ON COMBINING VISUAL AND WRITTEN ELEMENTS IN SCIENCE COMMUNICATION

Gil Costa | Filipa Vala

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

EuroSCitizen
Building on scientific literacy in Evolution

EvOKE

Basic principles of design and illustration

Gil Costa
@GilCostaDesign

Covers

Scientific stories with visual Impact

Outreach and media

Engaging with the public

Comics

Fun digestions of science

Identity

Supporting institutions and consortia

Diagrams

When realism is necessary

Articles

Clarity and Salience for scientists

Data visualization

In the realms of data

Brain - wider than the sky

Science illustration in a museum

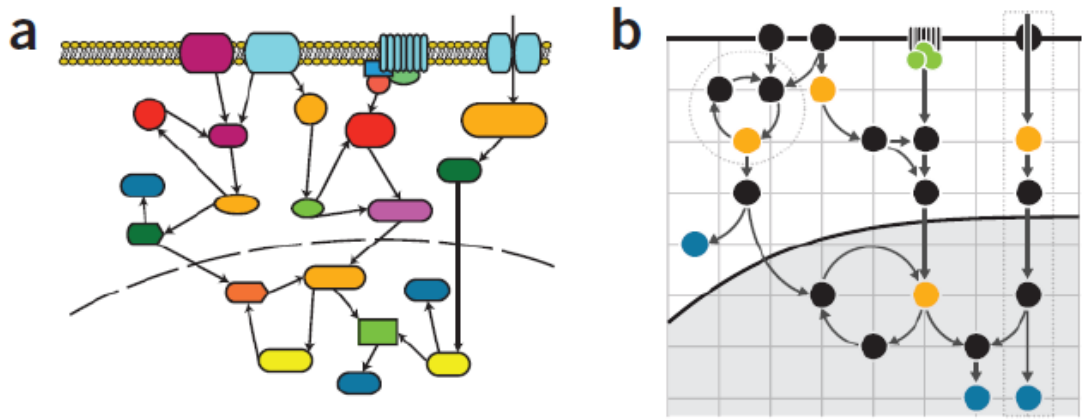
A chance to witness how people relate with scientific illustration

Story & Flow

Elements
Of Style

Salience

flow

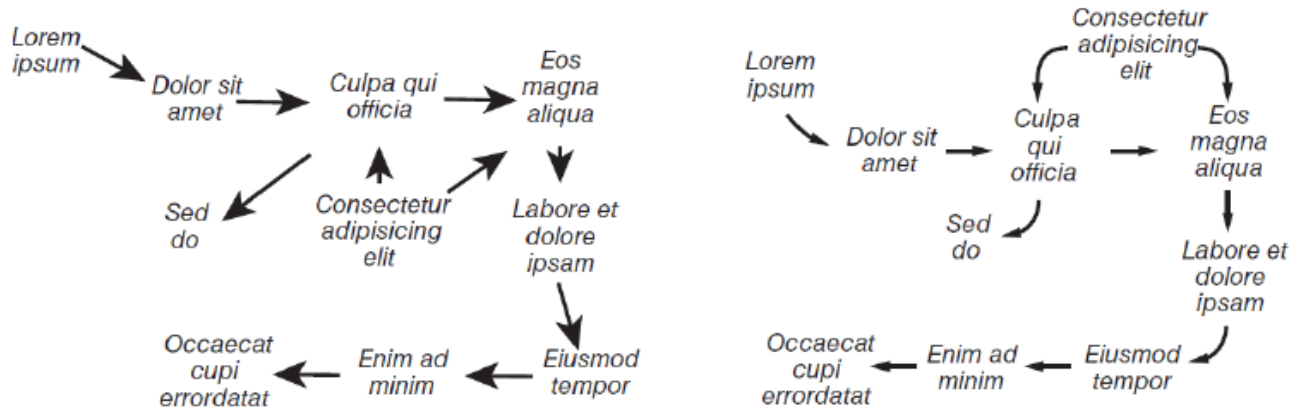


Think of aligning on top of an imaginary grid. Use this grid to direct the information flow

