

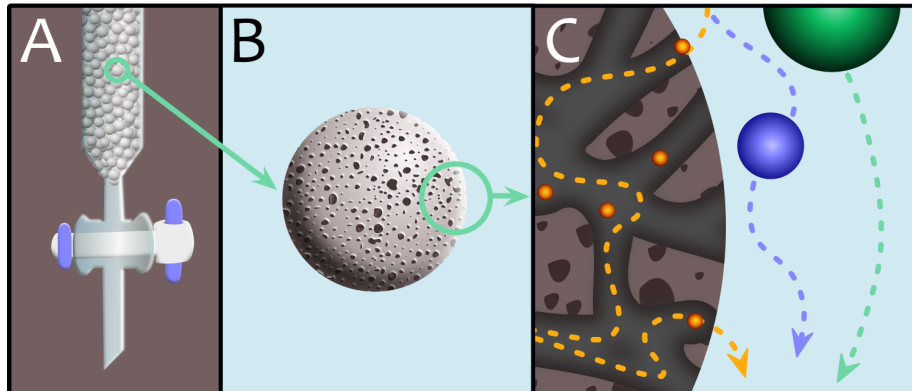
# Creating Digital Illustrations for Your Research

## Workshop III – Basic Illustration Demo

### Final Figure

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## Principles of Size Exclusion Chromatography



Size exclusion chromatography (SEC) is used primarily for the analysis of large molecules such as proteins or polymers. SEC works by trapping smaller molecules in the pores of the adsorbent materials adsorption ("stationary phases"). The larger molecules simply pass by the pores because those molecules are too large to enter the pores. Larger molecules therefore flow through the column more quickly than smaller molecules, that is, the smaller the molecule, the longer the retention time.

– Wikipedia

### Topics & Techniques covered

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- How to select, move, resize, and rotate objects.
- How to use layers.
- How to make standard shapes.
- How to change the stroke and fill color of an object.
- How to fill an object with a gradient and manipulate the gradient.
- How to make a complex shape using the pen tool.
- How to make an object transparent.
- How to create a complex shape by taking the difference between two shapes.
- How to create a complex shape by unifying two shapes into a single shape.
- How to crop a shape with a clipping mask.
- How to rearrange the stacking order of shapes.

## Introduction

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1. Open Adobe Illustrator.
2. Open a new document with *File > New*.
3. Enter a name and save the document with default settings. Make sure that you save your document in the appropriate location.
4. Click on the black arrow icon (or use the shortcut key *v*). This tool is how you select objects. Hover the mouse over a tool icon to see its name.

Select icon →



5. Notice that some tools have multiple options (indicated by the gray triangle in the icon's corner). Click and hold on a tool to open the option menu.
6. Before getting started with the illustration it's a good idea to make layers. Open the layer menu on the right hand side with the layers icon.

Layers icon →



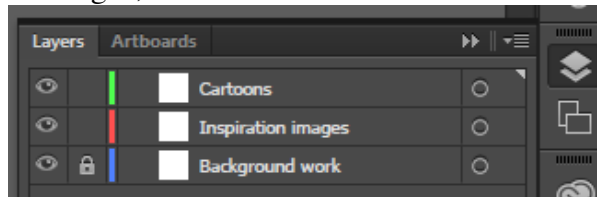
7. Click on the single page icon to create a new layer. Make two additional new layers in your document.

Single page icon →



8. Give each layer a name. I like to use a separate layer for background colors / shapes, inspiration images, and illustration.

Layers menu →



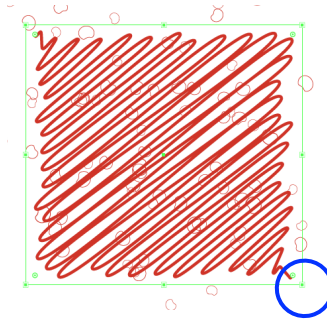
9. Lock the background layer for now by clicking on the lock icon. Locking a layer means that the layer can't be changed or added to. You can also hide a layer by clicking on the eye icon.

