figure.

The Ray Tool



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The Triangle Tools

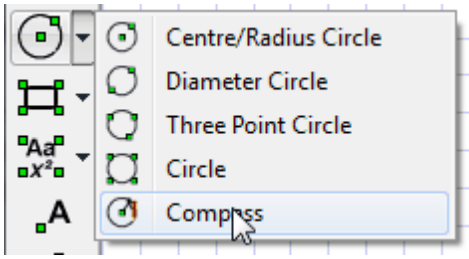
Two Ellipse Tools

Two Arc Tools

17 The Compass Like Tools

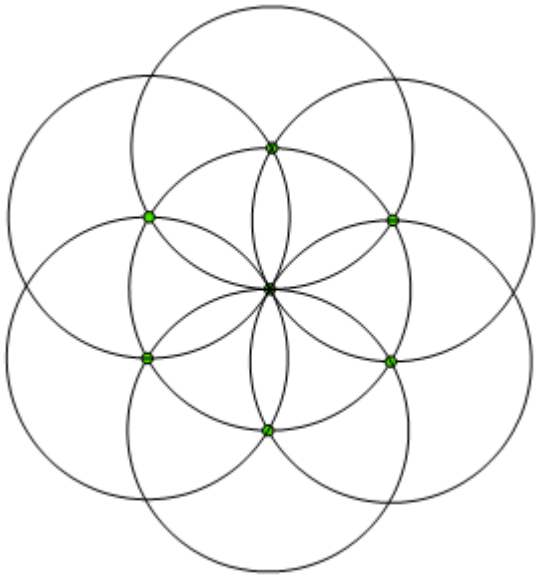
FX Draw 3 includes two tools that work a little like a compass. The important difference between these tools and other FX Draw tools is that once the radius of the compass is set - it is kept the same while the tool is active.

Lets look at the compass circle tool.



First select the tool, then draw a circle. The first time you use the tool, it operates in exactly the same way as the first circle tool - you start at the centre and move to a point on the circumference. The difference is that you have now set the compass's radius.

The next circle you draw, all you need to do is to click once to mark the centre. Every click will result in a new circle and you can use it in exactly the same way as you would use a compass set to a particular radius.



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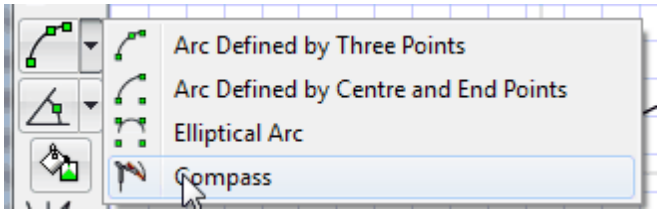
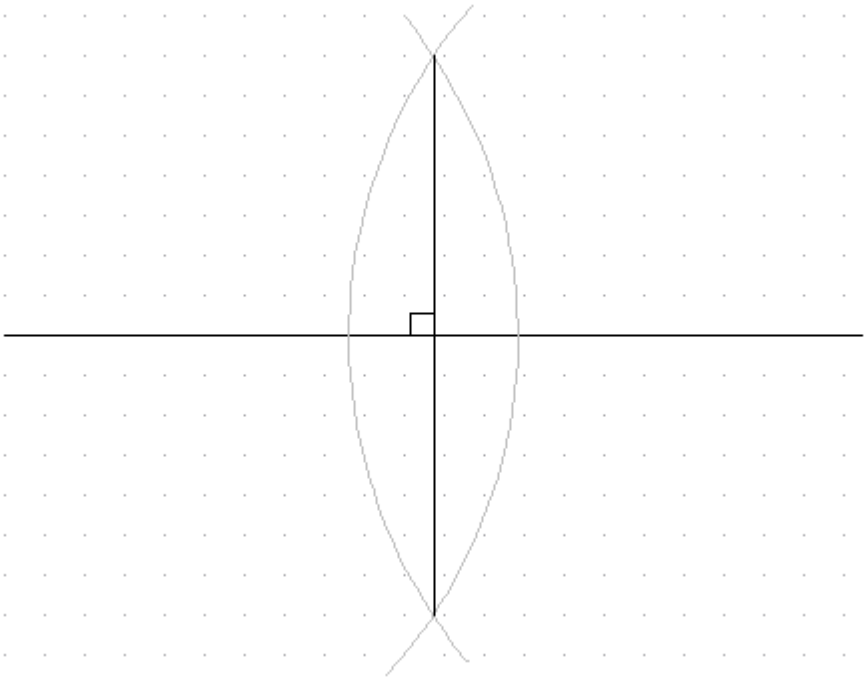
If you need to set a different radius, either RIGHT-CLICK on a blank part of the canvas or select a different tool and then go back to the compass tool. You will get to set the radius again.