---

Adapted from martin krzywinski, NMethods

flow

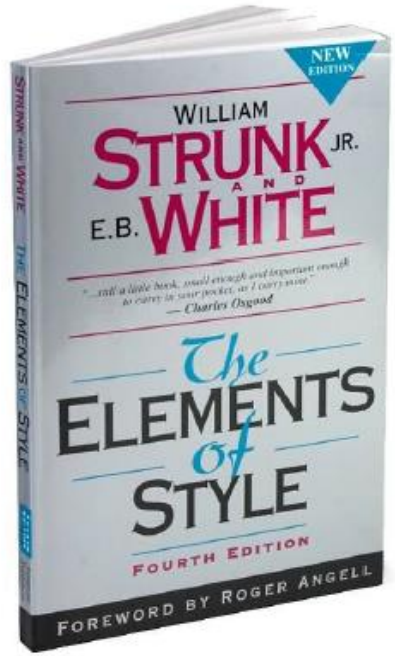


Orienting arrows in similar directions creates natural visual flow.

Adapted from Bang Wong, NMethods, 2010

”Je n’ai fait celle-ci plus longue que parce que je n’ai pas eu le loisir de la faire plus courte” wrote the french mathematician and philosopher Blaise Pascal in 1657[6].

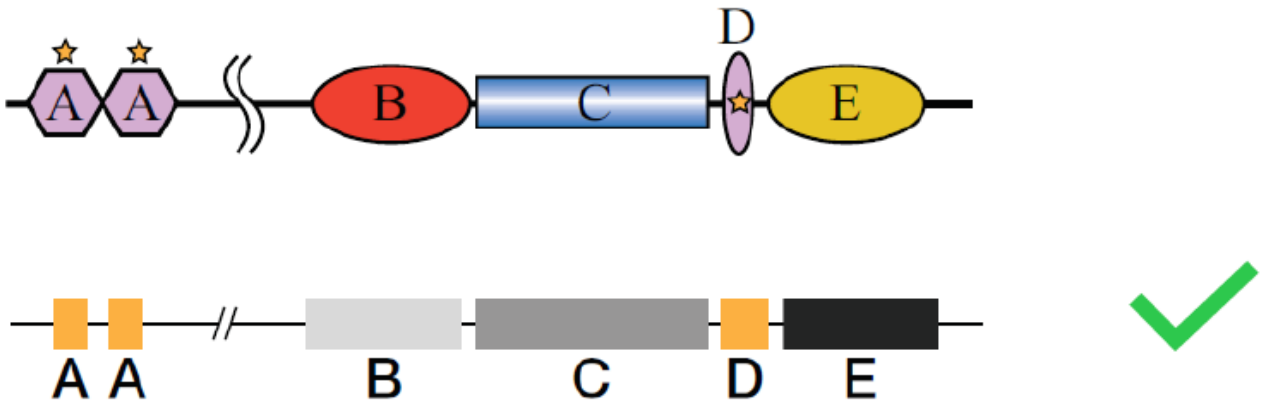
Elements of Style



Translate the principles of effective writing to the process of figure design

Martin Krzywinski, NMethods, 2013

- "Omit needless words"
- "Express coordinate ideas in similar form"
- "Use definite, specific, concrete language"
- "Rich, ornate prose is hard to digest, generally unwholesome, and sometimes nauseating"
- "place yourself in the background"



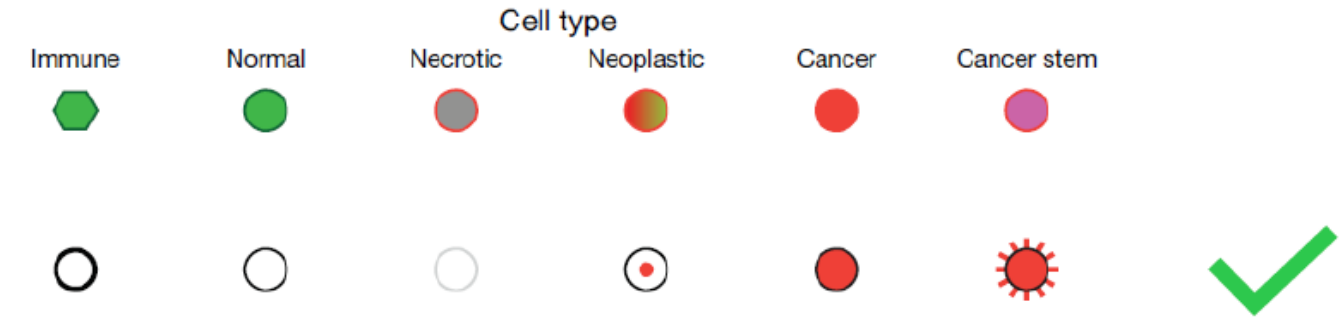
"Omit needless words"

