



Creating Scientific Illustration

Presented by Alexandra Pina Kingman, ap.kingman@gmail.com

Expectations

Illustration for your presentation:

Due Thursday end of day

Black and white vector line drawing depicting one aspect of your research

Final Illustration and written assignment:

Due Sunday September 17th

- Final version of your digital illustration
- One written paragraph describing what design principles you used and why
- All the sketches that lead you to your final illustration

Day 1

- The illustration process and sketching
- Hand drawing exercises
- Theory: Gestalt Principles
- Break
- Concept development breakdown
- Decide what to draw
- Design Principles
- Do 3 sketches of your research



**Why do we use
pictures to
communicate ?**

Picture Superiority Effect

In order to learn, information must be integrated into long-term memory.

The *picture superiority effect* states that forming memory from pictures is easier than forming memory from words (Johassen 2004).

Johassen, D.H., ed. 2004. *Handbook of research on educational communications and technology*, 2nd ed. Mahwah, NJ: Lawrence Erlbaum Associates.

Illustration process breakdown

Concept Development

Sketch by hand, many times over

Choose the best sketch, trace it with a black pen

Using Adobe Illustrator, trace the black pen line with a vector line with the pen tool

Add colour, fill and texture

What is sketching



Sketch

A way of drawing that is meant to help explore your ideas and communicate your ideas to others.

What matters is the process, not the end results



Final render

What is a sketch

- Quick
- Hasty
- Rough
- Disposable
- Plentiful
- Minimal detail

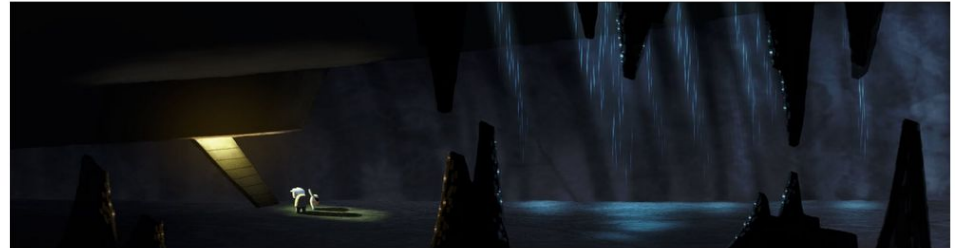


disneyconceptsandstuff.tumblr.com



disneyconceptsandstuff.tumblr.com

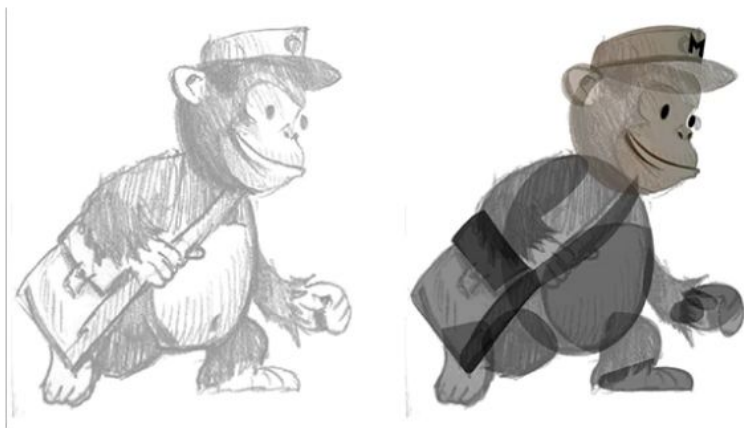
Keep all your sketches, you will need them during the course of this class!



Pixar / Via disneyconceptsandstuff.tumblr.com

Benefits of sketching

- Quickly explore different ideas
- A way to record what you “see,” either right in front of you or in your imagination
- Explore different perspectives
- Tools for problem solving
- Used in addition to taking written notes



MailChimp

Mailchimp Logo by Jon Hicks

Pixar's short film *The Blue Umbrella*





Sketching Exercises

Visual Perception and (some of) the Gestalt principles

Our visual system processes a vast amount of information, so our brains need a way to organize all this input.

This process is described by the Gestalt principles.

Designers use the Gestalt principles to help organize visual information and direct the viewer's attention.

The gestalt principles that we will discuss are:

- Similarity
- Proximity
- Closure
- Figure-ground
- Continuation

Similarity

The gestalt principle of similarity says that elements that are similar are perceived to be more related than elements that are dissimilar.

Use similarity in your design to organize content and create associations by showing which elements are related, or not related, to one another.

Similarity can be communicated through:

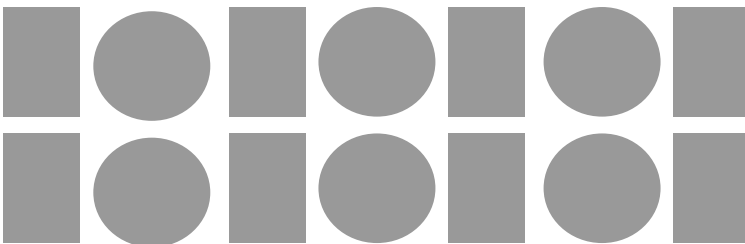
Colour



Size



Shape *(easier to see columns of similar shapes than rows of dissimilar shapes.)*



Orientation



Similarity and Colour

Color is very powerful in assigning relationships between elements.

Try using color in your work to differentiate elements or group elements.

Colour can override Size



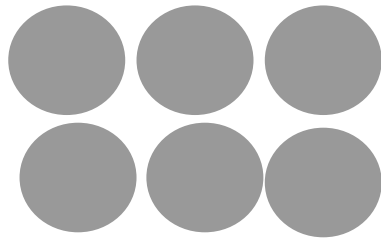
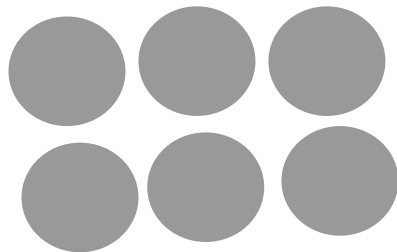
Colour can override Shape



Proximity

The gestalt principle of proximity says that elements that are closer together are perceived to be more related than elements that are farther apart.

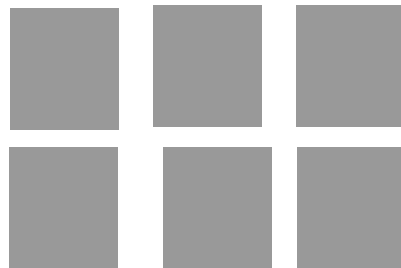
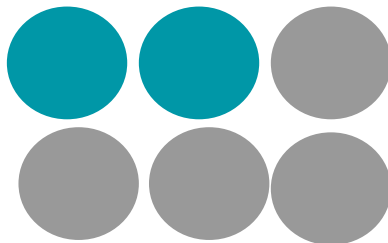
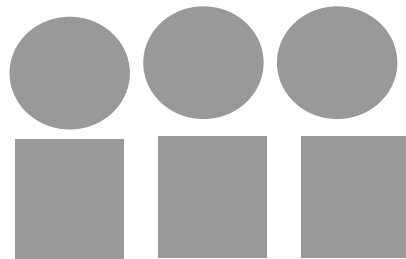
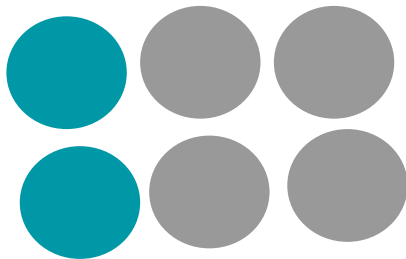
Use proximity in your design to organize information and create hierarchies.



Proximity

Note how you group these shapes in your mind.

Even with similarity (colour and shape) incorporated into the design, your brain still groups the shapes according to how close or far away they are from each other.



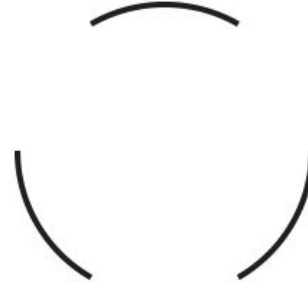
Closure

Gestalt principle of closure states that we have a tendency to perceive a set of individual elements as a single, recognizable pattern, rather than multiple, individual parts.

Provided with enough information, we will fill in the missing parts to create a whole. This is achieved through the use of positive and negative space.

Using closure, we can reduce the elements needed to convey visual information, reducing complexity and making designs more engaging.

We can close the lines in our mind to form a circle



Too little information is given and we cannot form a circle in our minds



Closure

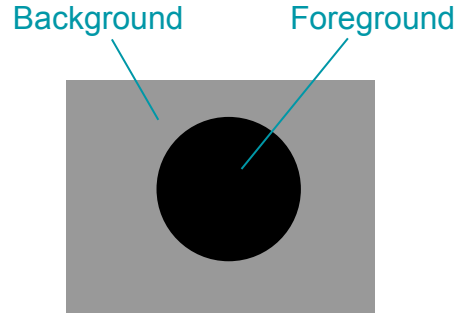


Instead of needing an outline, the image on the right uses negative white space to form the body of the peacock, and uses coloured positive space to form the tail. Our brain is capable of seeing a peacock body within the negative space.

Figure-Ground

Gestalt principle of figure-ground is the state in which we perceive elements as either the objects of focus or the background. Figure-ground works through the use of positive and negative space.

Stable figure-ground



Unstable figure-ground

Foreground? Background????

