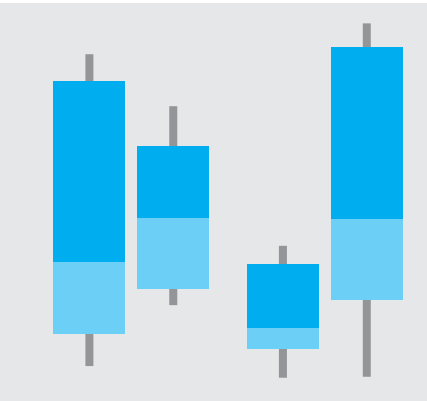
Visual communication of science
Creating effective figures

Kelly Krause, Creative Director

May 2021

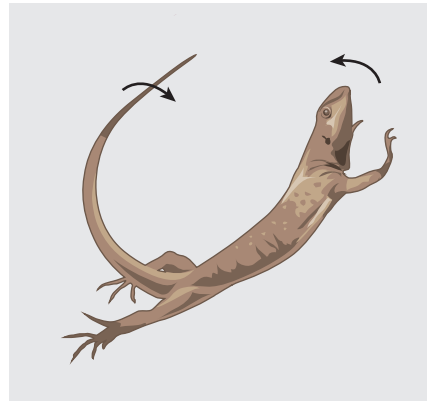
nature

We'll discuss these types of visual representations



Data figures

Numerical data translated into abstractions (shapes, symbols) in primary research. Can include charts, graphs, imaging, and computer-generated scientific models.



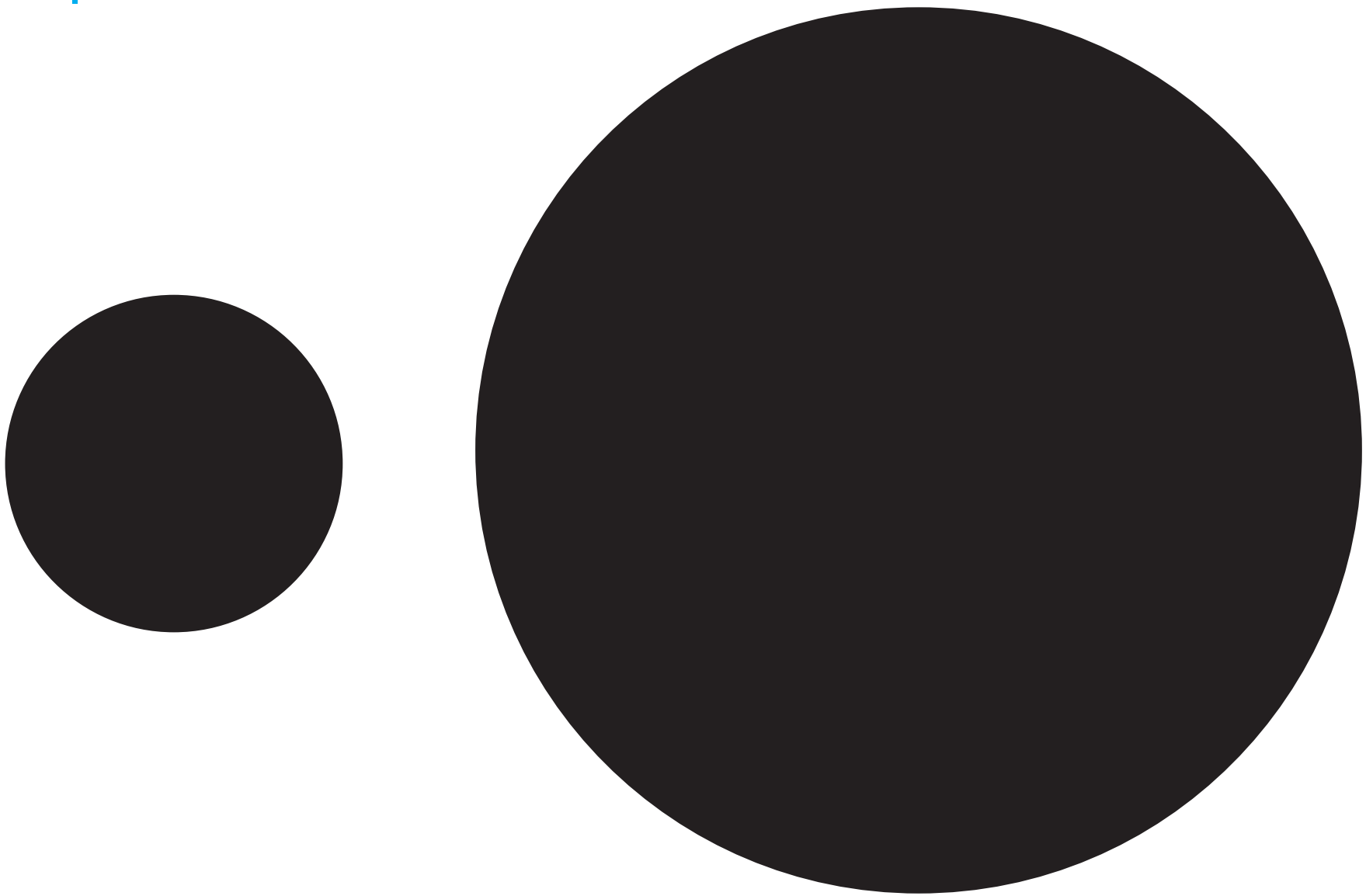
Figurative illustrations

Illustrated process or phenomenon. Can appear as summary figures in news and analysis pieces, press releases, grant applications, websites and posters.