Adapted from martin krzywinski, NMethods, 2013

"Express coordinate ideas in similar form"

Adapted from martin krzywinski, NMethods, 2013

be intuitive

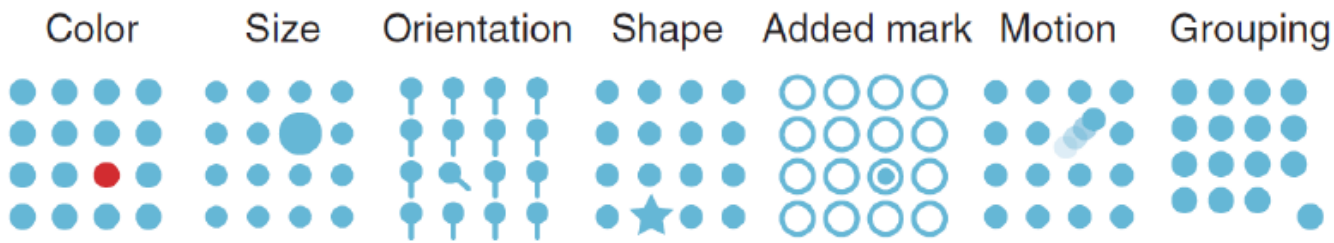


"Use definite, specific, concrete language"

Adapted from martin krzywinski, NMethods, 2016

Salience

“Whereas text is a natural place for nuance and alternative interpretations, multiple lines of argument in a figure can easily interfere with our perception of all its parts” [10]



salience

Bang Wong 2010 Nature Methods

IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT
IMPORTANT IMPORTANT IMPORTANT

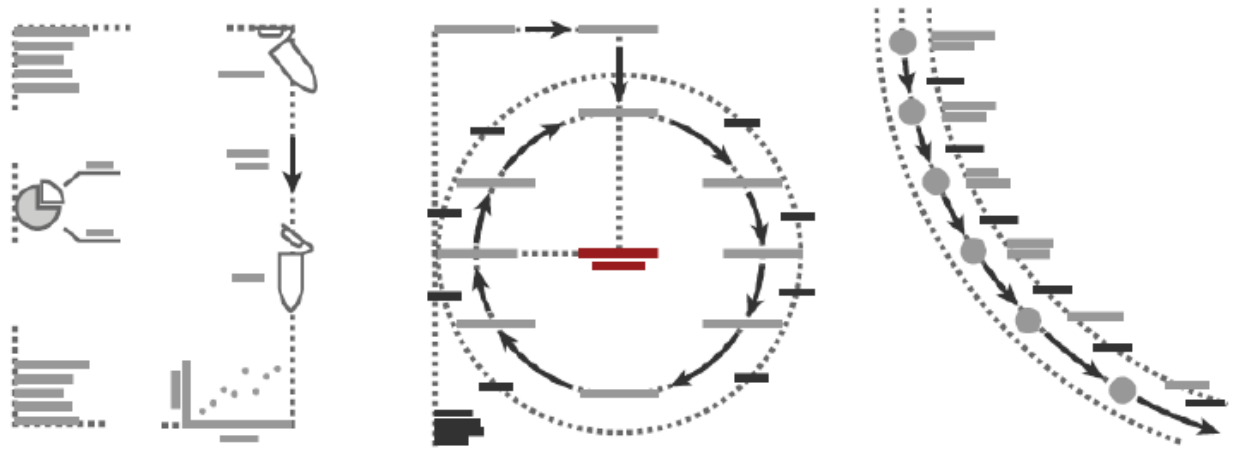
white
space

"According to the Gestalt principle of simplicity, the brain groups elements in order to minimize the number of objects in a scene. Pursuing simplicity became an aesthetic imperative for modern designers"
/ Ellen Lupton Design is Storytelling