## Panel A

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### Importing an illustration model

1. We will start with Panel A. First we need to import a model for our illustration.
2. Make sure the *Images* layer is selected by left-clicking on it. Then import the image of a glass column with *File > Place*. The image is named SigmaAldrichColumn.jpg and is located on the desktop.
3. When importing an image pay attention to the link option. Linking an image helps make the file smaller, but the link will break if the image is moved from the original location.
4. After selecting a file, left click somewhere on the page to place the image.
5. The image can be resized using the selection tool. Click and drag the square in the corner to resize an object. You can keep the aspect ratio of the object constant by holding down shift as you drag.



*Example object resize corner* →

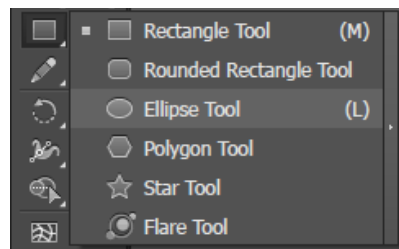
6. You can also change the location of an image by left clicking on the image with the selection tool and dragging it to a new position.
7. Objects can be rotated with the rotation tool. First click the rotation tool and then left click on the object. Drag the mouse to change the angle of rotation. Holding down shift will restrict the angle to 45° increments.

*Rotation tool icon* → 

8. After adjusting the model image lock the images layer.

### **Making basic shapes with gradient shading**

9. Now it's time to start making components. We can begin with the zoomed-out SEC bead. Since the bead is going to be small, we don't need to include texture and we can just make a sphere.
10. To make a sphere first left click and hold the rectangle tool. Select the ellipse tool from the options menu.



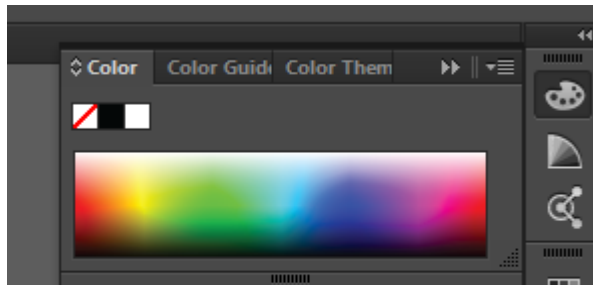
*Shape tool menu* →

11. Create a circle by clicking and dragging the mouse. Keep it a perfect circle by holding down shift while you drag.
12. Next we can work on the color of the circle. There are two aspects of a path that can be colored – the fill and the stroke. The fill is the color inside of the shape while the stroke is the color of the shape's outline.
13. You can see the current colors of an object at the bottom of the left hand menu. Switch between editing the fill or stroke by clicking on the square or the frame.



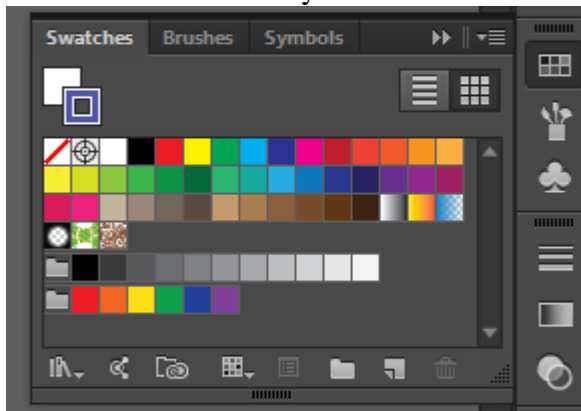
*Fill and stroke indicator* →

14. There are two different easy ways to edit color. In the color menu you can click anywhere on the color bar to select a color.




*Color menu* →

15. In the swatches menu you can instead select certain color shades. Add a swatch by first clicking on the single page icon. Then fill out the pop-up menu with the corresponding RGB or CMYK values for your color.




*Swatches menu* →

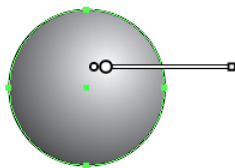
16. Another method to select a color is by using the eyedropper tool. After clicking the eyedropper tool, left click anywhere on the page to select a color.