The compass arc tool operates using the same logic.



The first time you use the compass arc tool, it operates in the same manner as the second arc tool (centre and two end points). After the first use, it will remember the radius. This allows you to do things like bisecting a line.



18 Overriding GAD - The Toolbar

Geometrically Aware Drawing is a wonderful tool that makes drawing geometric objects extremely simple.

BUT

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Sometimes it just gets in the way. It insists on jumping to the middle of the line when you really want the point just off the line for example.

SOMETIMES YOU NEED TO BE ABLE TO TURN IT OFF

And of course you can. One way is to use the GAD toolbar.

This toolbar helps you control the GAD system. Normally, with GAD on, the third button will be selected – so what are the other buttons?

The black X turns off everything. Your lines will start wherever the mouse is when you start.

The array of dots will force your mouse clicks to the underlying grid. You have probably noticed that there is an array of tiny dots in the drawing area – this is the grid. With this button depressed, your mouse clicks will ALWAYS end up on one of the dots. This is often useful – especially for drawing isometric diagrams.

The last two buttons turn GAD on – with restrictions and without restrictions (the GAD + infinity button).

GAD is powerful but EXTREMELY computer intensive. For example, if you have three lines on your screen, the system has to identify up to three points of intersection. By adding two more lines, the number of points of intersection can jump to 10 – not to mention all the other things the system finds. The job grows exponentially as you increase the number of figures.

Eventually, this can bring the most powerful computer to its knees. Standard GAD, in order to get around this problem, starts turning things off as you add more figures. For example – if you have more than fifteen lines – it does not find points of intersection anymore.

If you REALLY want to continue using the GAD system DESPITE the fact that it is getting slower and slower, push the infinity button.

19 Overriding GAD - The Keyboard

The last lesson described how to override the GAD system – but what if you only want to override it for a second or two?

What if you want one end of a line to start on the circumference of a circle (GAD on) but want the other end NEAR the end of a line (GAD off)?

FX Draw contains keyboard shortcuts that allow for this.

At ANY time, holding down the SHIFT or CTRL key overrides GAD and allows you more control of what you are doing.

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Holding down SHIFT turns GAD off but leaves the grid ON so your mouse will jump to the nearest grid point.

Holding down CTRL turns GAD off AND the grid off so you figure will start exactly where the mouse is.

20 Nudging

Often you will have a figure in ALMOST the right location but you just can't get it quite right with the mouse. You just want to give things a NUDGE (a very small push). Your keyboard's arrow keys permit this.

Pushing an arrow key will nudge any selected figures in the direction of the arrow by 0.25mm

The SHIFT and CTRL keys help you control the nudge.

Holding down SHIFT while you push an arrow key decreases the size of the "nudge" to 0.05mm

Holding down CTRL increases the size of the "nudge" to 1mm;

Nudging allows you extremely precise control over your diagram without forcing you to battle with the mouse.

You might have noticed that the keyboard has featured in the last few lessons. There are keyboard shortcuts for many important tasks and the shortcuts can save you lots of time and effort. Now would be a good time to take a look at the Keyboard Shortcuts page in the manual.

21 Filling Regions 1

Filling regions is a perenial source of issues for Efofex. People do not understand what is going on. FX Draw 4 makes a few small changes to try to improve understanding of the feature.

Some Objects Can Fill Themselves

Before you start using the flood fill tool (a.k.a. the "paint pot"), don't forget that closed objects know how to fill themselves. For example, if you want to shade a rectangle.

1. Select it.
2. Move to the Fill toolbar
3. Select a fill type, colour **and opacity**.

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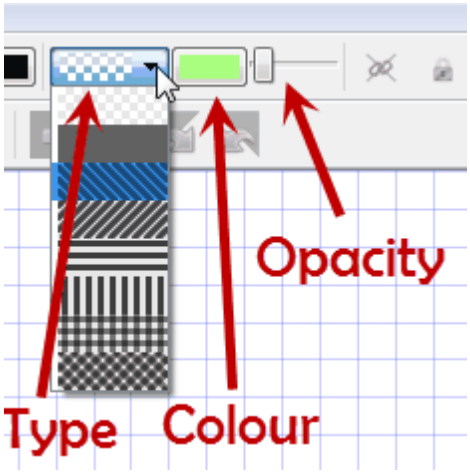
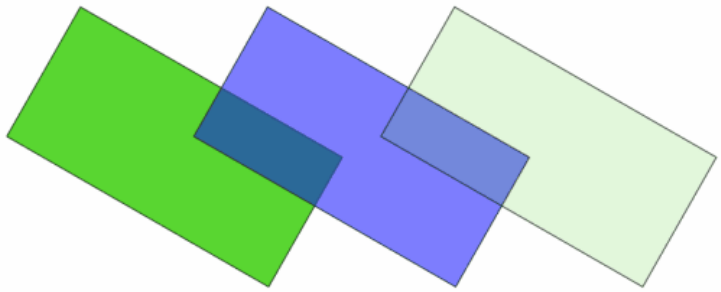