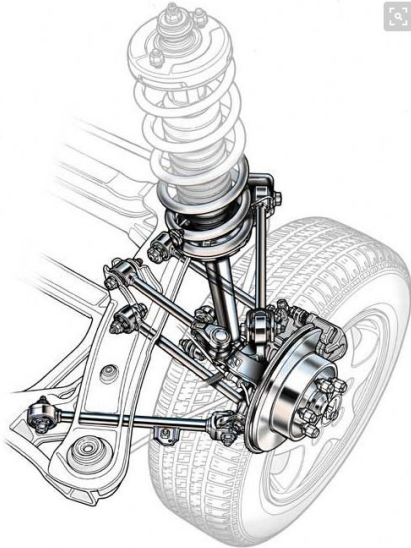


Unstable figure-ground used in design to add interest, tension and excitement.



Figure-Ground

It is important to focus the viewer's attention where we want it. You can achieve this through....



Contrast

Use light and dark colours to separate objects. White and black create the strongest contrast. Complementary colors also create good contrast.

If pure colors are too intense, alter the value (how dark or light the color is) to create more effective contrast.

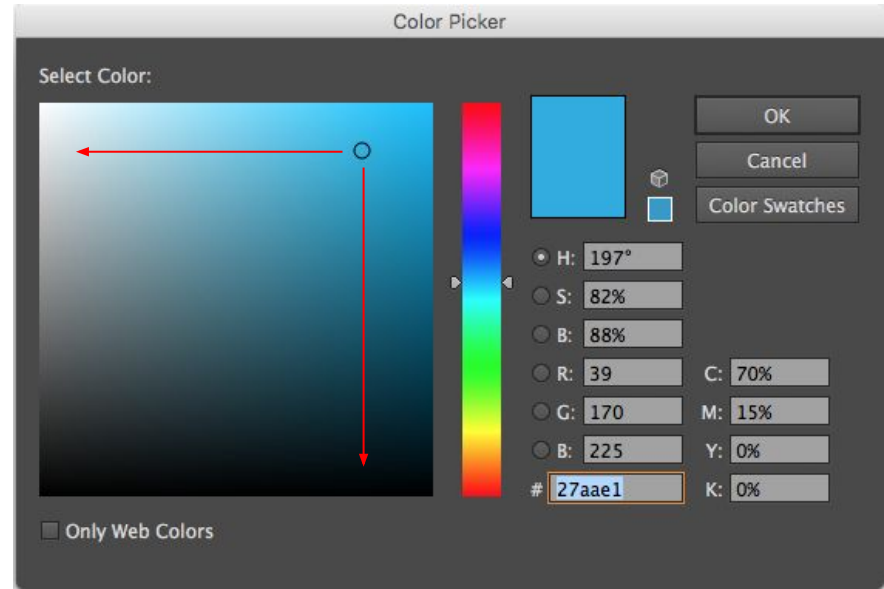


Figure-Ground

It is important to focus the viewer's attention where we want it.

Use these elements to reinforce the figure-ground relationship in your designs.

Color

Warm colors, such as yellows, oranges and reds, are perceived as approaching and can be used to strengthen figure.

Cool colors, such as purples, blues and greens, are perceived as receding and can be used to strengthen ground.

Size

When a large element fills the majority of the ground, it will be perceived as the figure. Conversely, a small element within a large ground will be perceived as the figure.

Figure-Ground

It is important to focus the viewer's attention where we want it.

Use these elements to reinforce the figure-ground relationship in your designs.

Position

Elements positioned in lower areas of your composition will be perceived as figure while elements positioned in upper areas will be perceived as ground. This plays with our perception of distance, as we perceive objects positioned in lower areas to be closer to us and objects positioned in upper areas to be farther away.

Focus

Elements that are in focus will be perceived as figure while elements that are out of focus, blurred, faded, or desaturated will be perceived as ground.

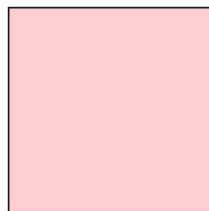
Figure-Ground

It is important to focus the viewer's attention where we want it.

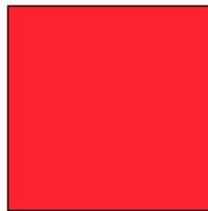
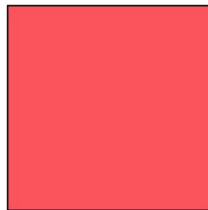
Use these elements to reinforce the figure-ground relationship in your designs.

Saturation

Elements that are saturated, or brightly coloured, will be perceived as figure (or in the foreground). Whereas elements that are desaturated, where you add white to the colour, will be perceived as ground.



Desaturated



Saturated

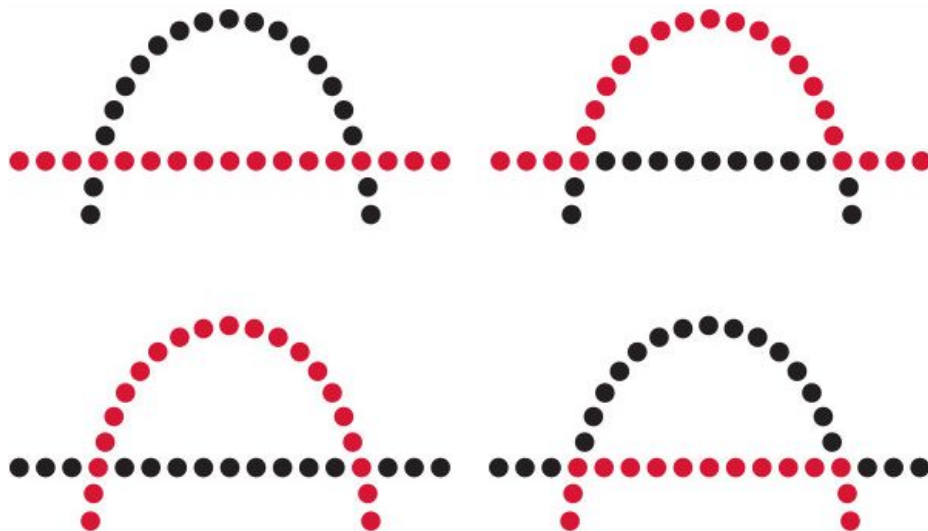
Continuity

Gestalt principle of continuity states that if elements are aligned within an object, we see them as being grouped together.

In cases where there is an intersection between objects, individuals tend to perceive the two objects as two single uninterrupted entities.

We are less likely to group elements with sharp abrupt directional changes as being one object.

Our mind follows the straight line or the curve. On the right, try to follow the red path, we instinctively still want to follow the straight line or the curve, not the paths with sharp directional changes.



Continuity

When designing, we can use continuity to guide the eye through the composition, for example: from left to right or bottom to top.

This is also used to direct attention to specific groups or elements. In photography, this is called leading lines.



Sveta Dorosheva



Break, 15 min



Concept development breakdown

What will you draw?

Decide on the content of your illustration. What will you show? What will you omit? What is your story?

Possible questions to help define this:

- What is the hardest part of your research to explain?
- What problem(s) are you trying to solve?

Why are you creating an illustration?

- What are your intentions or motivations?
 - Teach something
 - Sell an idea
 - Explain how to use something
 - Ext.
- Is a drawing the best way to communicate this topic?
Considering the content and your intentions, is text a better option?

Who will you draw this for?

Your audience will determine many design decisions, so you need to define this right from the start.

Typical audiences are:

- The general public (ie: your parents)
- Your supervisor
- Research scientists in other fields
- Policy makers

Where will this illustration be published?

Possible locations: Website, journal article, billboard, poster, ext.

This is important to keep in mind because it will help you decide what tools to use, and you will need to know this to decide on resolution to work, size of the illustration, and dimensions of your canvas.

Requirements for screen and print are very different. For example:

Print: 300 dpi, CMYK colour space

Web: 72 dpi, RGB colour space

How will you draw this?

- What illustration style will you use?
- How much detail will you add?
- Will you do a black and white illustration or use colour?
- What tools will you use?

Illustration Styles that I will focus on in this class



Line



Filled-shapes

Illustration by Jing Wei <http://jingweistudio.com/>



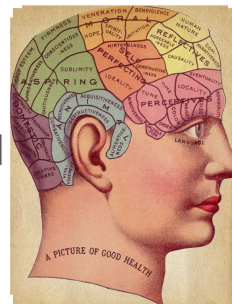
Both

Illustration by Jing Wei <http://jingweistudio.com/>

Black & White or Colour

Why use colour:

Coding: to help label



Grab the viewer's attention



Why black & white:

Budget and Time: colour illustrations cost more to print and cost more to make, because they take more time to make.

What tools are available for creating digital images?

Vector illustration use: Illustrator or Inkscape

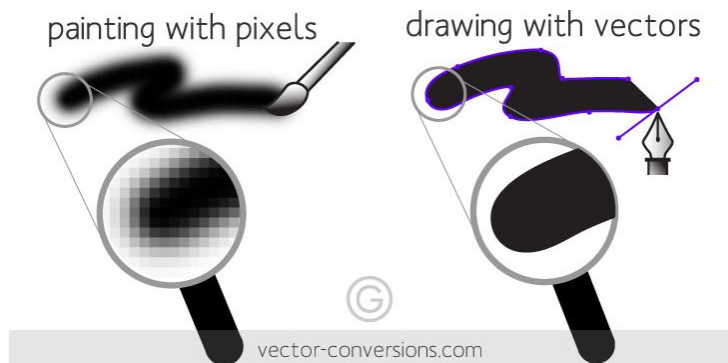
Vector images are mathematical calculations from one point to another that form lines and shapes. If you zoom into a vector graphic it will always look the same.

Create vector illustrations if you need to scale your work, or are drawing with lines and shapes.