*Eyedropper tool icon* → 

17. For the fill of our bead we want to use some sort of shading to help the bead appear 3D. This can be accomplished with the gradient tool.
18. Open the gradient menu by clicking on the gradient icon. You can control the type of gradient and also adjust the colors that make up a gradient.

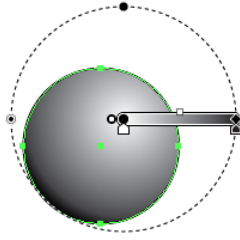
*Gradient menu icon* → 

19. Change the gradient type to radial as the first step for shading the sphere.
20. Now you can adjust the gradient's colors and their position. Move the center position of the gradient by clicking on middle black circle and then dragging.



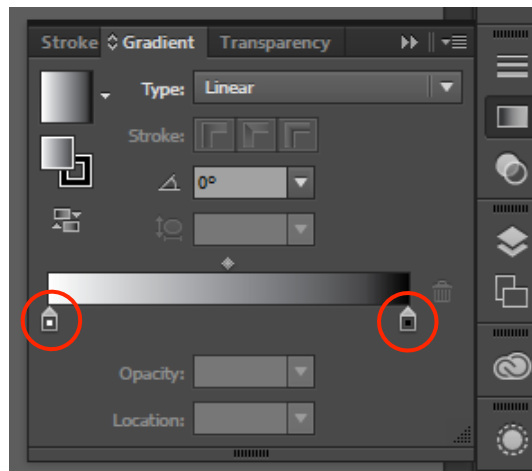
*Center of gradient* →

21. You can also adjust the size of the gradient by dragging the outer anchor point.



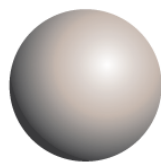
*Size of gradient* →

22. Gradients are composed of different color stops. You can adjust the color of each stop in the gradient menu.



*Gradient stops* →

23. Double click on the stop to change the color and then use either the color or swatches menu.
24. Add an additional color to the gradient by clicking below the gradient bar to add a stop. Drag the stop away from the gradient bar to delete it.
25. On the sphere set the center stop to white. Set the second stop to black.
26. Add an additional stop in the center of the gradient and color it gray / tan.
27. Move the gradient center to the upper right. Adjust the spacing between stops until you are satisfied with how the gradient looks.
28. Remove the stroke (if there is one) and the bead is finished!



*Final bead* →


### **Making more complex shapes**

29. Next we will draw the column. This is a shape that can't be made with one of the shape tools, so we'll have to use the pen tool instead.
30. Select the zoom tool (by clicking on the magnifying glass) and zoom in on the column.

*Zoom tool icon* →

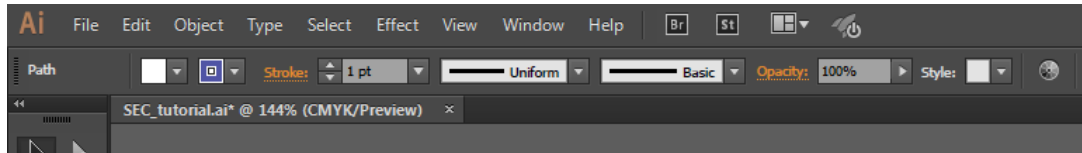


31. Now select the pen tool. We will use the pen tool to trace the shape. The pen tool works by adding anchor points or “corners” to a path.

*Pen tool icon* → 

32. First set the fill color to empty and the stroke to a bright color. You can also change the width of the stroke to make it easier to see on top of the image if needed using the stroke menu on top of the screen.

*Stroke menu* →



33. Pick a starting place and then add anchor points along the edge of the glass piece of the column in each corner. Don't worry about following the curves yet. Just place an anchor point at the middle of each curve for now.

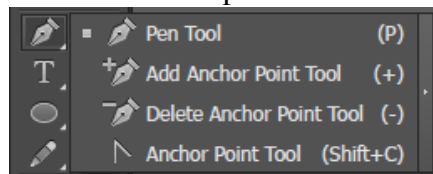


*Rough outline with pen example* →

34. Close the shape by connecting the line to the first anchor point. Alternatively, end a path without closing the shape with *ctrl + left click*.
35. If you need to delete an anchor point as you go, press delete.
36. After making the initial rough outline you can adjust the position of anchors with the direct selection tool. Click on the direct selection tool (white arrow) and then click on an individual anchor point (make sure you've selected only 1). Drag the anchor point to change its position.