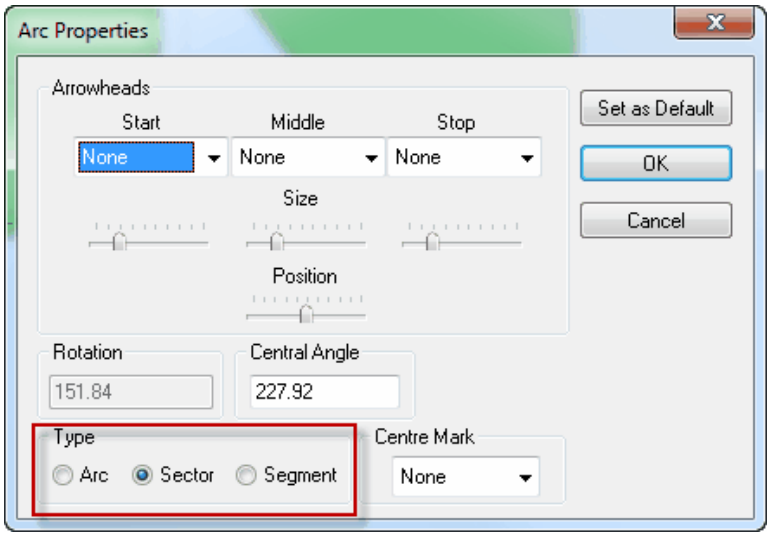
Letting objects fill themselves has many advantages. Firstly, you can control the opacity of the filling. Paint pot fill can only be solid.



The second advantage is that the filling is an integral part of the figure and cannot "fall out". More on this later. You can fill rectangles, circles, ellipses, polygons and **arcs**.

Filling Arcs??

Not really. But the arc tools are also used to draw segments and sectors. Draw an arc and right click on it.



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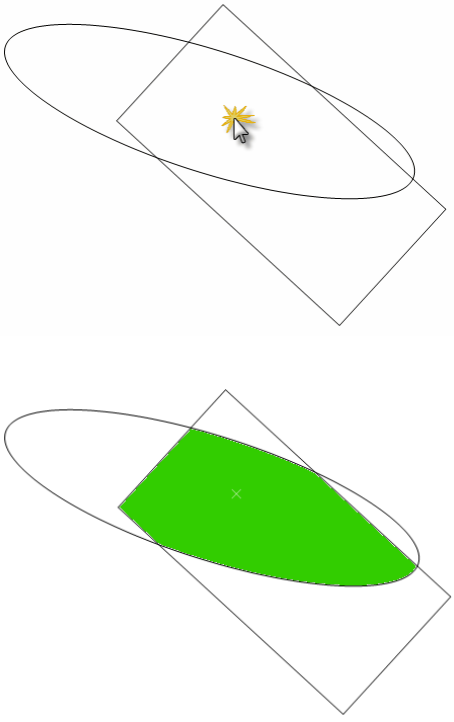
Now set the arc as a sector or a segment

The Paint Pot

The main advantage of the paint pot tool is that it can fill any closed region. Just click in the region you want to fill.



But wait... There's more...

22 Filling Regions 2

Most people have experienced paint pot tools before - using in painting packages. FX Draw is different. Unlike a paint program, an FX Draw user can move one of the boundaries after the fill has been added. This creates some points of misunderstanding for users.

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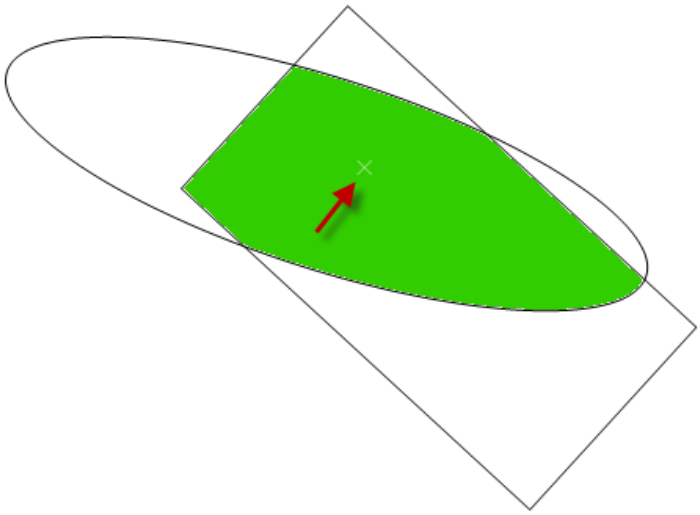
The Fill is Attached to a Click