---

found on the web, author unknown

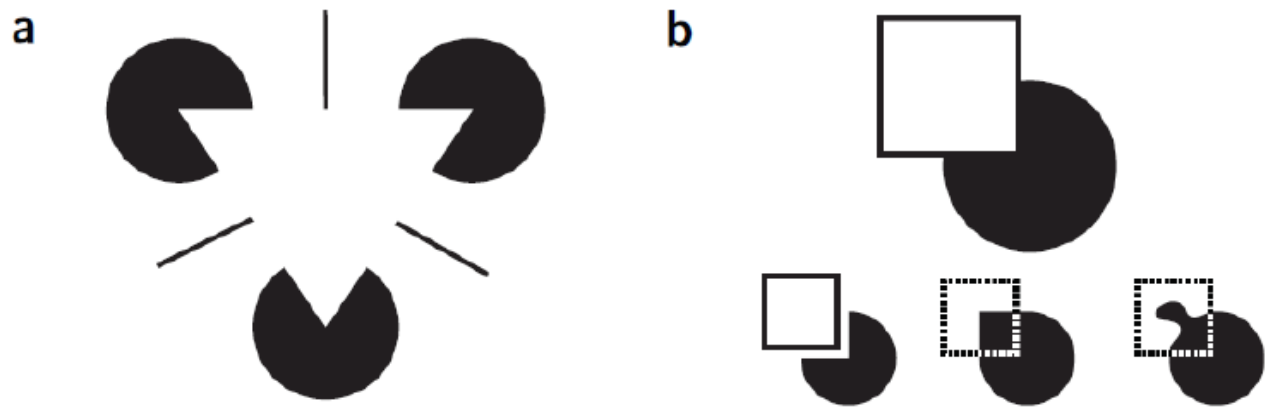
Aligning is grouping by common position. That is why it's so powerful



alignment

Bang Wong 2010 Nature Methods

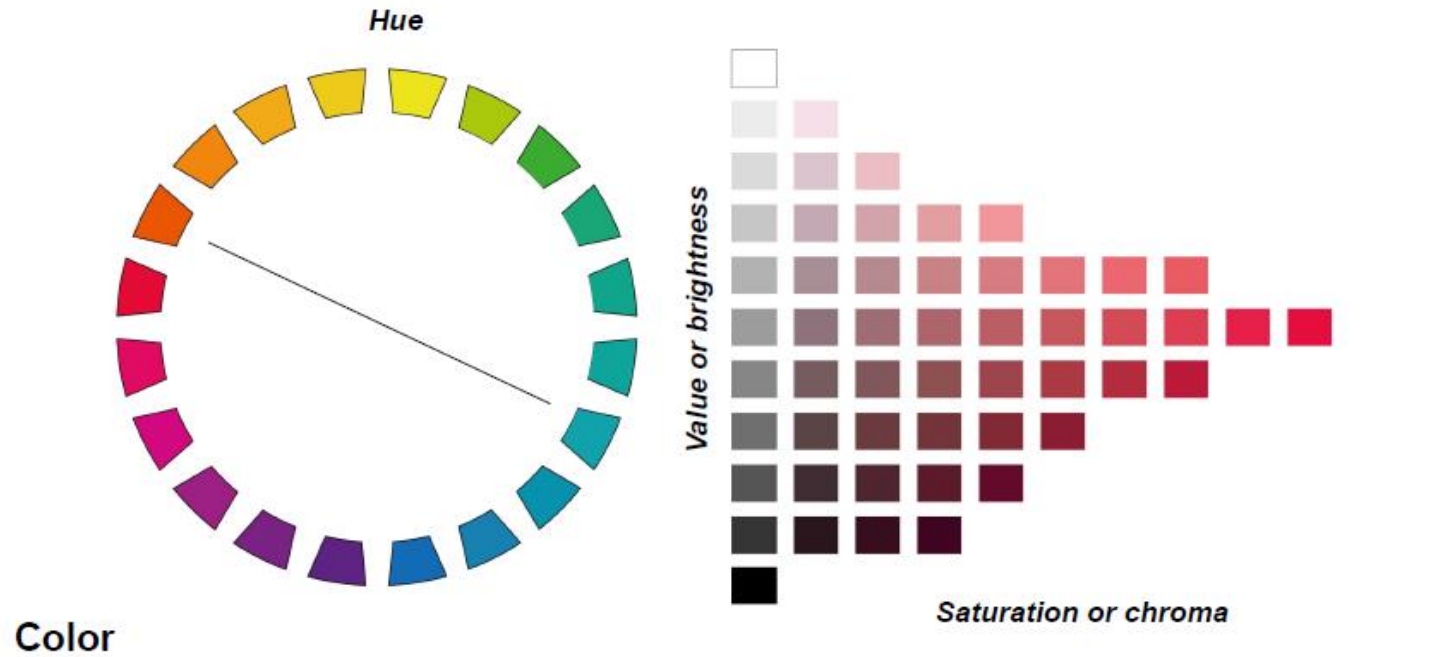
visual completion



Adapted from martin krzywinski, NMethods, 2013

Too
much
color
emphasizes
nothing

Color can cause the wrong information to stand out and make meaningful information difficult to see