Part 1
Best practice for data figures

Group exercise

Compare area of circles



Group exercise

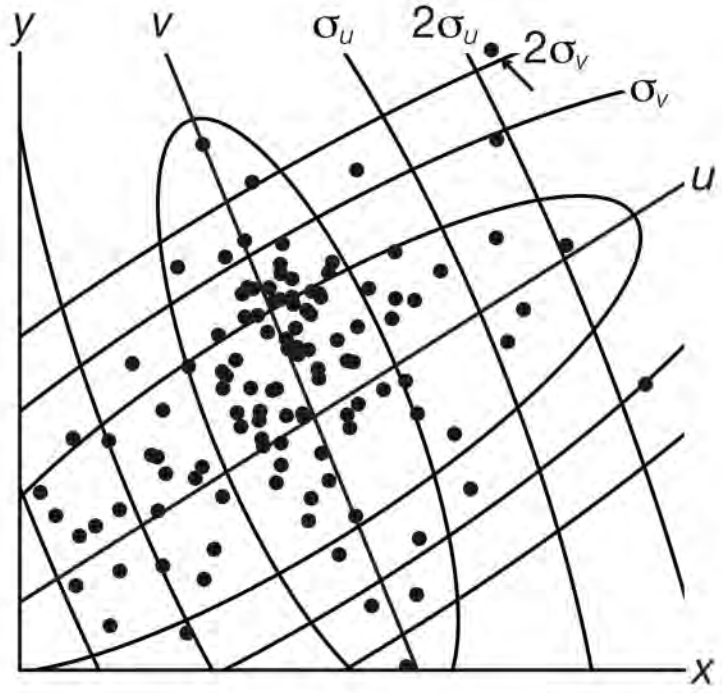
Compare length of bars

Relative magnitude estimation [Mackinlay 86]

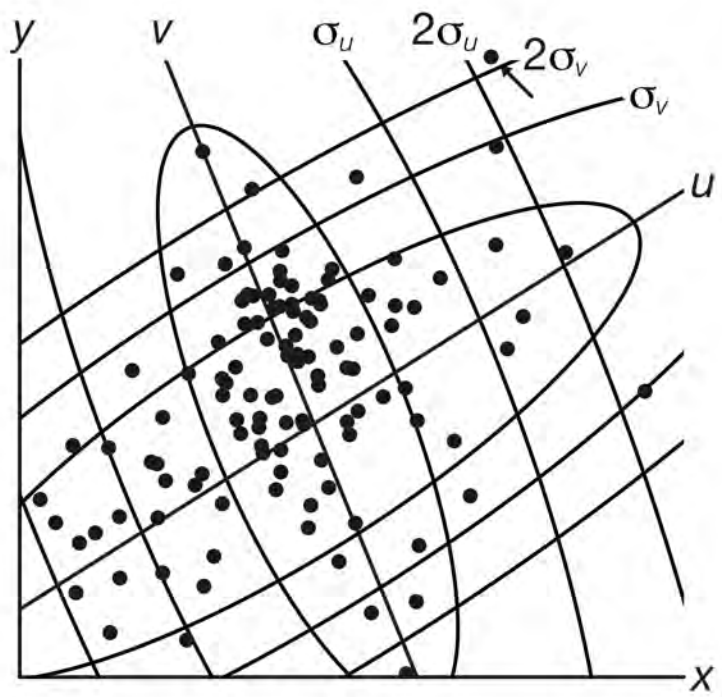
Remember:

What is encoded by you must be decoded by your audience

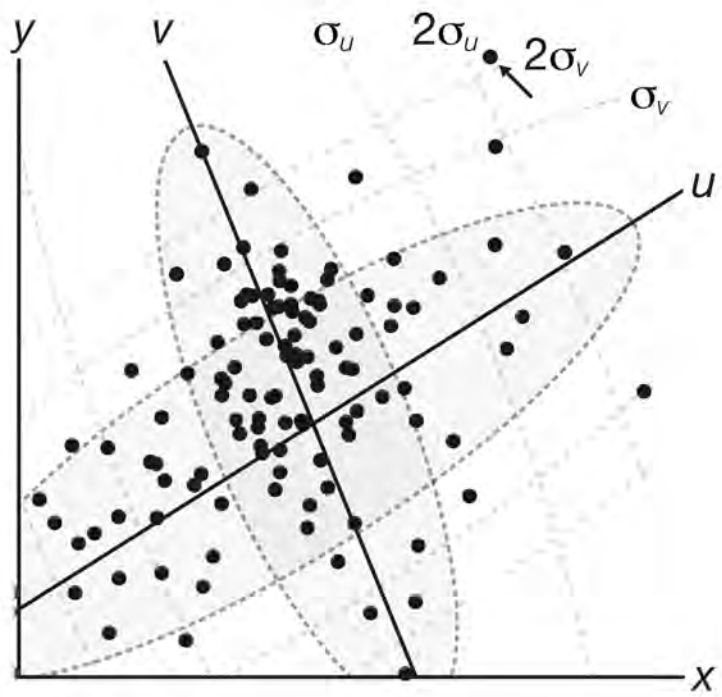
Considered design changes can improve comprehension



Considered design changes can improve comprehension



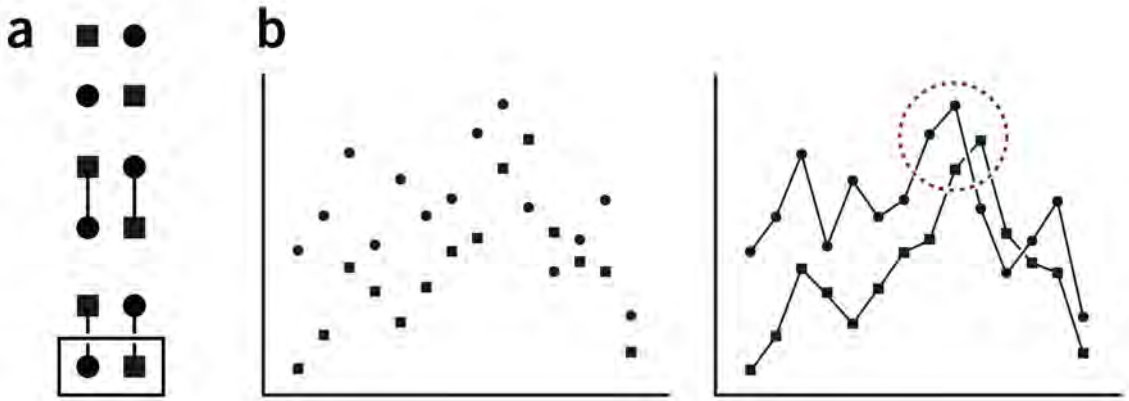
Same line style is used for different purposes.