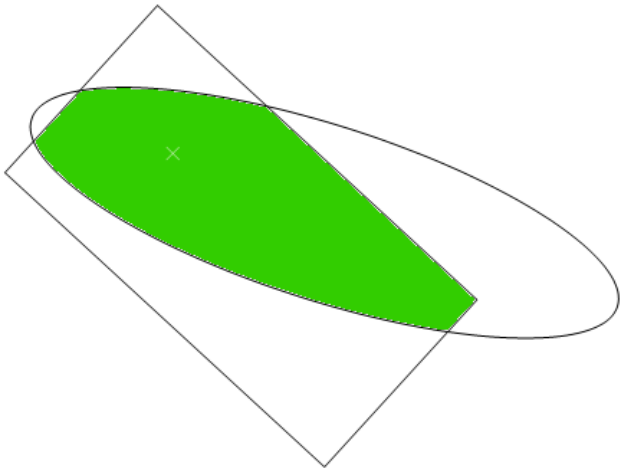
To add the flood fill to a diagram, you had to click somewhere. **The fill will always be attached to that click.** FX Draw now shows you exactly where that click is using a light cross.



The little cross will not appear on any output. It only appears while you are editing inside FX Draw.

The Fill is Always Being Redrawn

Every time you move anything, FX Draw will redraw the fill. This means that you can move the boundaries and still have the area filled properly. In the next image, we have moved the ellipse and the fill still fills the area defined by the rectangle and the ellipse.



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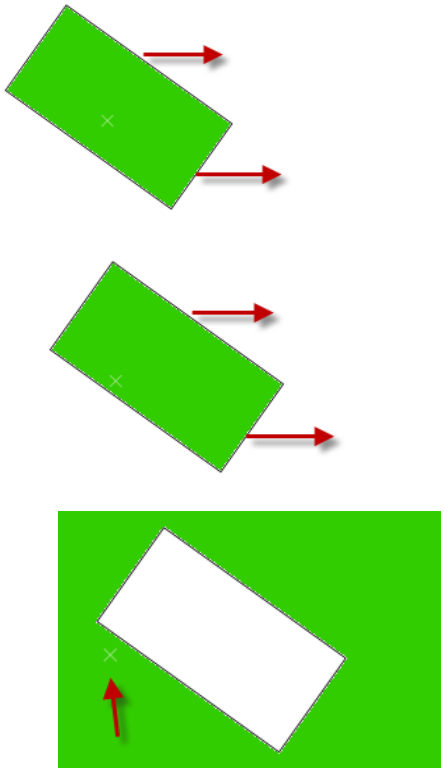
The Fill Is Not Attached to Any Other Object

The fill exists all by itself. It is not attached to the rectangle, the ellipse or anything else. This means that you can fill a region (a rectangle for example) and then move the rectangle. The fill click stays put. We normally hear about this when someone comments that "The fill fell out of the rectangle!"



Oops!

Actually, the fill didn't fall out of anything. It was the rectangle that moved!

If you really want the fill to stay in the same place relative to its boundaries, you need to group it all together.

But wait... There's even more...

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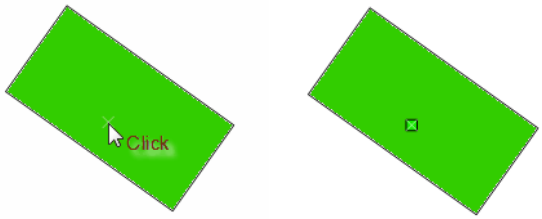
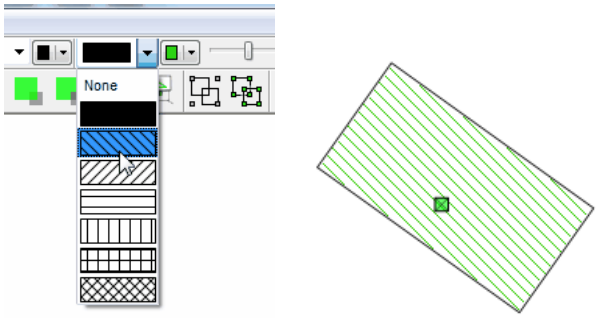
23 Filling Regions 3

Changing The Fill

To change anything about the fill (colour, style, location) you need to select it. That's easy, just click on the cross.



Now you can change the colour and style using the fill toolbar

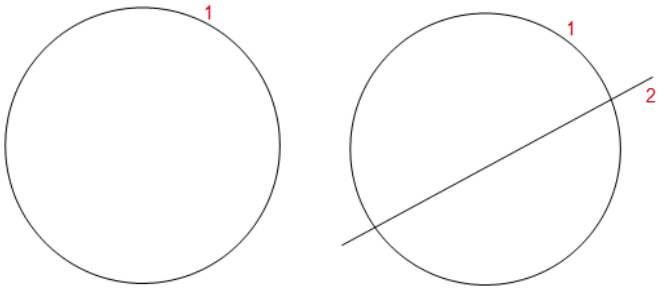


You can also move the fill by clicking and dragging.