Color

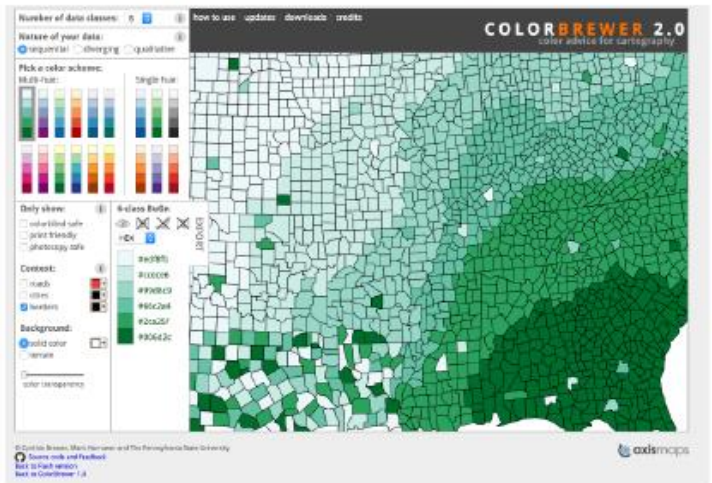
https://classicalatelierathome.com/munsell-101-for-the-artist

Color

work with a small selection of systematically chosen colours (palette) and stick to them throughout the project