Raster illustration use: Photoshop or Gimp

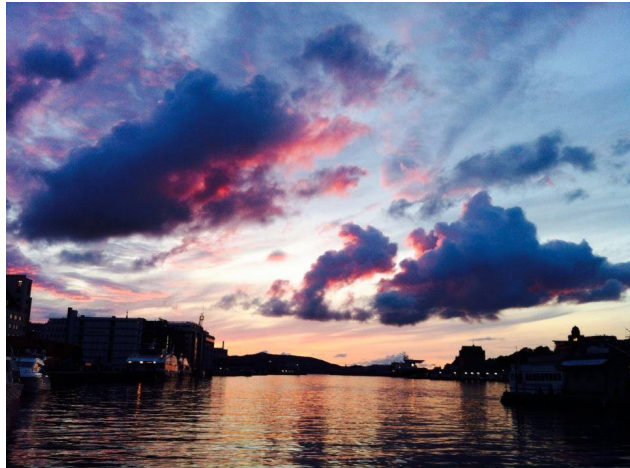
Raster images are made of pixels. A pixel is a single point or the smallest single element in a display device. If you zoom in to a raster image you may start to see a lot of little tiny squares.

Create raster images if you are painting digitally or editing photographs.



Find inspiration

Look through the internet (pinterest is good for this), books, movies to find images that inspire you.



Paths of Hate - short film



Cloudy with a
Chance of Meatballs

Take 30 min to answer these questions for yourself

What - what story do you want to tell?

Why - what are your objectives?

Who - who is your audience?

Where - besides a class assignment, do you want to use this anywhere else?

How - line-drawing or filled-shapes or both

- do you need to use colour to better communicate your message?

Inspiration (...at home?)

Design concepts to consider

- Simplicity vs Complexity
- Outlines vs No Outlines
- 2D vs 3D
- Rule of thirds
- Odd numbers vs Even numbers

Simplicity vs Complexity

A case for Simplicity

- Eliminate extra details that might be distracting.
- Distractions can hinder learning.

(Brisbourne et al. 2002)

A case for Complexity

- If an object is complex, then these complexities should be communicated.
- Simplification can take away too much information, and this can be misleading.

(Stith 2004)

Simplicity vs Complexity

How is this balanced?



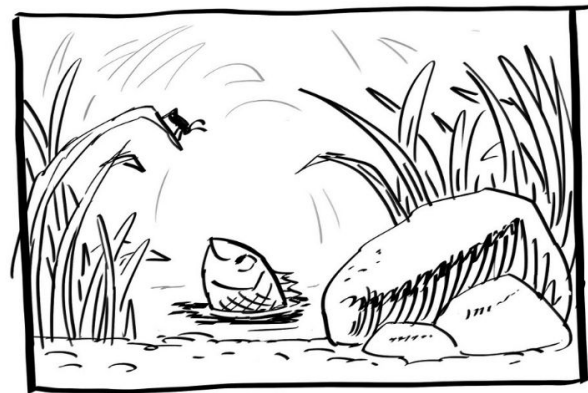
too simple

- Line weight is uniform
- Empty space beside empty space



too complex

- Areas with a lot of detail are beside areas of a lot of detail



just right

- Fish (focus point) is detailed to bring attention to it and is beside an area of with less detail

Simplicity vs Complexity

Note the areas of the drawing that look more complex?

Note the areas of the drawing that look more simple?

How does the artist achieve this balance?



Examples of line variation to increase visual interest



James Jean | Figure Drawing

GOUIZ
AND
NORM
1.com



Simplicity vs Complexity

Add complexity to simple illustrations through varying line weight

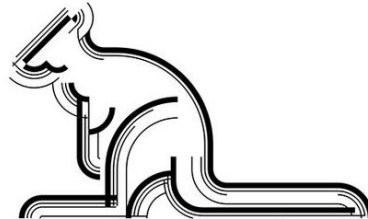
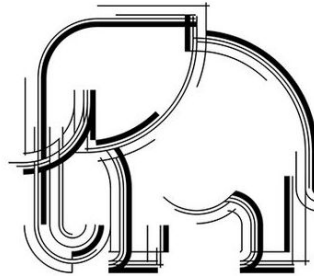
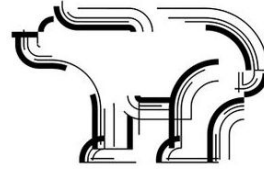


<http://thevirtualinstructor.com/line-quality-cross-contour.html>

Illustrator: change the STROKE size, shape, opacity

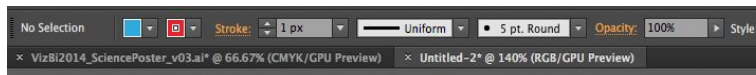
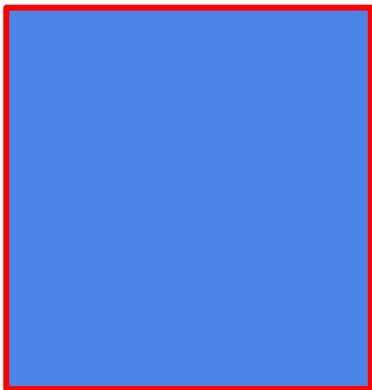


Example of varying line weight to increase visual interest



— Outlines vs No Outlines

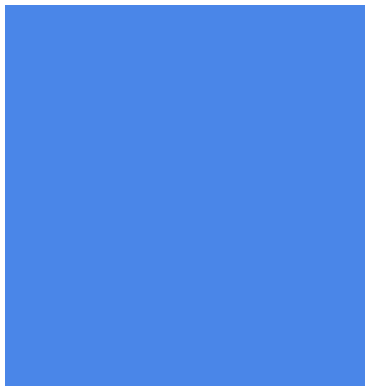
Illustrator: control the STROKE colour or ...



A case for outlines:

Highlighting the outer contour of the surface with a line drawing increases clarity and speed of recognition (Woolridge 2013)

transparency



3D vs 2D

A case for 3D

Spatial relationships are difficult to visualize. Showing volume and space in three dimensions helps the viewer visualize conceptual spatial relationships (McClean et al. 2005).

A case for 2D

Abstraction is an accessible form of visual representation. Learners have the ability to associate generalized visuals to the natural environment even though the representations may not be realistic (Brisbourne et al. 2002).

Furthermore, some theorists argue that people think and reason by visualizing abstract shapes (Johassen 2004).

3D vs 2D

How is this achieved?



3-Dimensional volume representations are achieved through tone, surface texture, shadow, ambient occlusion, depth of field, and highlights.



2-Dimensional representation is achieved with a line drawing of the surface contour and eliminating all tonal information.

2D vs 3D

How is this achieved?



3-Dimensional volume representations are achieved through tone, surface texture, shadow, ambient occlusion, depth of field, and highlights.



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Rule of Thirds

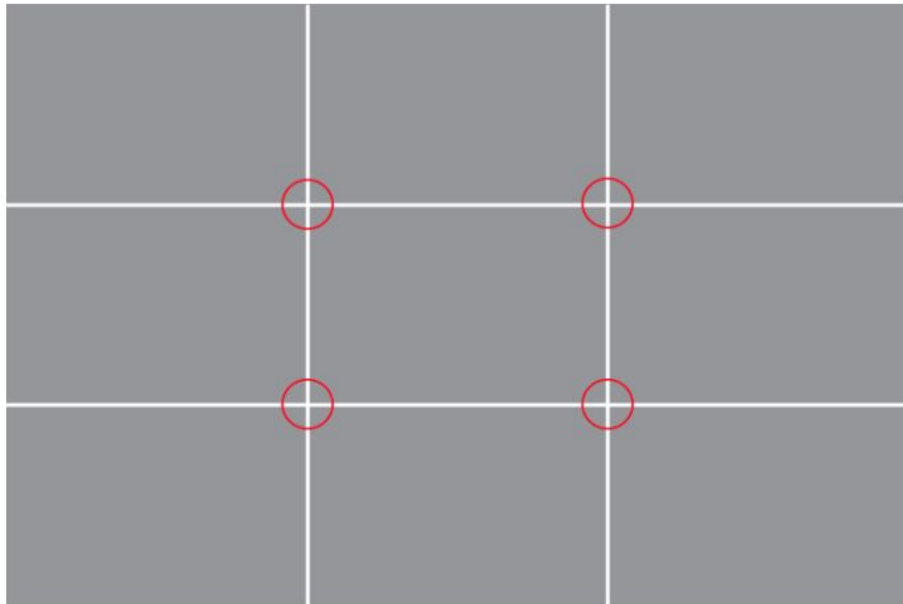
The rule of thirds is a guideline to set up compositions.

Important elements should be placed along these lines or at their intersections, this creates more tension, energy and interest in the composition than simply centering the subject.