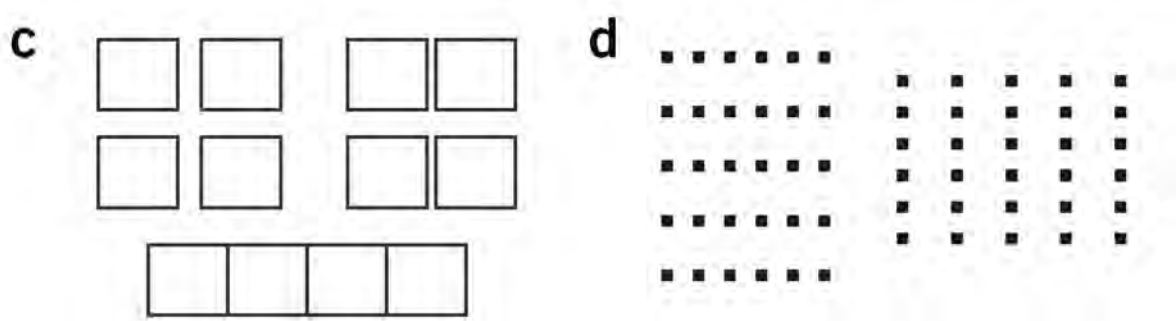
Visual distinctions are made by assigning different styles to axes, contours and cluster boundaries.

Gestalt principles

Relationship of elements



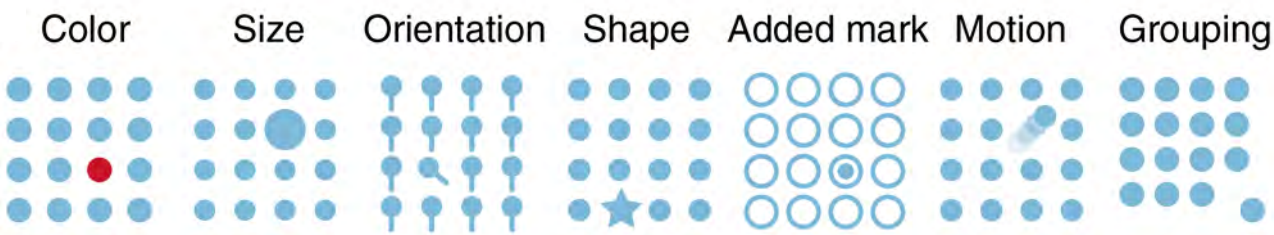
Create clear connections using proximity and enclosure.



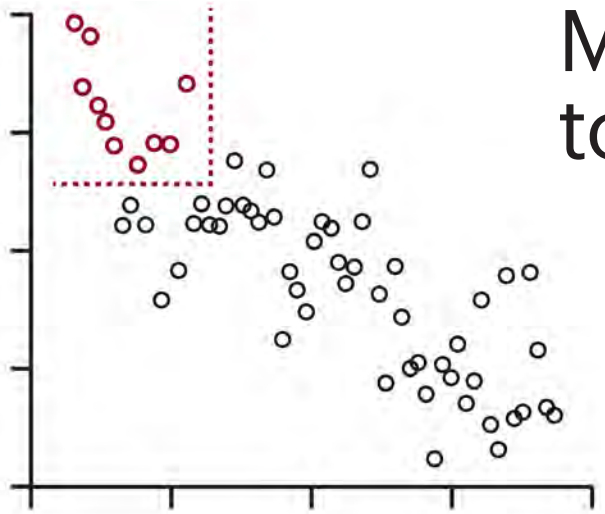
Objects placed closed to one another are seen as going together.

Salience

Setting an object apart from its surroundings to create contrast



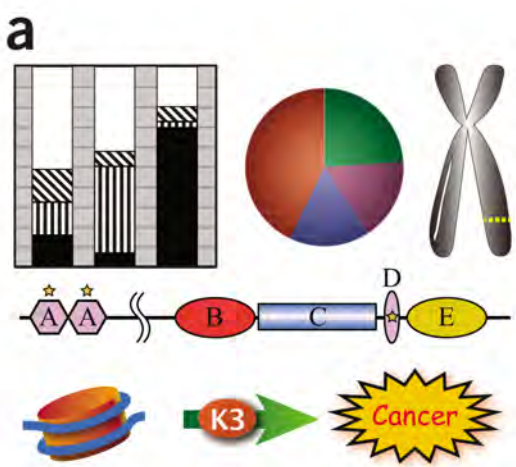
Color name	RGB (1–255)
Black	0, 0, 0
Orange	230, 159, 0
Sky blue	86, 180, 233
Bluish green	0, 158, 115
Blue	0, 114, 178
Vermillion	213, 94, 0

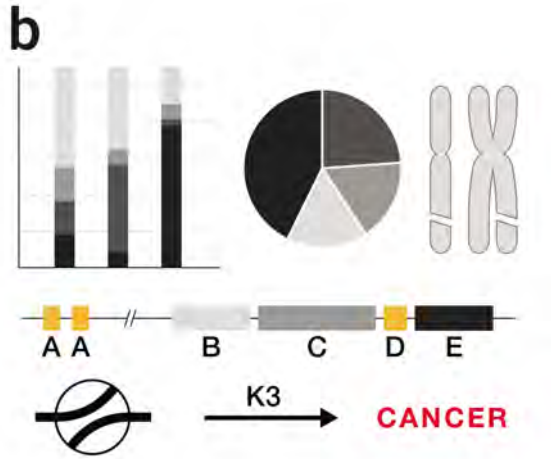


Map salience to relevance

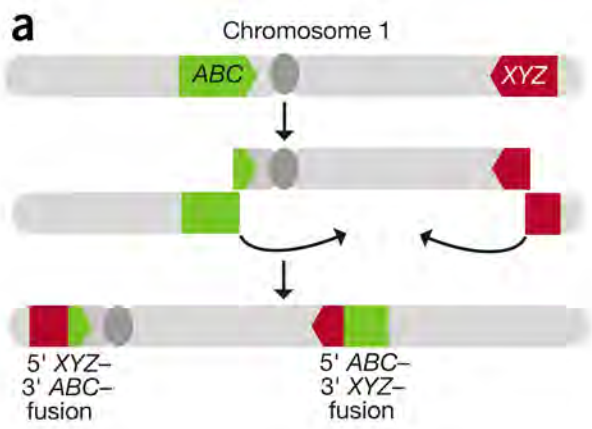
Simplify and edit

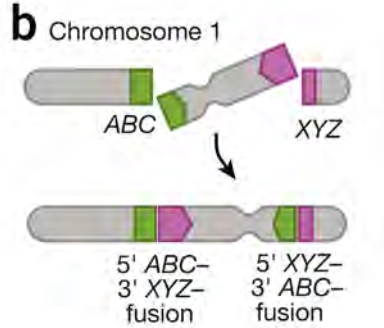
Like good writing, figures are better when clear and concise