And finally!!...

Filling Depends on the Drawing Order

Objects drawn in FX Draw have a "Drawing Order" and what is filled depends on the order things are drawn in.



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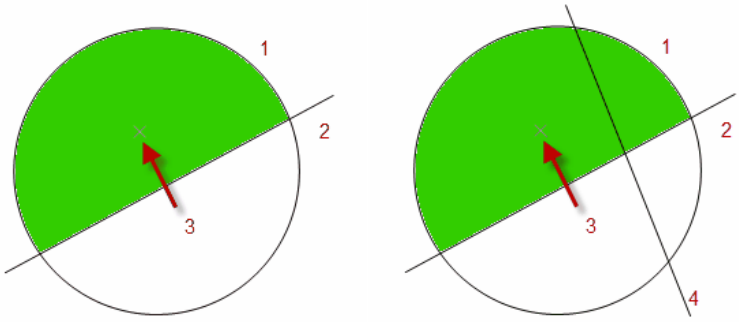

Notice how the fill tool fills up to objects that are before it it the drawing order and ignores things drawn after it. If you wanted the fill to take the second line into account you would need to select the fill and use the drawing order toolbar to change its location in the drawing order.

24 Grouping & Ungrouping

Often, the figures you have drawn belong together. For example, if you have spent some time and drawn a pictorial representation of Pythagoras, all the squares and lines you have drawn really belong together. You do not want to inadvertently move something. You also might want to move, resize or copy your masterpiece. The answer is to make your figures a group – a collection of figures that FX Draw will treat as one.

Grouping is easy. Draw yourself a diagram with two or more figures in it – anything will do.

Now select all of the figures. Each of the figures will have its own selection squares.

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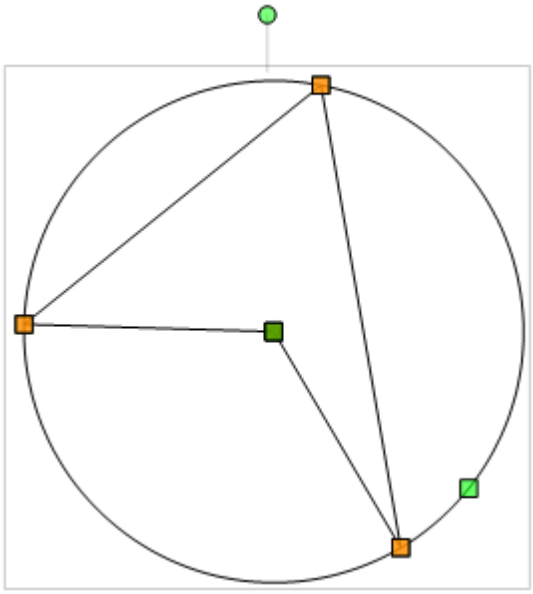
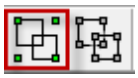
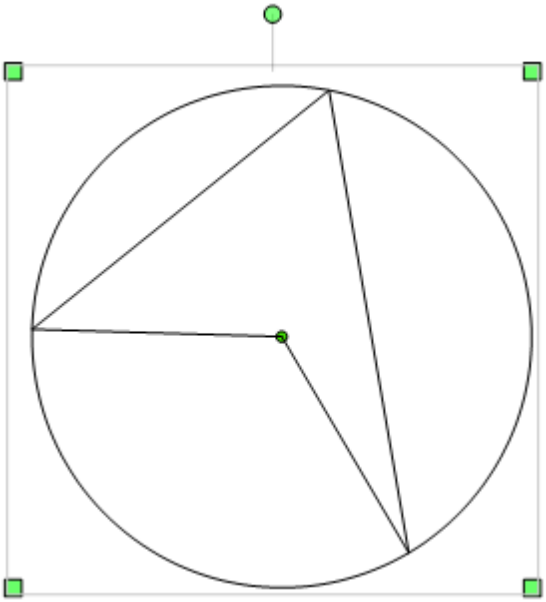


You can tell FX Draw to group the figures in three different ways.

- Typing CTRL G
- Choosing Group from the Edit menu
- Pushing the Group button



The selection will change so that all figures are grouped into one rectangular region. Try moving and resizing the group – the figures are now treated as one "thing".