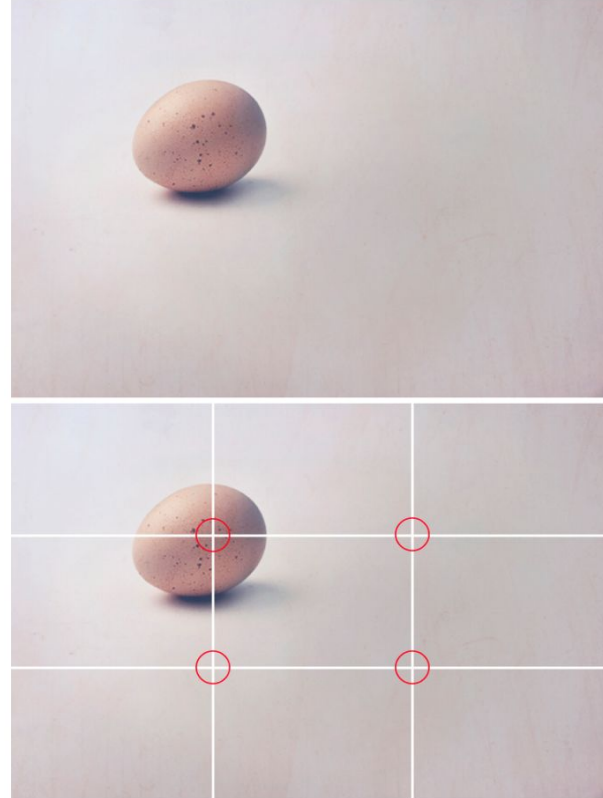
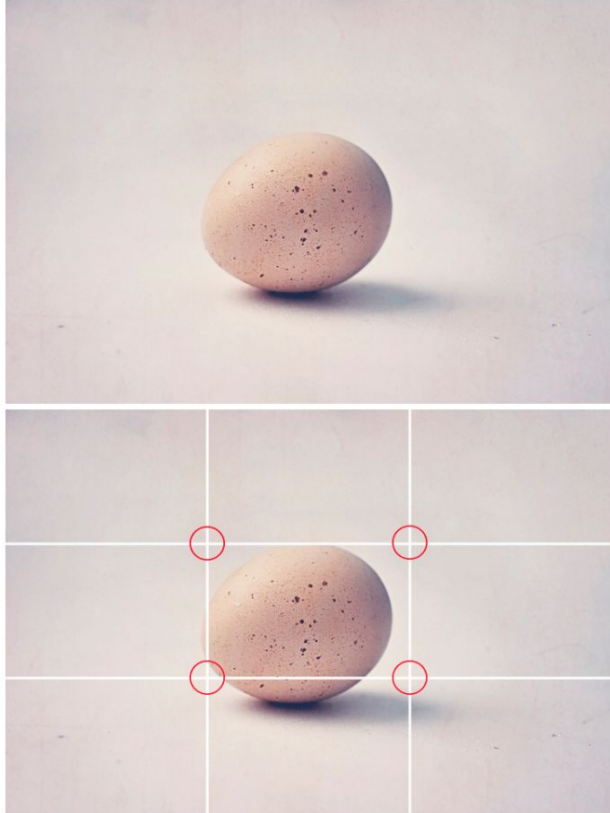
Illustrator Video Tutorial:

Craig Huffman - Create a Rule of Thirds Grid

<https://www.youtube.com/watch?v=Fmsiw-oYn38>



Rule of thirds



Odd number vs Even number



Even numbers of elements in your designs create symmetry, but odd numbers create interest.



References:

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Brisbourne, M.A.S., S. S.-L. Chin, E. Melnyk, and D.A. Begg. 2002. Using web-based animations to teach histology. *The Anatomical Record (New Anat.)* 269: 11-19.

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Price, S. 2004. *Processing animation: Integrating information from animated diagrams*. United Kingdom: Univ. of Sussex.

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Stith, B.J. 2004. Use of animation in teaching cell biology. *Cell Biology Education* 3:181-188.

Tasker, R. and R. Dalton. 2006. Research into practice: visualisation of the molecular world using animations. *Chem. Educ. Res. Pract* 7 (2):141-159.

Thomas, C. and A. V. Tulin. 2013. Poly-ADP-ribose polymerase: Machinery for nuclear processes. *Molecular Aspects of Medicine* 34 (6): 1124-1137.

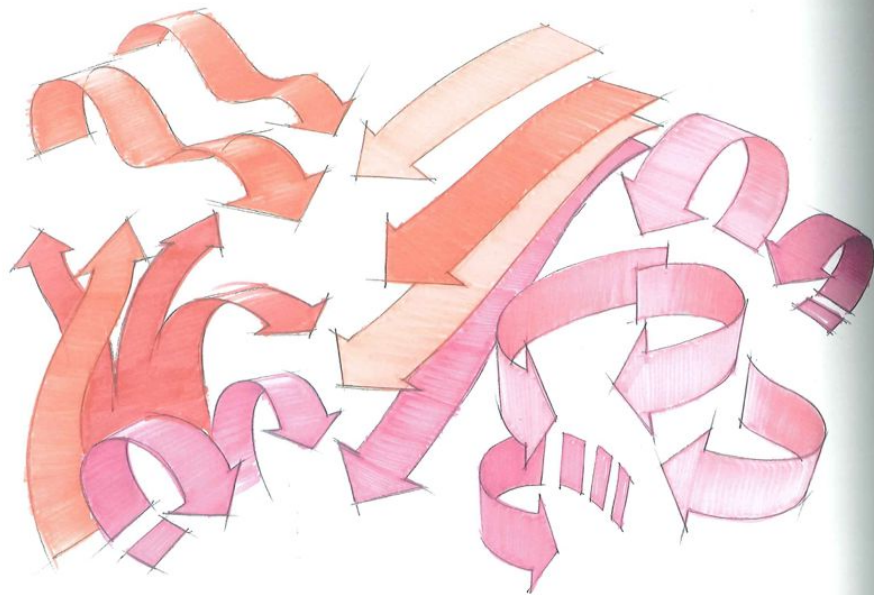
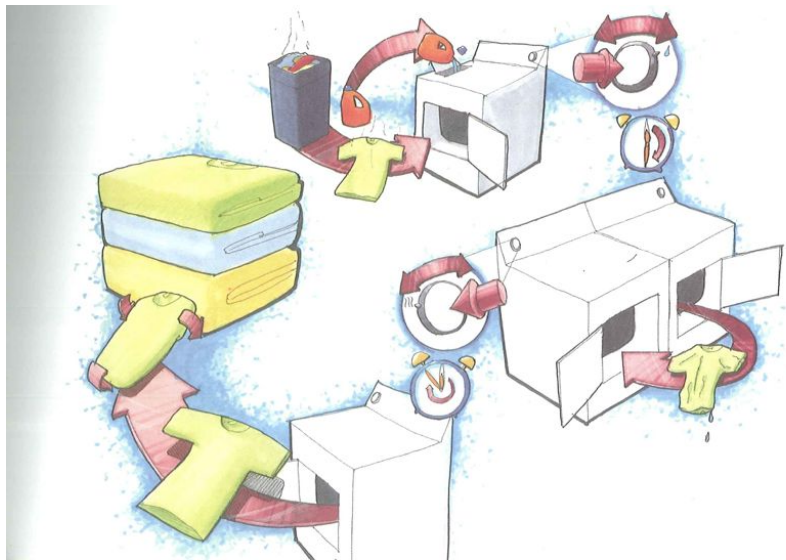
Woolridge, N. 2013. Drawing a Line in the Mind. *JBC* 39 (1): 26-31.

Arrow types

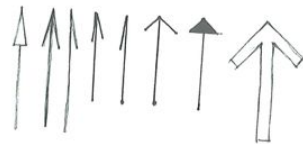
Drawing Ideas: A Hand-Drawn Approach for Better Design

by Mark Baskinger and William Bardel

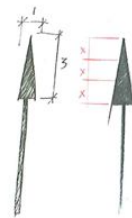
www.drawingideasbook.com



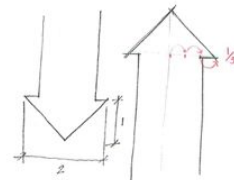
CURVILINEAR FORMS, PLANES • ARROWS



Detail arrows, directional arrow



Detail arrows, proportion 1:3



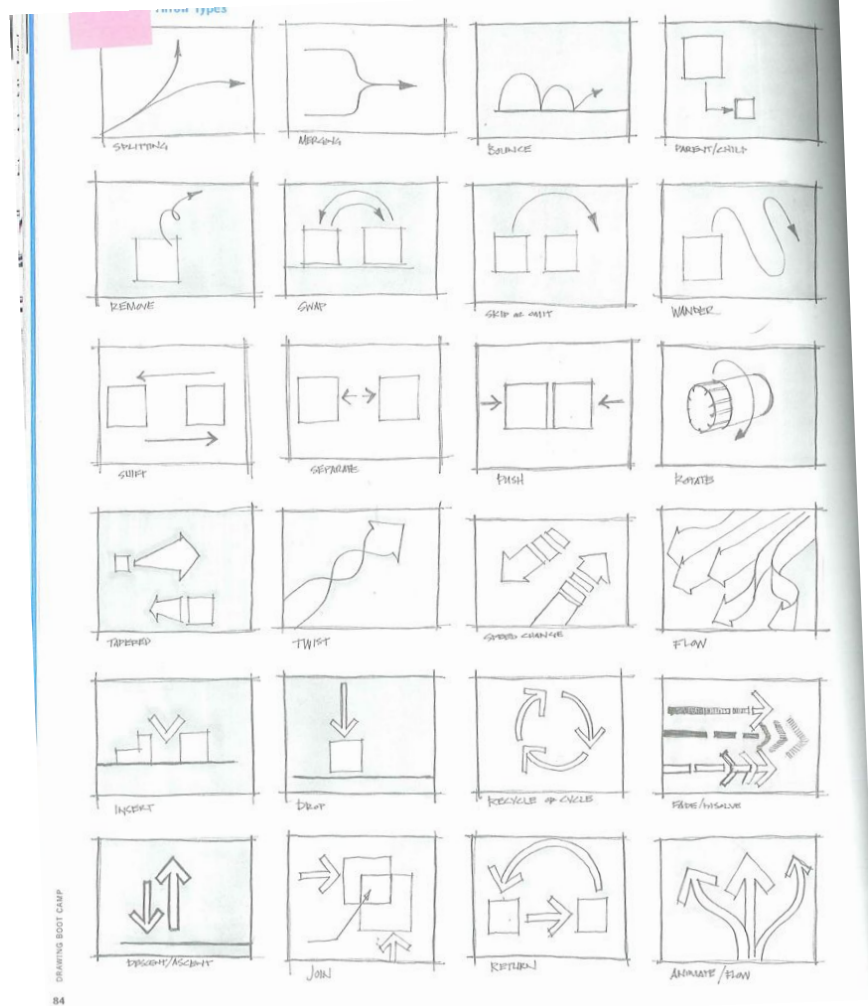
Action arrows, proportion 2:1

Arrow types

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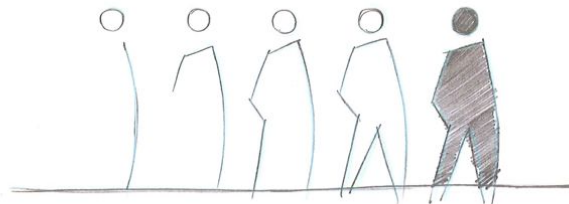
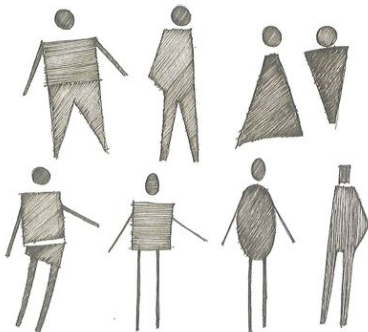
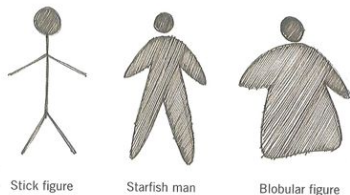
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Drawing figures