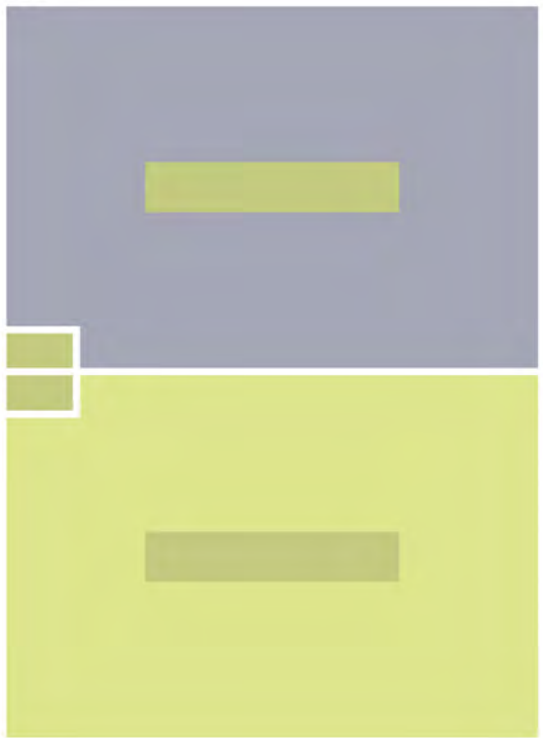
resist decoration



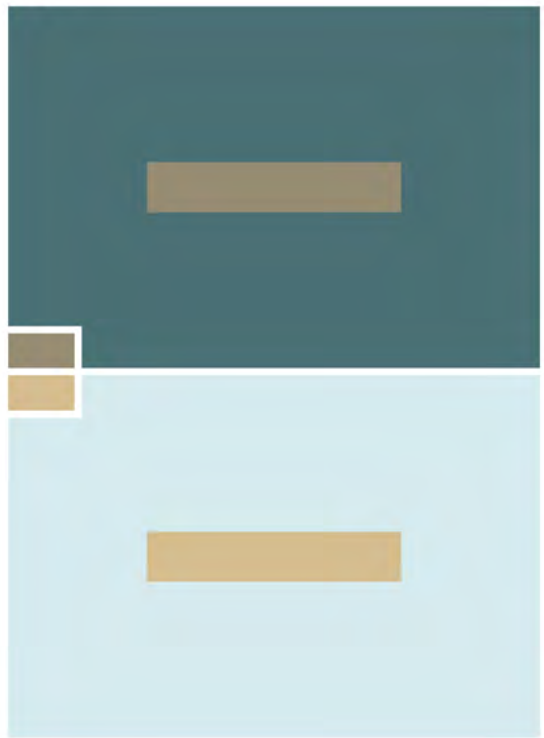


remove redundant elements

Color
is subjective



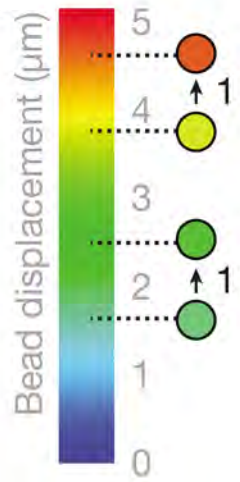
same color looks different

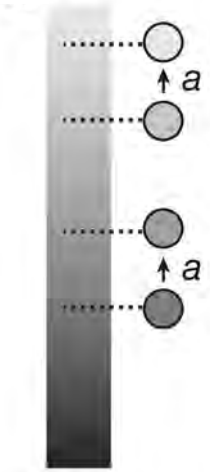


different color looks the same

same color looks different

Color
can misrepresent data

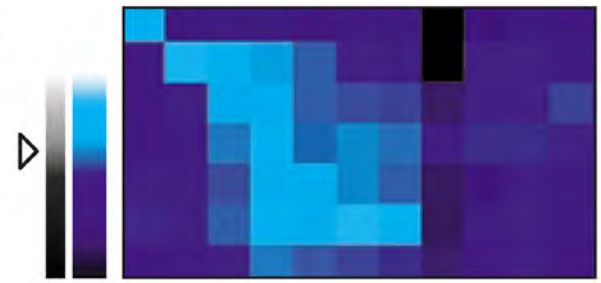




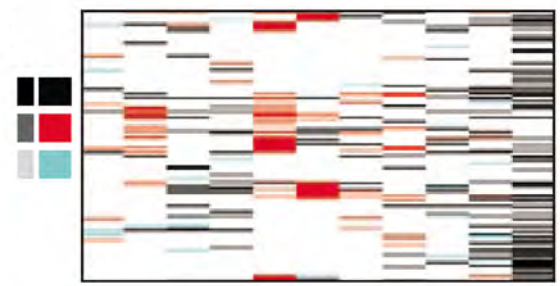
Avoid the rainbow

Shifts shown in circles do not match change in value

Gradation from 10-90% black produces even transitions



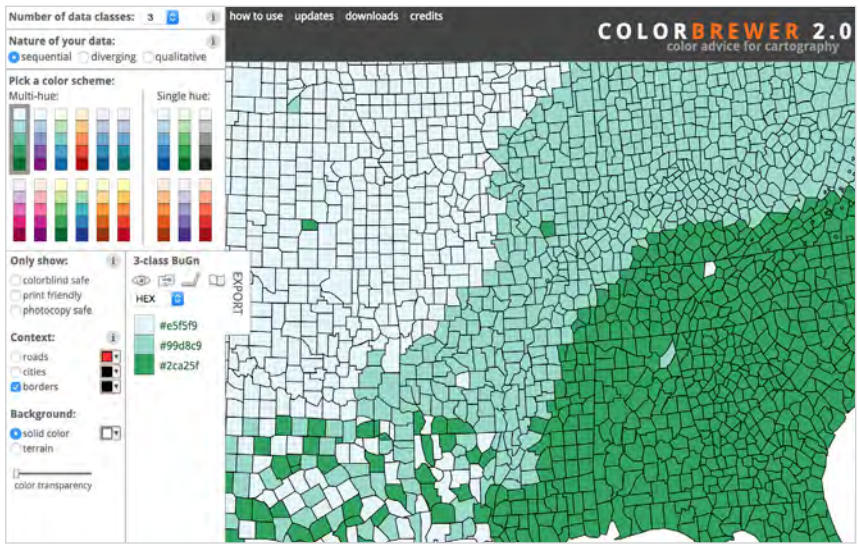
Color scales with sharp transitions can exaggerate data ranges.