Of course, if you later want to change something that is part of a group, you can “ungroup” your group. Simply select your group and do one of the following:

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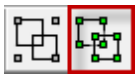
- Typing CTRL H
- Choosing Ungroup from the Edit menu
- Pushing the Ungroup button

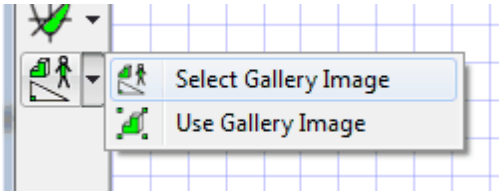


One of the most important applications of groups is the supplied gallery figures. We will discuss gallery figures in the next few lessons.

25 Galleries - The Basics

Galleries are collections of pre-drawn figures that can be used in your diagrams. There are hundreds of images where you have almost no work to do at all.

To access the galleries you push the Gallery Select button.



When you push this button you will see a collection of images (most likely Chance Processes).

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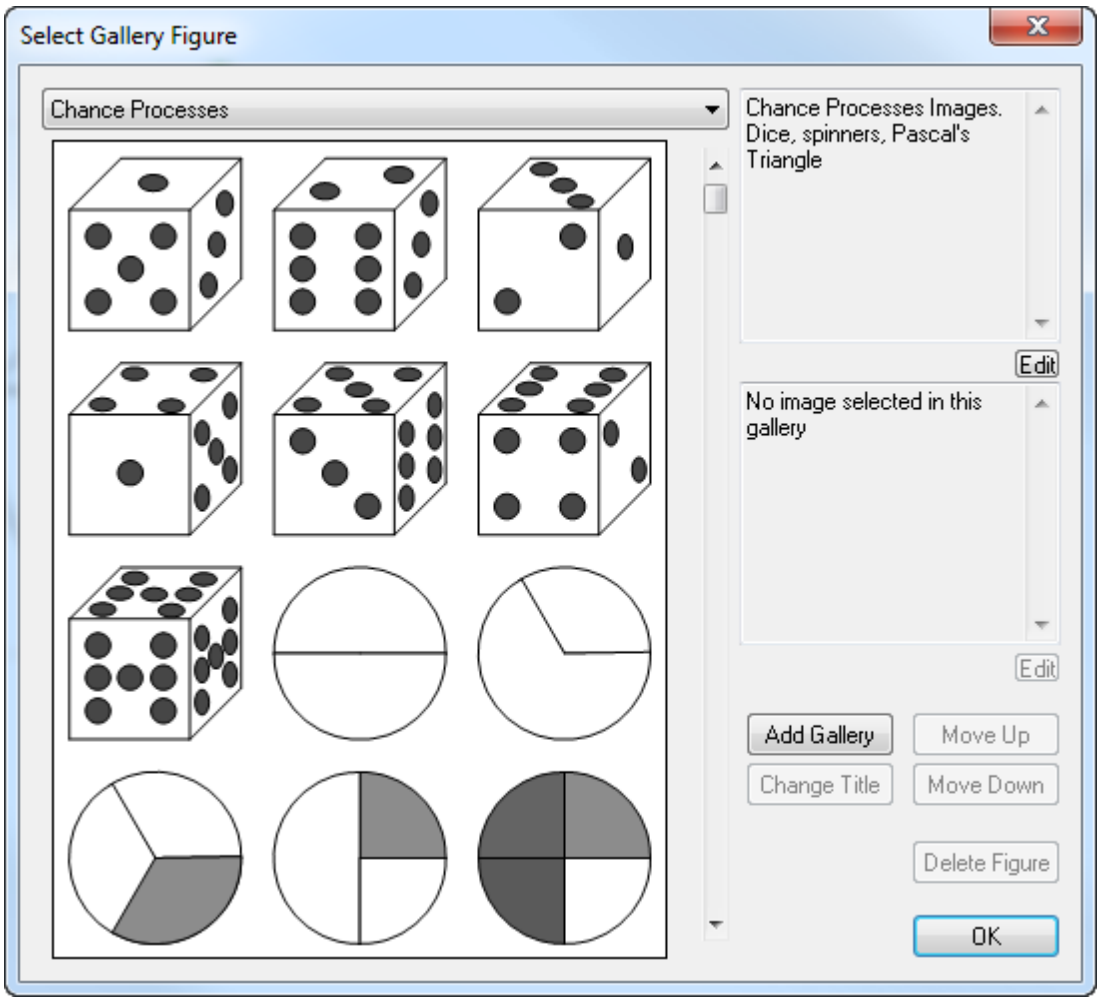
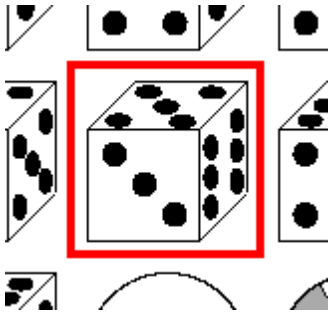


Click on one of the images and it will be surrounded by a red square.



Click OK and you will be returned to the main drawing screen.

Move over into the drawing screen and start drawing. The image you select will be drawn into the rectangular area you sketch out.