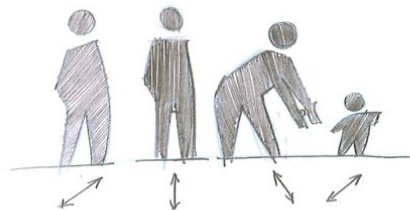
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Steps for drawing a simple figure



Strokes that enhance direction and movement

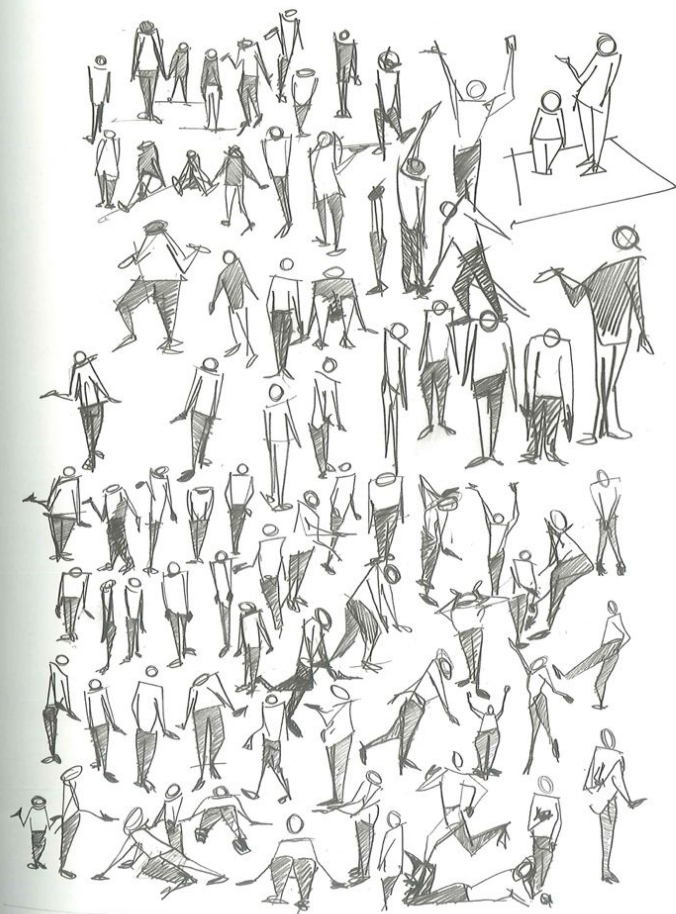


Time-based sequence of silhouettes

gestural silhouettes

Once you add a figure to a sketch, by default you will be creating a scene about the relationship between a person and the designed object/system. You may then consider sketching sequences of actions or interactions, employing multiple figures to communicate past, present, and future states. The presence of a human figure will also speak about proportion, scale, interactions, touch points, and the like.

*Drawing Ideas: A
Hand-Drawn
Approach for
Better Design by
Mark Baskinger
and William
Bardel*
[www.drawingidea
sbook.com](http://www.drawingidea
sbook.com)



Day 3

morning

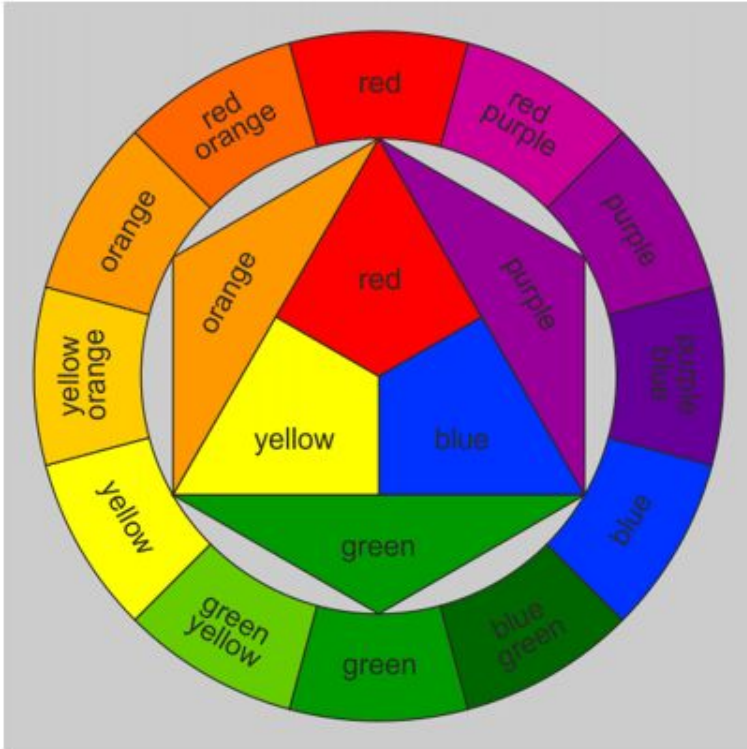
- Colour Theory
- Labelling

Colour Theory

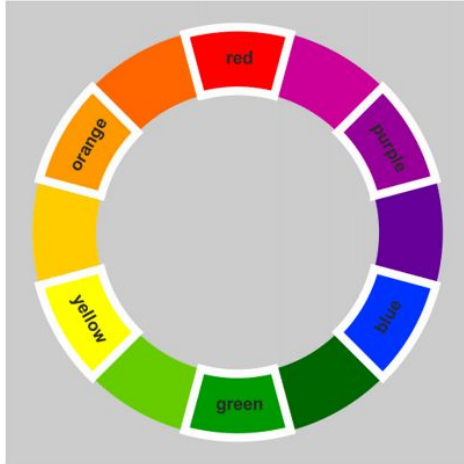
The Colour Wheel showing different hues.

A hue is one of the colours on the spectrum.

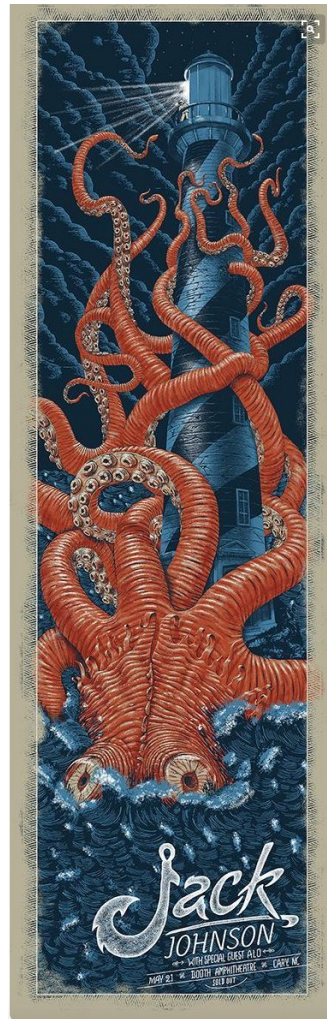
Use the colour wheel to help choose colours that work well together, like **complimentary** colours and **analogues** colours.



Complimentary colours

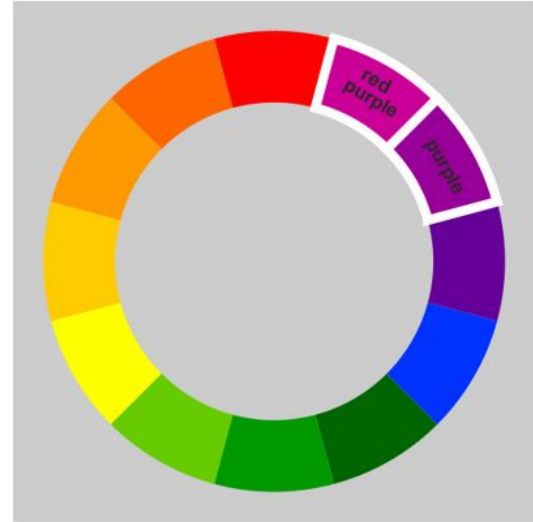


Opposite colors are diagonally opposite one another on the color wheel. Opposite colors create the maximum contrast with one another.

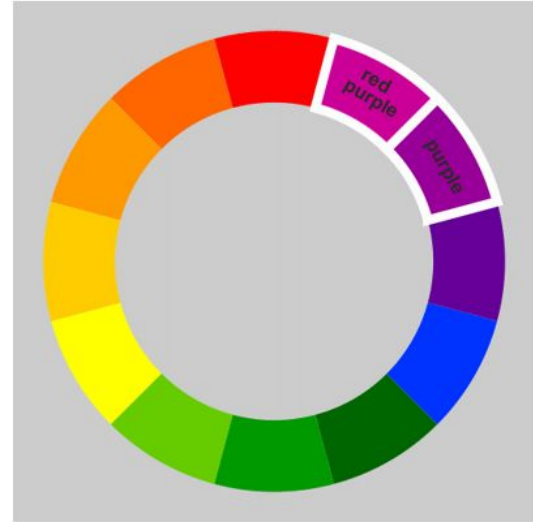


by Karl James Mountford

A circular color palette with 12 segments. The colors transition from red at the top, through orange, yellow, green, blue, and purple, back to red. Two segments are labeled: 'red purple' and 'purple'.