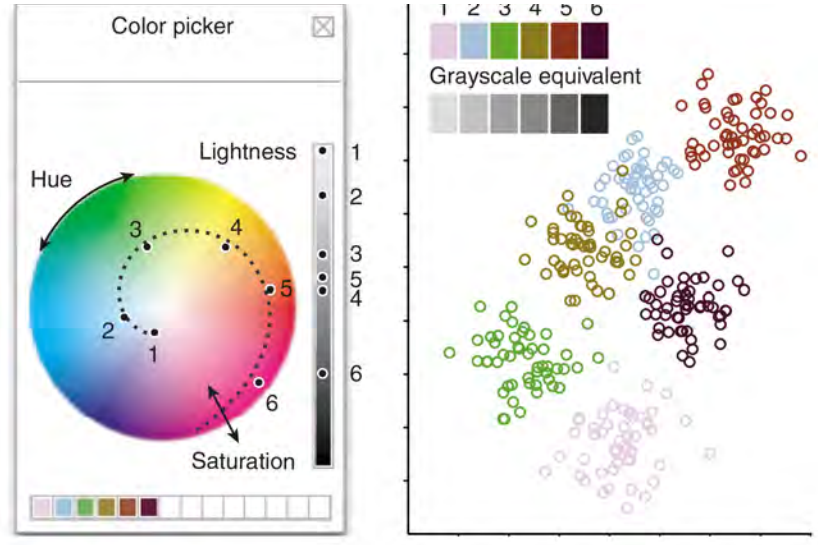


When colors have uneven saturation, data can be underrepresented

Color

Choosing a color palette





When mapping color to quantitative data: seek help

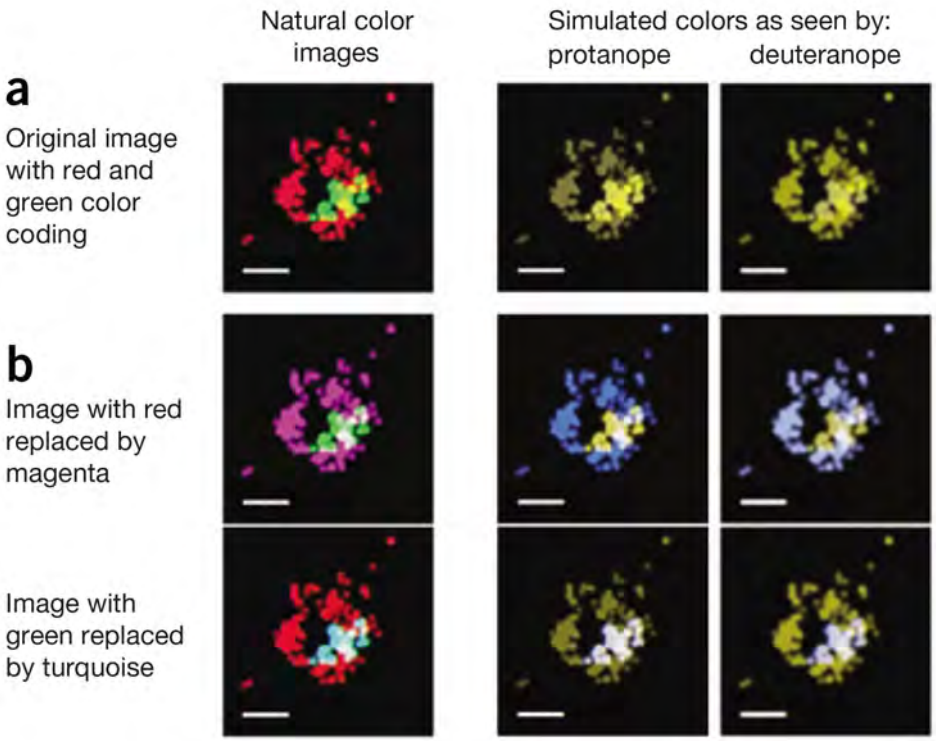
Experts have done the work for you:

Color Brewer: http://colorbrewer2.org
NASA: http:/colorusage.arc.nasa.gov/ColorTool.php
Viridis (R package for Python matplotlib library)

For categorical data: do it yourself

Spiral technique: use a color picker to select a palette that varies in hue, saturation and brightness.

Color
blindness



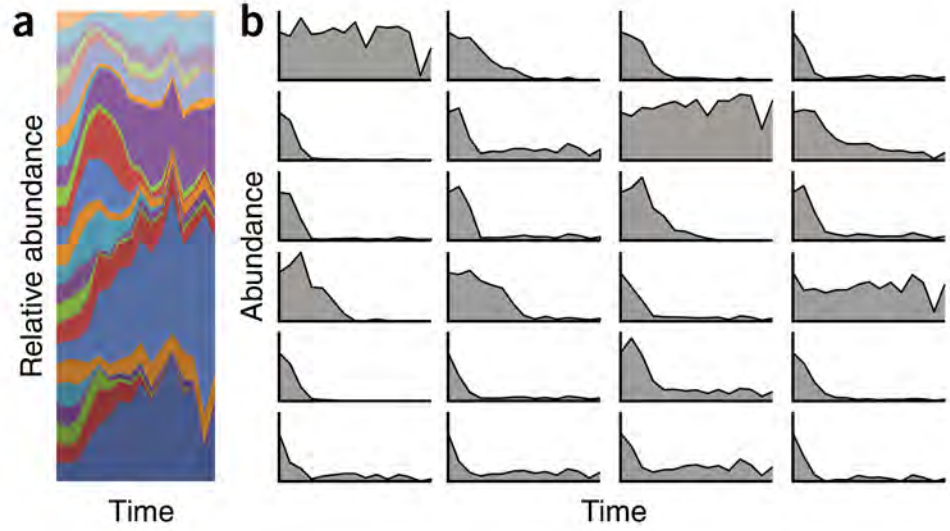
Avoid red and green combinations

Color	Color name	RGB (1–255)	CMYK (%)	P	D
	Black	0, 0, 0	0, 0, 0, 100		
	Orange	230, 159, 0	0, 50, 100, 0		
	Sky blue	86, 180, 233	80, 0, 0, 0		
	Bluish green	0, 158, 115	97, 0, 75, 0		
	Yellow	240, 228, 66	10, 5, 90, 0		
	Blue	0, 114, 178	100, 50, 0, 0		
	Vermillion	213, 94, 0	0, 80, 100, 0		
	Reddish purple	204, 121, 167	10, 70, 0, 0		