*Direct selection tool icon* → 

37. You can add nodes with the + pen tool option, and remove them with the - pen tool option, which are both located within the pen tool menu.




*Different pen tool options* →

38. You can also change the anchor point into a curve instead of a corner. With the anchor point selected, click on the curve icon in the top menu to change the anchor point type. You can also use the anchor point tool shown in the pen tool menu above.

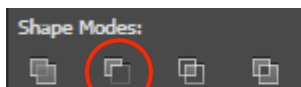
39. Once an anchor point has been changed, you can adjust the handles to control the shape of the curve.
  40. Adjust the anchor points and curves until the shape of your vector glass column matches the image well. Try to use the fewest anchor point possible to accurately describe the shape.
  41. Create a copy of the column and move it to the side. Change the color of the original column to light blue or gray.
  42. After adjusting the color make the column somewhat transparent to mimic glass using the transparency menu (*Window > Transparency*).
- Transparency menu icon* → 
43. Add a linear gradient parallel to the long edge of the column with white as the center to imitate the shine of light on the glass.

### Shading irregular shapes

44. In this case the gradient doesn't follow the shape well because the shape is irregular. Luckily it's easy to shade this shape in a different way.
45. Make two more copies of the uncolored column shape. Fill each copy with a different solid color.
46. Place the copies on top of each other, shifting the lower copy to the bottom left slightly. This edge will eventually become the shadow side of the shading.
47. Create a copy of the overlapped pair of column shapes and paste it next to the original pair.
48. Change the stacking order of the columns in the 2<sup>nd</sup> pair by right clicking on the top column and selecting *> Send to back*. This should result in the back column being shifted to the top right instead of the bottom left. This edge will eventually become the highlight side of the shading.
49. Next we need to create a new shape from these edges. Open up the pathfinder menu from the bar on the right hand side. If the menu icon is not visible first open the window with (*Window > Pathfinder*).

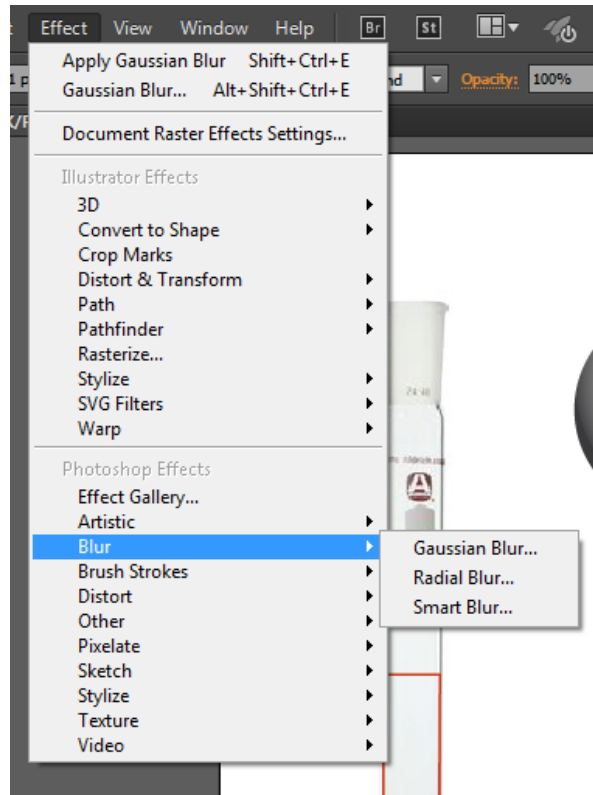
*Pathfinder menu icon* → 

50. Select both columns in one of the pairs and then click on the "difference" icon. This operation will remove all parts of the lower object that are covered by the upper object. In this case it should leave the shadow edge we identified earlier.