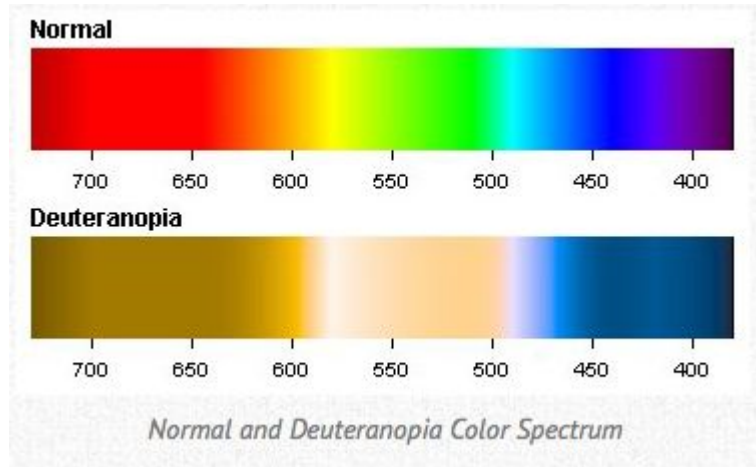


A circular color palette with 12 segments. The colors transition from red at the top, through orange, yellow, green, blue, and purple, back to red. Two segments are labeled: 'red purple' and 'purple'.



A circular color palette with 12 segments. The colors transition from red at the top, through orange, yellow, green, blue, and purple, back to red. Two segments are labeled: 'red purple' and 'purple'.

Considerations when choosing colours



<http://www.color-blindness.com/deuteranopia-red-green-color-blindness/>

- Colour blindness affects approximately 1 in 12 men (8%) and 1 in 200 women in the world. Most common in red/green colour blindness (Deuteranopia).

<http://www.colourblindawareness.org/colour-blindness/>

- Colours have different cultural meaning.
- Different industries have their own colour conventions. For example, in medical illustration, red represents pain.
- Psychology of colour in branding design....

Psychology of Colours by the Logo Factory

Blue

Psychology of Blue:

• Trusted • Conservative • Staid • Dependable • Honesty • Calm • Secure • Cool



Notable: Most popular corporate color. Evokes trust so used frequently for online businesses & financial institutions. Masculine color.

Black

Psychology of Black:

• Sophisticated • Luxurious • Formality • Style • Elegance • Expensive • Authority



Notable: Black used by 'high-end' brands either as main or paired corporate color. Black is a somber, serious. Most logos designed in B/W first.

Red

Psychology of Red:

• Bold • Passion • Strength • Attention • Love • Exciting • Action • Aggressive



Notable: Red works on white & black. Can mean stop, danger and hot. Pinks (tints of red) are generally considered feminine colors.

Psychology of Colours by the Logo Factory

Yellow

Psychology of Yellow:

• Logical • Optimistic • Progressive • Confident • Playful • Creative



Notable: Yellow is too bright to stand on its own & will require a secondary background or bordering color. Universal caution color. Represents clarity.

Orange

Psychology of Orange:

• Happy • Energetic • Sociable • Friendly • Affordable • Enthusiastic • Sunny



Notable: Orange is thought to stimulate appetite. Orange is used in some warning labels. Used frequently in retail. Often used as a "call to action."

Green

Psychology of Green:

• Nature • Wealth • Fresh • Life • Harmony • Environment • Growth • New



Notable: Means "Go." Used frequently to represent eco-friendly companies & products. Thought to be a calming color.

Psychology of Colours by the Logo Factory

Purple

Psychology of Purple:

• Royalty • Mystery • Pomp • Ceremony • Creative • Unique • Majesty



Notable: Once the most expensive color to reproduce, thus often viewed as "elitist." Appeals to children & often used in toys and candy packaging.

Multi-Colored

Psychology of Multi-Color (Rainbow):

• Fun • Easy-going • Child-like • Internet • Multi-disciplinary • Authority

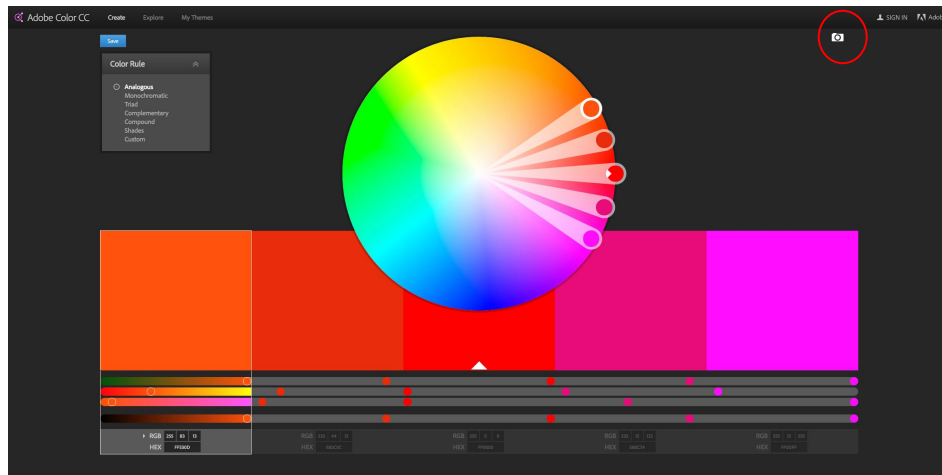


Notable: Relatively new phenomenon due to internet usage and economical 4 color printing. Represents color-branding challenge.

How to choose colours for your illustrations

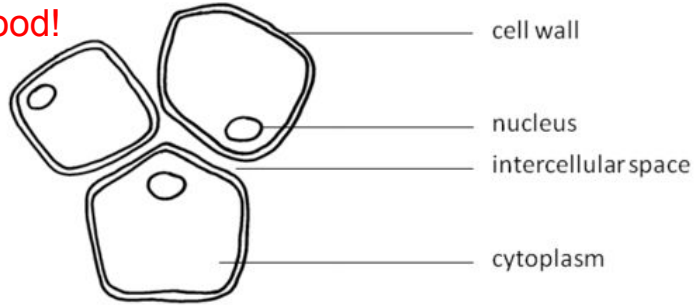
- Find Inspiration from a photograph or a famous painting or from an illustration on Pinterest. Use Adobe Color &...
- Import the image into Adobe Colour CC
- Use Adobe Colour CC, explore or create your own colour palette

<https://color.adobe.com/create/color-wheel/>

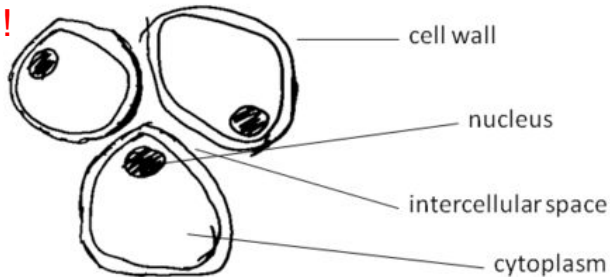


Labelling

good!



bad!



Labels

- You do not need to label everything, only label the elements that part of your story.
- Align the labels in columns
- Align left

Lines to the labels

- Straight lines
- Lines are parallel to each other
- Angelling the lines are okay as long as the lines are parallel
- Lines do not intersect
- Lines should touch the element that it is labelling

Starting in Illustrator

Create a new folder where you place your scanned sketch and where you save your illustrator document

Open Illustrator

File > New

Choose document specifications



Recent

Saved

Mobile

Web

Print

Film & Video

Art & Illustration

BLANK DOCUMENT PRESETS (15)



Postcard
288 x 560 pt



Poster
1296 x 1728 pt



1280 x 1024
1280 x 1024 pt



1920 x 1080
1920 x 1080 pt

View All Presets +

TEMPLATES (13)



Geometric Patterns

FREE



Office Illustrations

FREE



Abstract Illustrations

FREE



Find more templates on Adobe Stock

Go

PRESET DETAILS

Untitled-2

Width

1920

Points



Height

1080

Orientation



Artboards



1



Bleed

Top



0



Bottom



0



Left



0



Right



0



Color Mode

RGB Color



More Settings

Close

Create



Recent

Saved

Mobile

Web

Print

Film & Video

Art & Illustration

BLANK DOCUMENT PRESETS (7)



Letter
612 x 792 pt



A4
595.28 x 841.89 pt



Legal
612 x 1008 pt



Tabloid
792 x 1224 pt

View All Presets +

TEMPLATES (23)