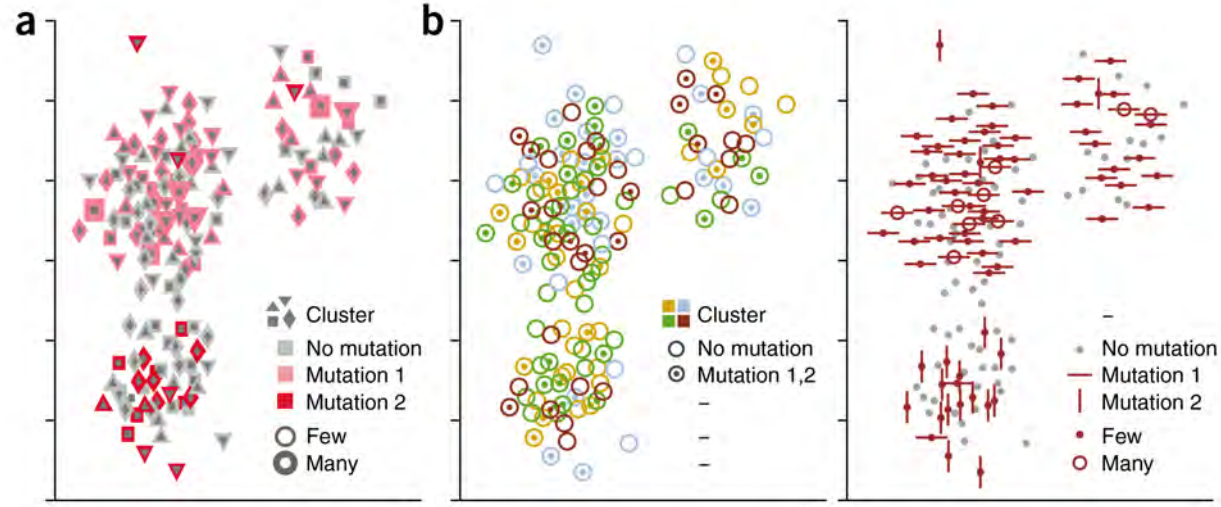
Colorblind friendly color palette

Data density

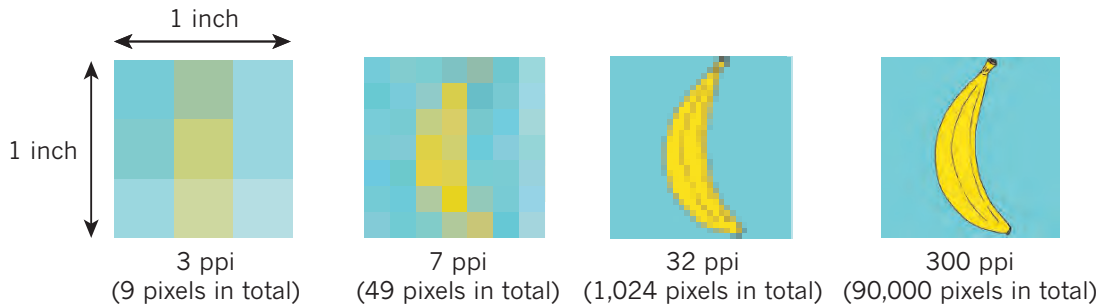
Avoid overlapping data. Use small multiples.



Avoid symbol overload. Use multiple views of the same data for clarity.



Resolution



Resolution is measured by calculating the number of pixels **within a linear unit** rather than area.

Adding pixels after an image is created is called **artificial enlargement**. Software will insert pixels with estimated data, not real data.

Capture images in the highest resolution possible from the beginning.

Plan for it in your experimental set-up.

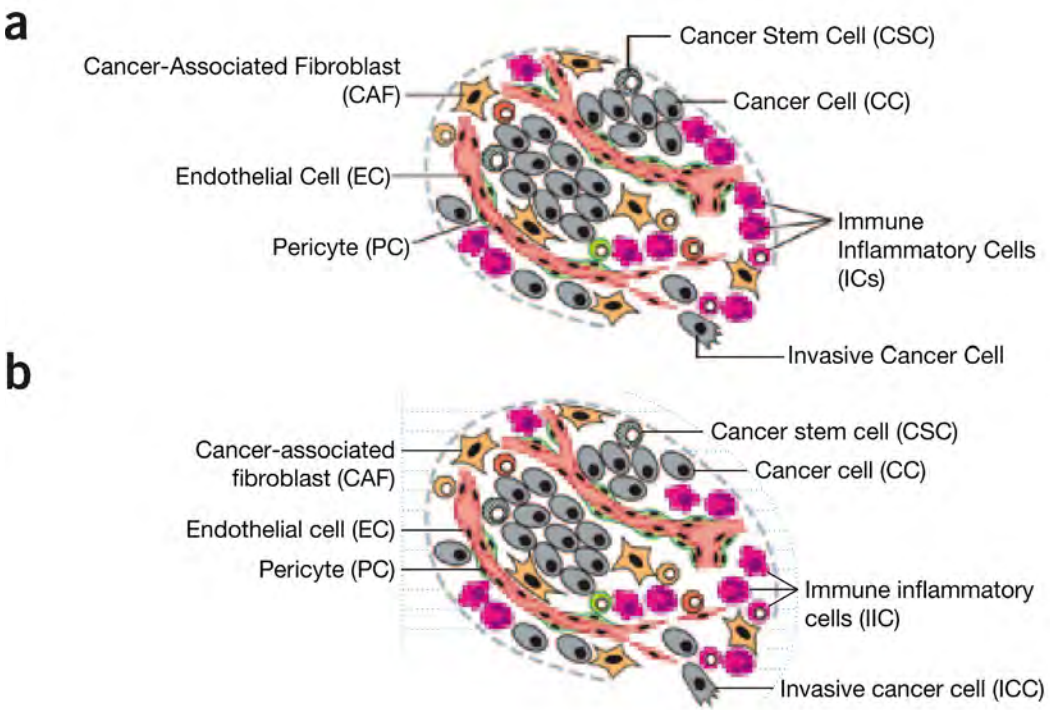
Resolution

Nature's print cover is 2516 x 3331 pixels.