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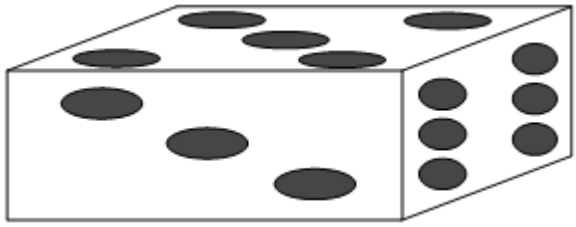
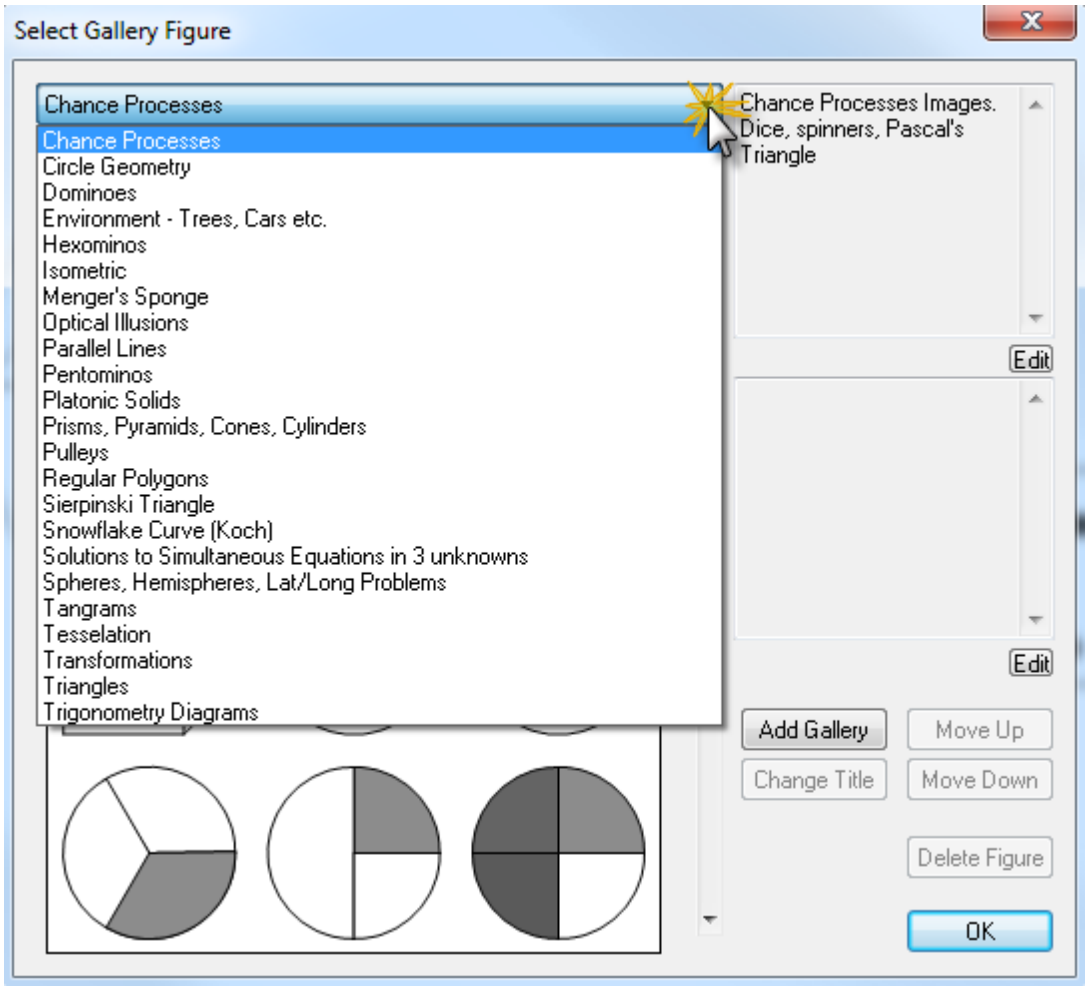


When you wish to use a different image, push the gallery select button again and select another image. You can select from other galleries by pushing the arrow shown below...



Explore!! More information about galleries tomorrow.

26 Galleries - Direction Counts

Go to the Prisms, Pyramids, Cones and Cylinders gallery and load the very first image – a cube.