*Difference operation icon* →

51. Repeat the step above for the 2<sup>nd</sup> pair of columns. This operation should leave the highlight edge we identified earlier.
52. Change the fill color of the shadow to black and the fill color of the highlight to white.
53. You can use these edges for shading as is, but you can also imitate a gradient by applying the blur effect. Select an edge and apply a Gaussian blur with *Effect > Blur > Gaussian blur*. Click the live preview option and adjust the blur radius appropriately.



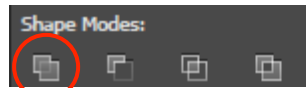
*Blur effect* →

54. Move the blurred shapes to the top of the stack over the column. Position the edges so that the blur shades the contour of the column shape. Don't worry about any excess blur that spills over the edge yet.
55. Once you have placed the highlight and shadow, group them and the column together by selecting all three objects and then applying *Object > Group* or typing *ctrl + g*.
56. Now make one more copy of the original column shape. Remove the fill from this shape (if there is any), and give it a colored outline. Position the outline on top of the column exactly.
57. Select the column outline and the group of column + shading. Crop the group into the outline shape with *Object > Clipping Mask > Make*. This will make anything outside of the clipping shape (mask) invisible.

### **Another method for making irregular shapes**

58. Next we will make the white and red parts of the column valve. Instead of starting from scratch with the pen tool another option is to edit and / or combine basic shapes.
59. Practice this technique on the white piece of the stopper. Make an ellipse the same size as the curve on the left end. Next make a rectangle along the center part of the stopper.
60. Make a square for the right end. Round the corners of the square with *Effect > Stylize > Rounded Corners* as needed.
61. Combine all 3 shapes by selecting them and then clicking the "union" icon in the pathfinder menu.





Union operation icon →

62. Adjust the anchor points and their curvature to finalize the new shape. Repeat this process with the red parts of the stopper.
63. Once you are satisfied with the shapes you've created repeat the "difference + blur + clip" shading method for each piece. Use the eyedropper tool to color each shape based on their colors in the image.

### Using align and distribute

64. The only remaining component left to make is the packing material. First, create a copy of the sphere we made earlier. Resize the copy to make it smaller.
65. Next create many copies of the small sphere using copy / paste. Start by copying the sphere several times then select this group of spheres and copy them again. Repeat until you have ~ 30 spheres.
66. Move one sphere just above the top of the column shape and one sphere to the bottom.
67. Select all of the spheres. Arrange them into a column by opening the align and distribute menu and then clicking on the horizontal align center button (which looks like two shapes stacked vertically with a vertical line through the center).

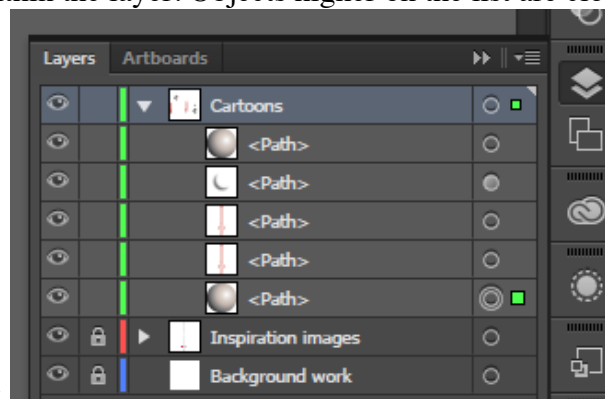
Align and distribute menu icon →



68. Distribute the spheres along the column using the vertical distribution option.
69. Group the spheres together with *ctrl + g* and then copy the column several times.
70. Paste the columns randomly to form a patch filled with spheres that is a little larger than the size of the column.
71. Then, applying the same method we used earlier, group all of the beads together and clip the group to the column shape.

### Stacking objects

72. To finalize the column all the elements need to be stacked in the right order. On the layers menu you can expand the contents of a layer and see the stacking order of all objects within the layer. Objects higher on the list are closer to the top.



Object order →

73. The order of an object can be changed by dragging the object up or down in the layer menu.

74. Reorder the objects so that the stopper and packing material are below the glass column.
75. The illustration for panel A is now complete!