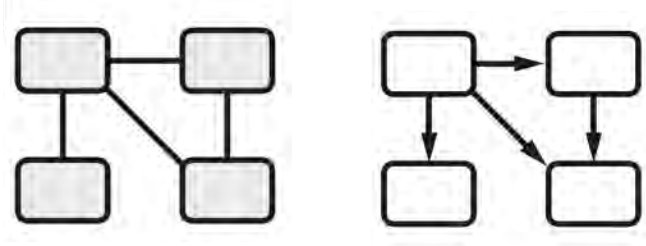
High resolution images are needed to properly communicate your research.

- journal covers
- press releases
- journalistic outputs
- websites

Labels, arrows and grids



Use consistent line lengths and angles with uniform spacing. A grid is helpful.



Use arrows when the relationship is directional, not simply as a pointer.

Part 2
Figurative illustrations

Figurative illustration: a case study

Nature expert analysis piece (News & Views)

IMMUNOLOGY

Chronic effects of acute infections

Acute infection of mice with an intestinal pathogen leads to long-lasting inflammation that is maintained by intestinal microorganisms. This observation reveals a path by which infection history can affect long-term immune function.

NICOLA HARRIS

Our bodies' history of infections shapes our immune system and can influence the development of subsequent diseases, including inflammatory bowel disease and autoimmune disorders[1]. It has also been postulated[2] that individuals' past infections can undermine vaccine programmes, particularly in developing nations. For certain cases, such as infection with *Streptococcus pyogenes* bacteria and rheumatic heart disease, this link can be explained by the presence of similar antigens (proteins against which the immune system reacts) in both the pathogen and the host[3]. Writing in *Cell*, Morais da Fonseca *et al.*[4] map a different pathway by which infections alter immune status. The authors observe that mice infected with the common intestinal bacterial pathogen *Yersinia pseudotuberculosis* have an altered long-term ability to react to experimental antigens that mimic human exposure to food or oral vaccines.

Morais da Fonseca and colleagues show

Step 1
Establish information hierarchy

1. Purpose
What is the purpose of the figure?

2. Key elements
What are the 3 or 4 most
essential things to show?

3. Useful context
Other information that is
essential for understanding?

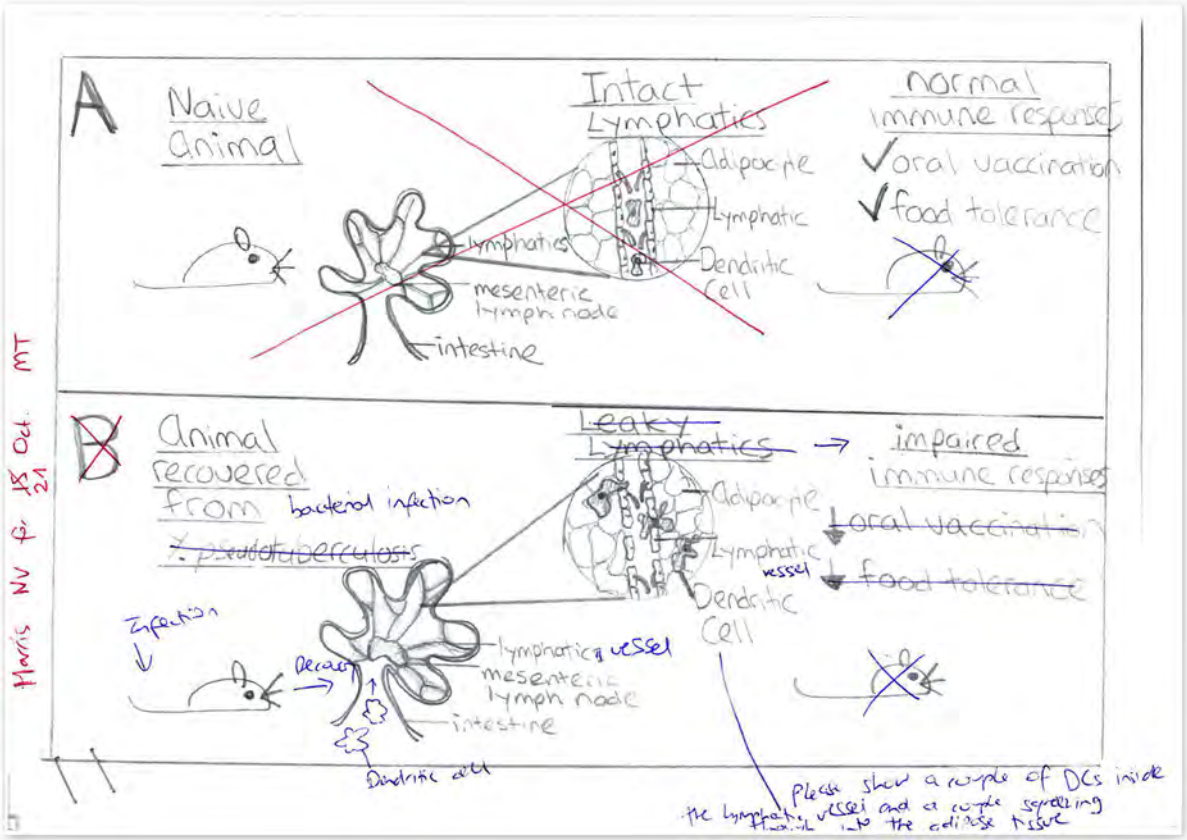
4. Details
Can be added then pared back

Step 1
Establish information hierarchy

1. Purpose What is the purpose of the figure?	*to show immune response to intestinal antigens*
2. Key elements What are the 3 or 4 most essential things to show?	*animal, intestines, lymphatics*
3. Useful context Other information that is essential for understanding?	*intact versus leaky lymphatics*
4. Details Can be added then pared back	*dendritic cell, inflamed node, leaky vessel*