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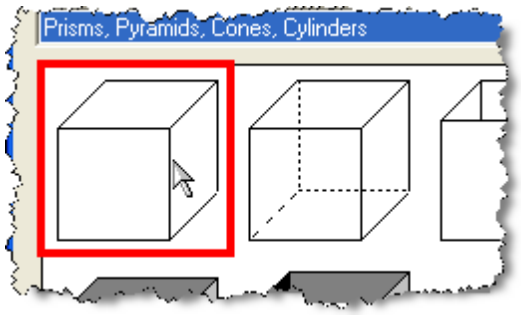
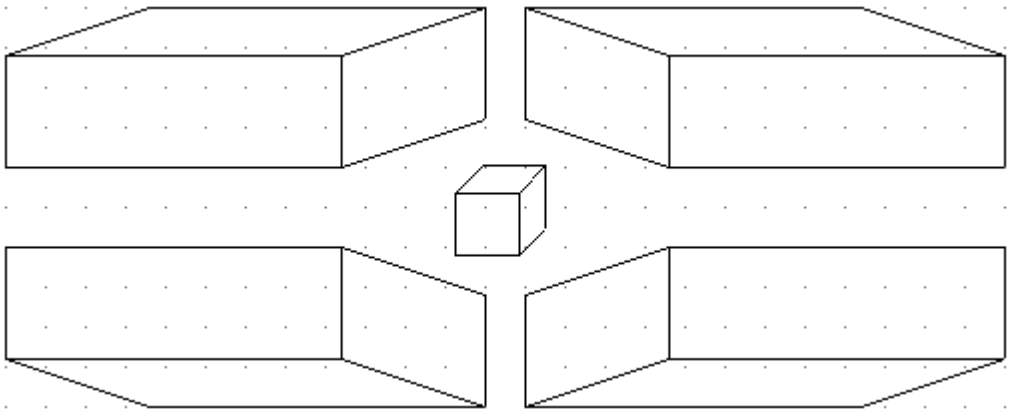


Now press OK and start drawing.

- Start at the top left and draw towards the bottom right.
- Now start at the top right and draw towards the bottom left
- Now start at the bottom left and draw towards the top right

This one gallery image can be a cube, a flat box, a tall box, a worm's eye view… By changing the direction you draw in and the ratio of height to width, you can make one gallery image be many different things.



This is an important feature of gallery images – they are NOT just clipart – they are much more versatile than that.

27 Galleries - Changing Things

One of the nicest features of gallery images is that they are not fixed – you can add to them, pull them apart, delete lines, change colours… The reason you can do all of these things is because gallery images are just GROUPS (see lesson 17).

Once you have drawn a gallery image, select it – then ungroup it. The image will change from one big image to lots of little figures, all selected.

You normally have to click off the figures some place to unselect everything and then select the one figure you wish to change.

Try it. Get one of our images and make it your own.

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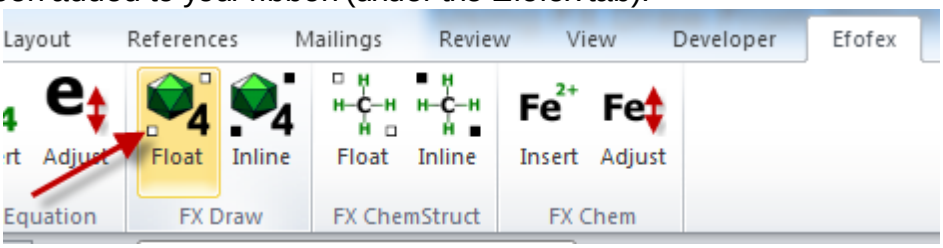
28 Using FX Draw From Within Word (Windows only)

Even though FX Draw adds itself to your Start menu, the best way to use it is from within Word.

To use FX Draw in this manner...

1. Load Word

2. When you wish to insert a diagram, push one of the FX Draw buttons that has been added to your ribbon (under the Efofex tab).



The two buttons (Float and Inline) insert slightly differently into Word. You probably want to use Float. The actual graphics produced by FX Draw are the same regardless of which button you use - the only difference is how Word uses them.

3. Draw your diagram.

4. Once you are happy with your diagram, PUSH THE GREEN TICK on your toolbar. This is the most important step - if you do not push the green tick, your diagram will not be returned to Word.

5. You should now be returned to Word and you diagram should be on your page. If you wish to edit your diagram later on, DOUBLE-CLICK on it. FX Draw will reopen and let you edit the diagram. To return to Word, you PUSH THE GREEN TICK again and your changes will be shown in your Word file.

[****]

29 Conclusion

Well that brings us to the end of this series of lessons but you have probably realised that we have not looked at many of the tools available. You can get information on the other tools from the manual, or your can sign up to the next series of email tutorial lessons.

There are four email tutorials that you should consider after this one.

Advanced FX Draw

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Introduction to Efofex Function Graphing (FX Draw / FX Graph)
Introduction to Efofex Equations (FX Equation/FX Draw)
Introduction to Efofex Statistics Tool (FX Stat / FX Draw)

You can register for these tutorials on our Email Tutorials page

Each of them will provide valuable information that will make using your copy of FX Draw more productive. Together they will turn you into an FX Draw guru!

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