Brewer color palettes

http://mkweb.bcgsc.ca/brewer/



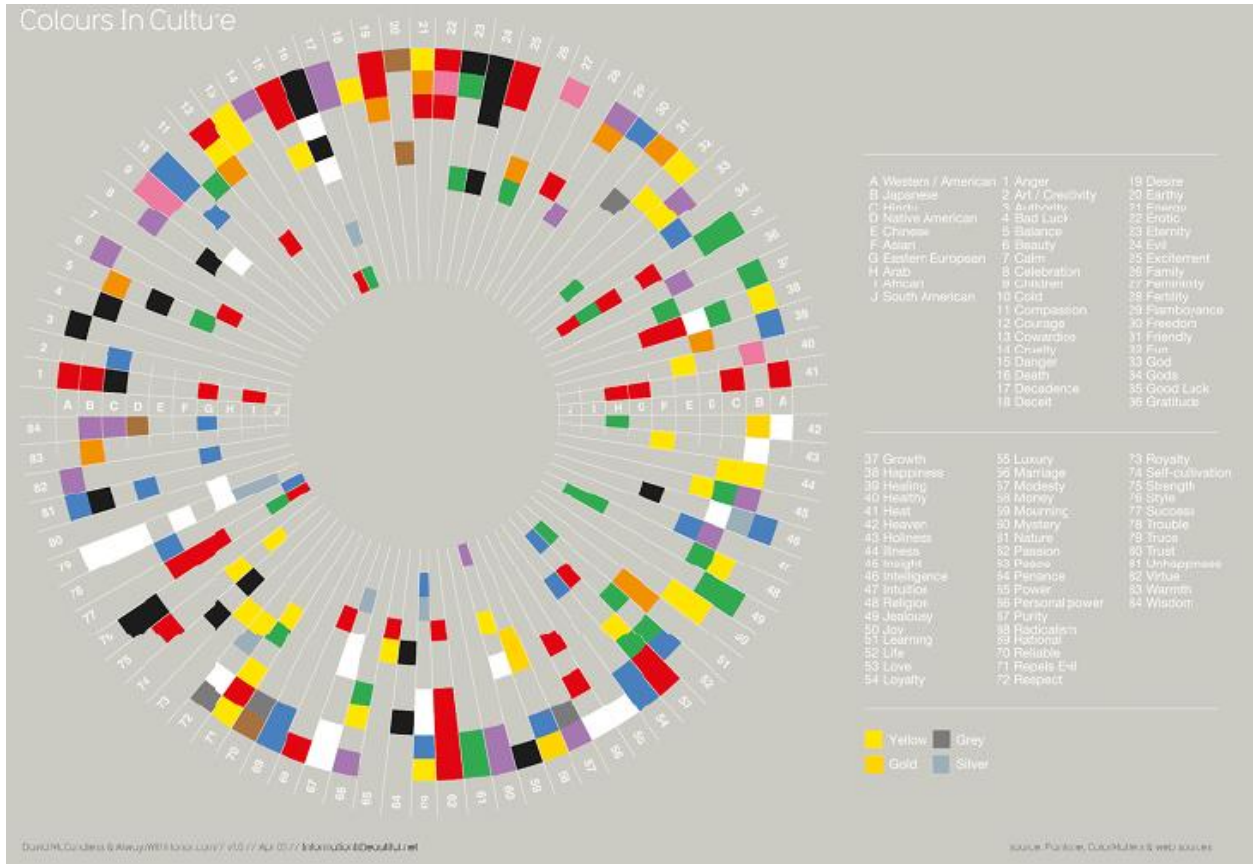
colorbrewer.org

Color

Brewer color palettes

A color space that is perceptually uniform defines colors based on how we perceive them.
Distances between colors in the space are proportional to their perceived difference.
Brewer palettes were selected for their perceptual properties by Cynthia Brewer for cartography.

figure from M Krzywinski


Colours In Culture
A Western / American
B Japanese
D Native American
E Chinese
F Asian
G Eastern European
H Arab
J South American
1 Anger
2 Art / Creativity
4 Bad Luck
5 Balance
6 Beauty
7 Calm
8 Celebration
10 Cold
11 Compassion
12 Courage
13 Cowardice
15 Danger
16 Death
17 Decadence
18 Deceit
19 Desire
20 Earthy
22 Erotic
23 Eternity
24 Evil
25 Excitement
26 Family
28 Fertility
29 Flamboyance
30 Freedom
31 Friendly
33 God
34 Gods
35 Good Luck
36 Gratitude
37 Growth
38 Happiness
39 Healing
40 Healthy
41 Heat
42 Heaven
43 Holiness
44 Illness
46 Intelligence
47 Intuition
48 Religion
49 Jealousy
50 Joy
51 Learning
52 Life
53 Love
54 Loyalty
55 Luxury
56 Marriage
57 Modesty
58 Money
59 Mourning
61 Nature
62 Passion
63 Peace
64 Penance
65 Power
66 Personal power
67 Purity
68 Radicalism
69 Rational
70 Reliable
71 Repels Evil
72 Respect
73 Royalty
74 Self-cultivation
75 Strength
76 Style
77 Success
78 Trouble
79 Truce
80 Trust
81 Unhappiness
82 Virtue
83 Warmth
84 Wisdom
Yellow
Grey
Gold
Silver

Basic principles of science writing and narrative

Filipa Vala
Centre for Ecology, Evolution and Environmental Changes

Science communication

is “a variety of practices that transmit scientific ideas, methods, knowledge and research to non-expert audiences”

Intro to a SciComm Course at New Castle Univ.

Science writer

Scientific writing is technical writing by a scientist, with an audience of peers -- other scientists. *Science writing* is writing about science for the popular media.

I'm a storyteller.

Science communication

is "a variety of practices that transmit scientific ideas, methods, knowledge and research to non-expert audiences"

Intro to a SciComm Course at New Castle Univ.

News article

A documentary

An exhibition

Narrative
noun

a spoken or written account of connected events; a story.
"a gripping narrative"

Oxford online

Scientific paper

A play

An infographic

Storytelling: my single golden rule

Language

Nominalization vs action (verb):

We performed an analysis of the data vs We analysed the data

Scientific paper *vs* the rest: audience

Language

Technical vs not:

The evolution of tetrapods *vs* The history of 4-limbed animals

Detail

The park extends over 69,594.48 hectares, from the Mourala to the Castro Laboreiro highlands…

vs The park extends almost seventy thousand hectares …

About 70% of terrestrial animal species found in Portugal occur within the Park's 74,224.89 hectares…

vs About 70% of terrestrial animal species found in Portugal occur within the Park's more than seventy-four thousand hectares...

Scientific paper *vs* the rest: audience

Language

Technical vs not:

"The evolution of tetrapods" *vs* "The history of 4-limbed animals"

Detail

unless *detail* is the point:

LHCb measures tiny mass difference between particles

The LHCb collaboration has measured a difference in mass between two particles of 0.000000000000000000000000000000000001 grams – or, in scientific notation, 10^{-38} g. The result, submitted for publication in the journal *Physical Review Letters* and presented today at CERN, marks a milestone in the study of how a particle known as a D^0 meson changes from matter into antimatter and back.