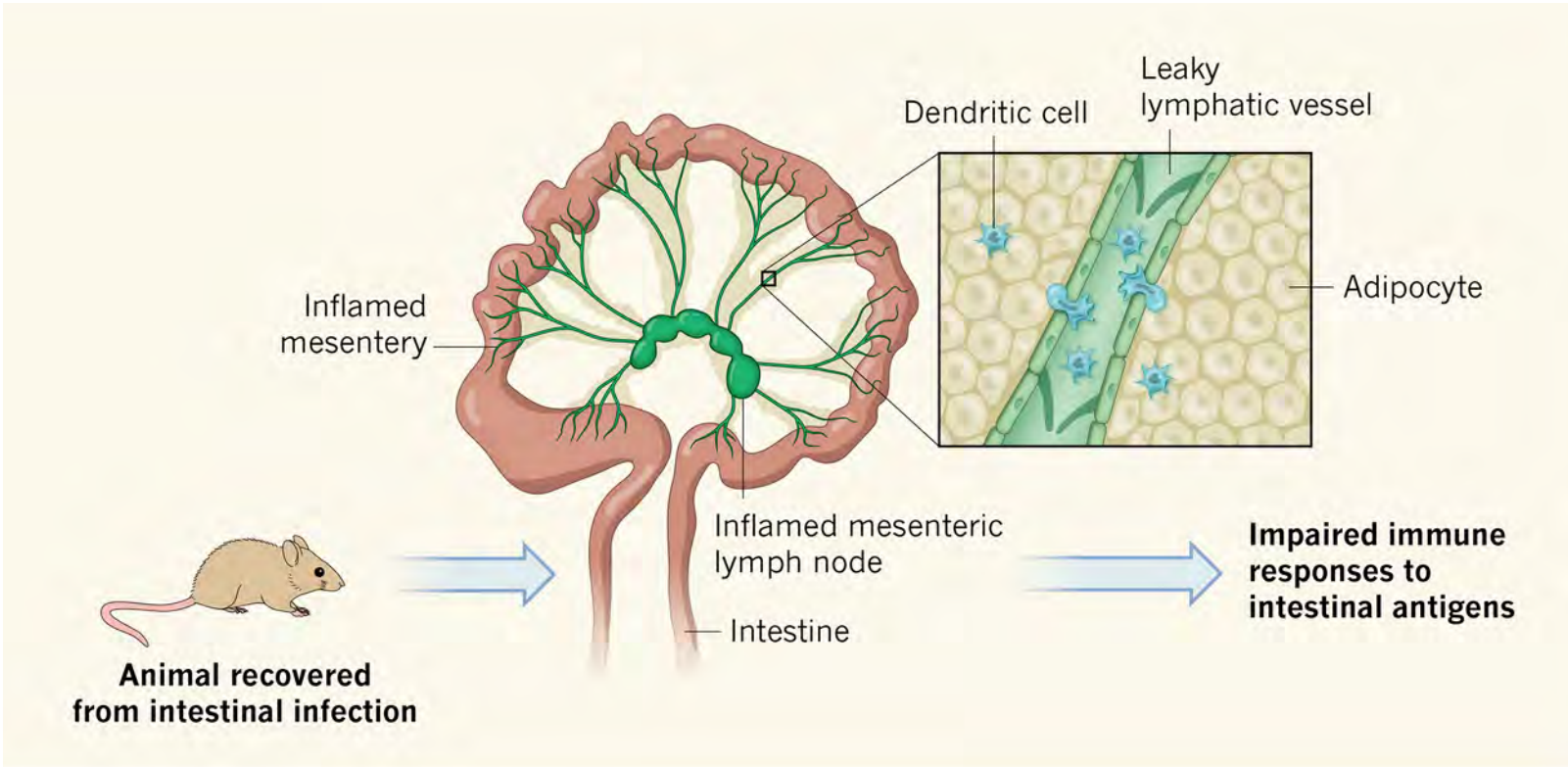
Step 2

Initial sketch (pencil strongly encouraged!)



Pencil sketch from expert author
(editor notes in blue and red pen)

Step 3
Create and refine in illustration software



Final published piece after editing and refining

Further reading

The collected Points of View

available here:

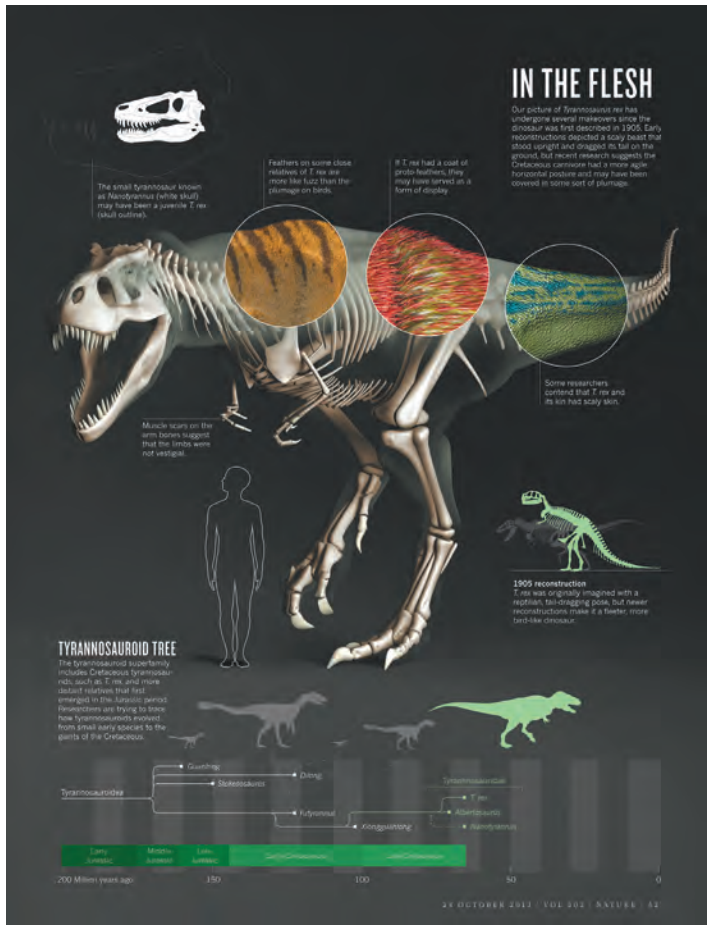
bit.ly/21kH6pO

$7.99

Many figures in this presentation are from the Points of View column in *Nature Methods*. Special thanks to Bang Wong and Martin Krzywinski.

Further reading

Public Understanding of Science (journal essay)



A framework for visual communication at *Nature*

doi: 10.1177/0963662516640966

Describes the kinds of visuals that appear in Nature - such primary research, expert analysis, and journalism - how they differ and how we create and publish them.

Thank you :)

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