Brochure with Instructions

FREE



Invitation with Instructions

FREE



Flyer with Instructions

FREE



Find more templates on Adobe Stock

Go

PRESET DETAILS

Untitled-4

Width

210

Millimeters



Height

297

Orientation



Artboards



1



Bleed

Top



2



Bottom



2



Left



2



Right



2



Color Mode

CMYK Color



More Settings

Close

Create

Starting in Illustrator

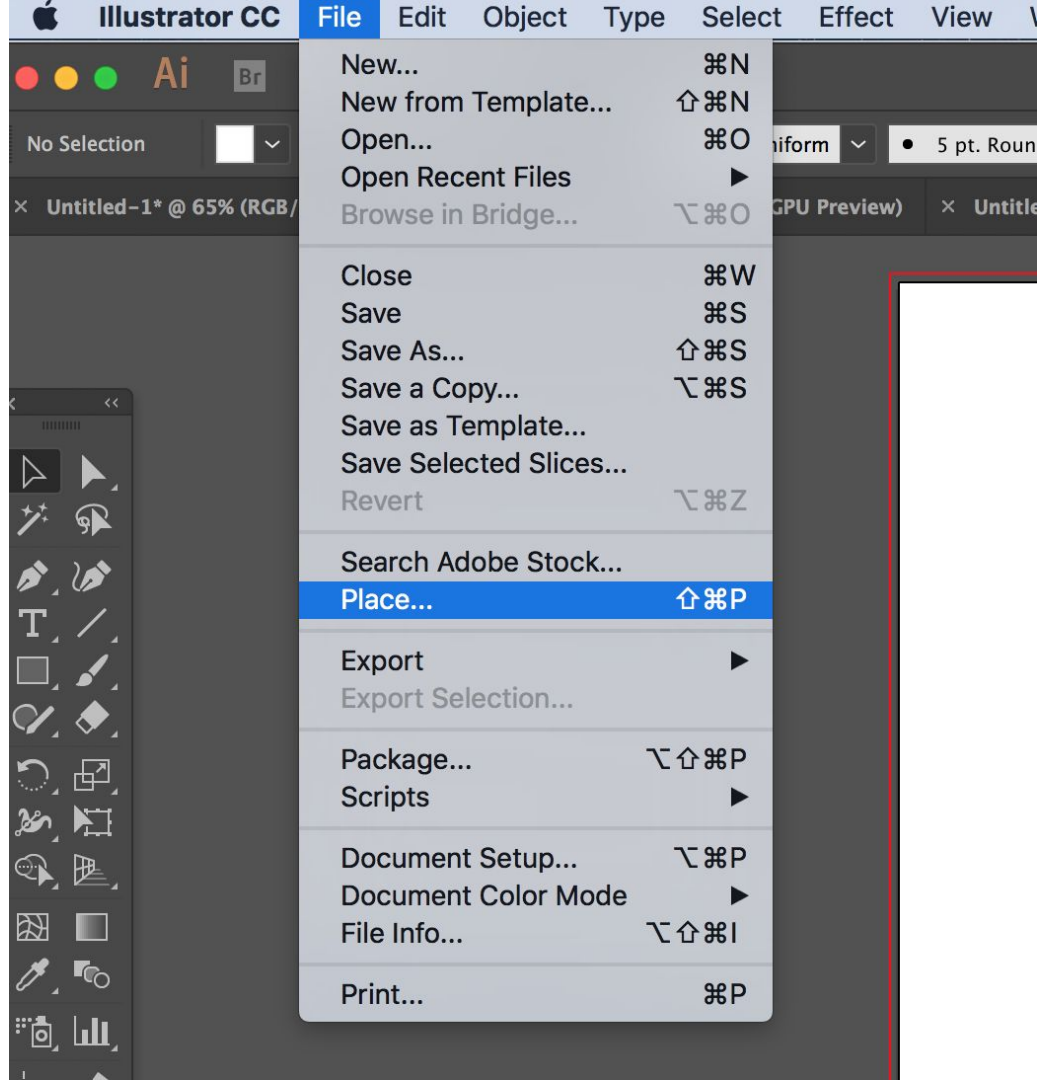
Create a new folder where you place your scanned sketch and where you save your illustrator document

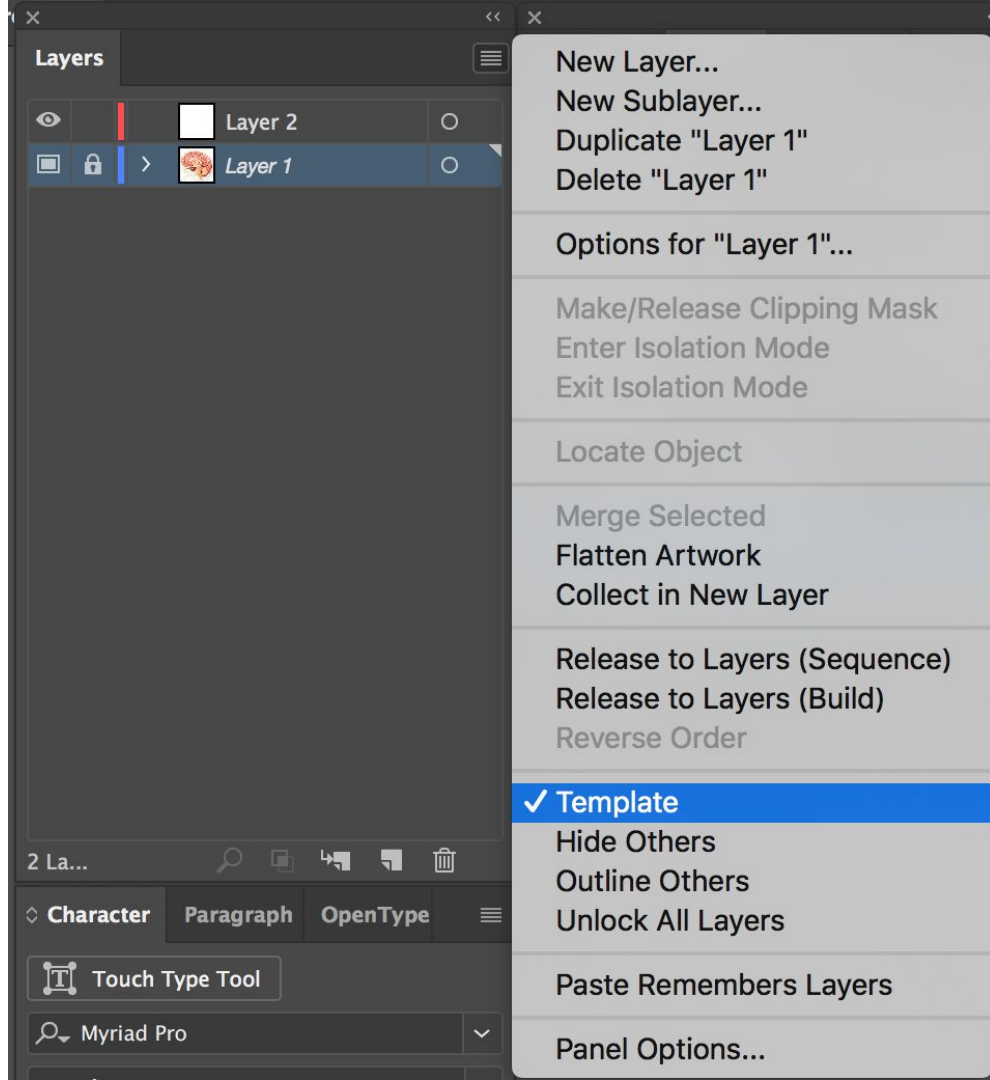
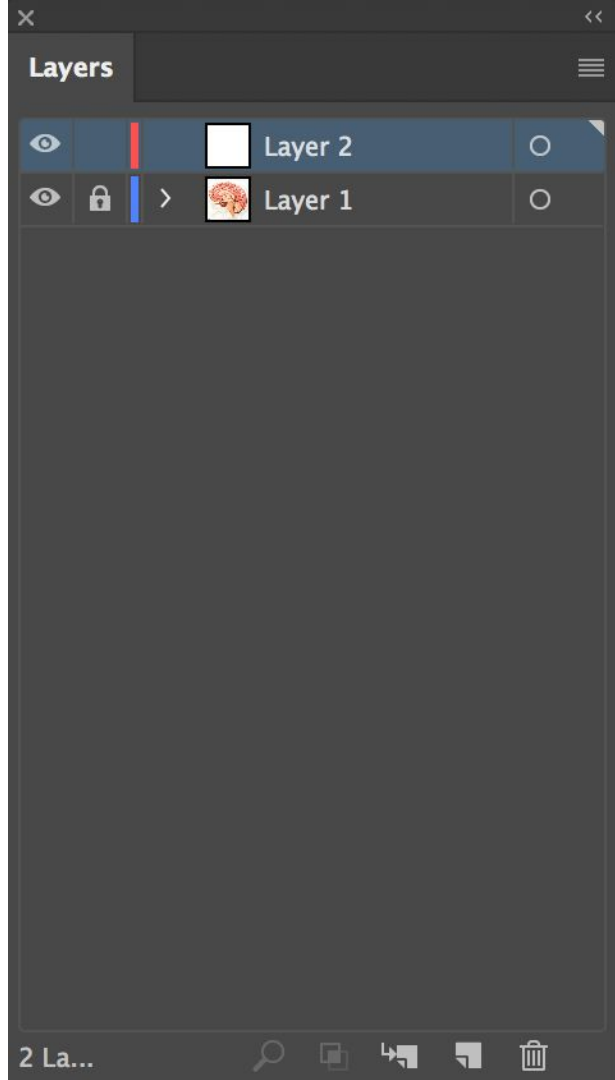
Open Illustrator

File > New

Choose document specifications

File > Place (Linked document)



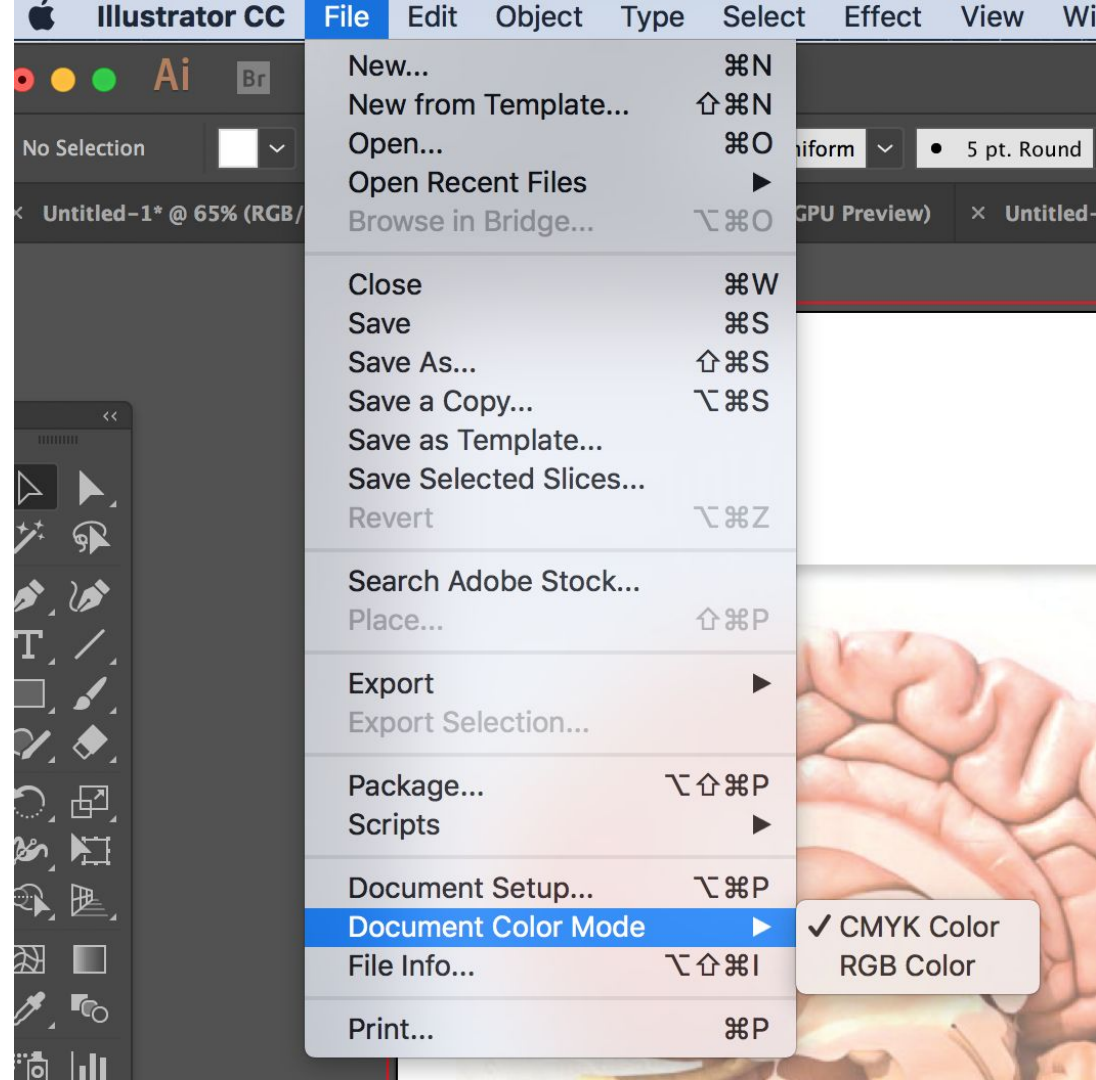


**Work in RGB
Color.**

**Before printing,
change to CMYK
color mode**

Or

**For web or video,
export with RGB
Color**



Starting in Illustrator

Create a new folder where you place your scanned sketch and where you save your illustrator document

Open Illustrator

File > New

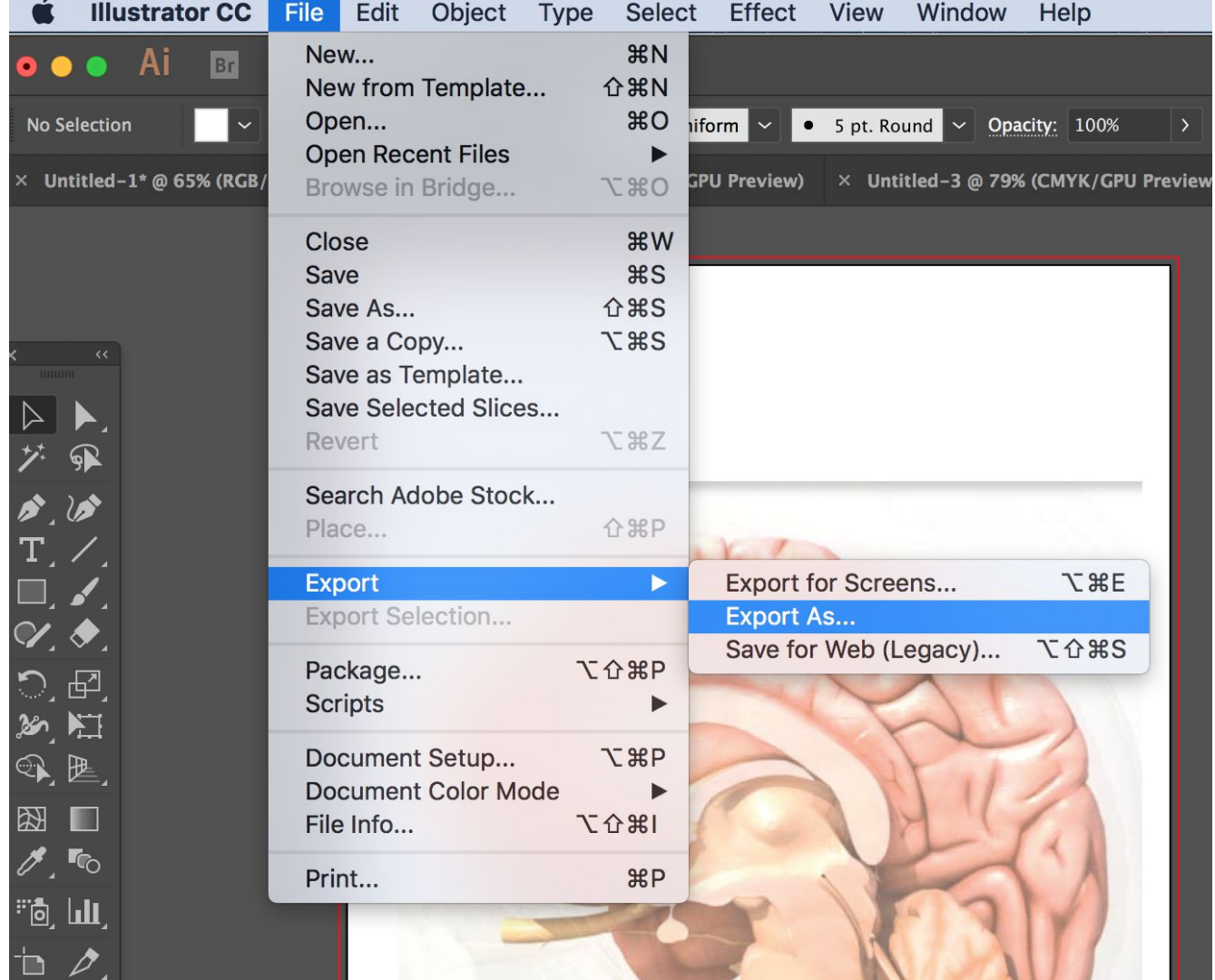
Choose document specifications

File > Place (Linked document)

Trace your sketch with the pen tool



Exporting from Illustrator



Export

Save As: Tags: 

Desktop



Search

Favorites

iCloud Drive

Applications

Desktop

Documents

Downloads

Devices

Remote Disc

Tags

barn.jpg
FromLightComesColour.jpg
IlluminatingSci.jpg
LightFromDistantStars.jpg
LightOntheRetina.jpg
livingwithNature copy.jpg
livingwithnature.jpg
old stuff
Screen Shot...7 at 18.16.14
Screen Shot...4 at 20.05.27
Screen Shot...4 at 20.05.37
Screen Shot...4 at 20.05.41
Screen Shot...4 at 20.05.51
Screen Shot...4 at 21.25.38
Screen Shot...1 at 18.26.28
Screen Shot...7 at 16.31.35
Screen Shot...7 at 22.17.38
Screen Shot...4 at 23.51.14
Screen Shot...4 at 23.51.41
Screen Shot...5 at 00.17.16
Screen Shot...2 at 00.03.11
Screen Shot...2 at 00.03.18
Screen Shot...4 at 15.11.09

Format: JPEG (jpg)

☒ Use Artboards☒ All☐ Range: 1

New Folder

Cancel

Export

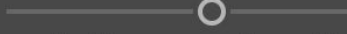
JPEG Options

Export in multiple scale factors in one click.

Try Export for Screens

Image

Color Model: **RGB** ▾

Quality:  **6** **High** ▾
smaller file larger file

Options

Compression Method: **Baseline (Standard)** ▾

Resolution: **Medium (150 ppi)** ▾

Anti-aliasing: **Art Optimized (Supersampling)** ▾ ⓘ

☐ Imagemap

☐ Embed ICC Profile: sRGB IEC61966-2.1

Cancel

OK

Due for Friday's presentation

Trace your sketch using Illustrator.

First draw everything with a uniform line, 1 or 2 pt.

Then, when you are done, consider playing with stroke width and opacity. To create line variation.

By **end of day you will have a black and white line drawing**. This is what you will add to your presentation on Friday.

Final Assignment: Due September 17th 2017

Email to:
ap.kingman@gmail.com

Illustration:

Create one vector based illustration depicting your research.

Colour or Black & White

Export:

RGB Colour

JPEG, High Quality

150 dpi

Written assignment:

One written paragraph describing what design principles you used and why. Max 1 page.

Sketches:

Email me photos or scans of all the sketches that lead to your final illustration.