Narrative structure

News article

A documentary

An exhibition

Narrative
noun

a spoken or written account of connected events; a story.
"a gripping narrative"

Oxford online

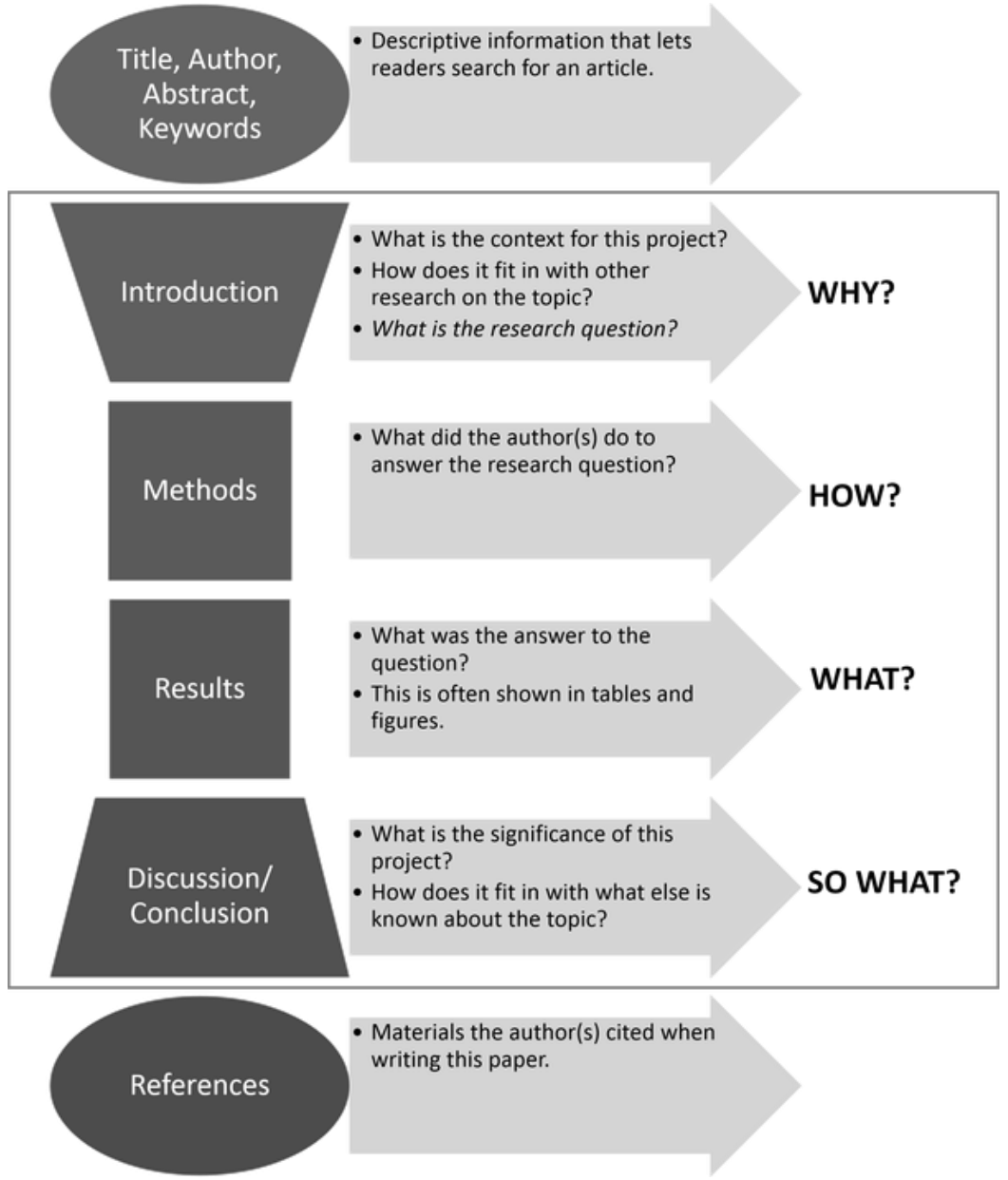
Scientific paper

A play

An infographic

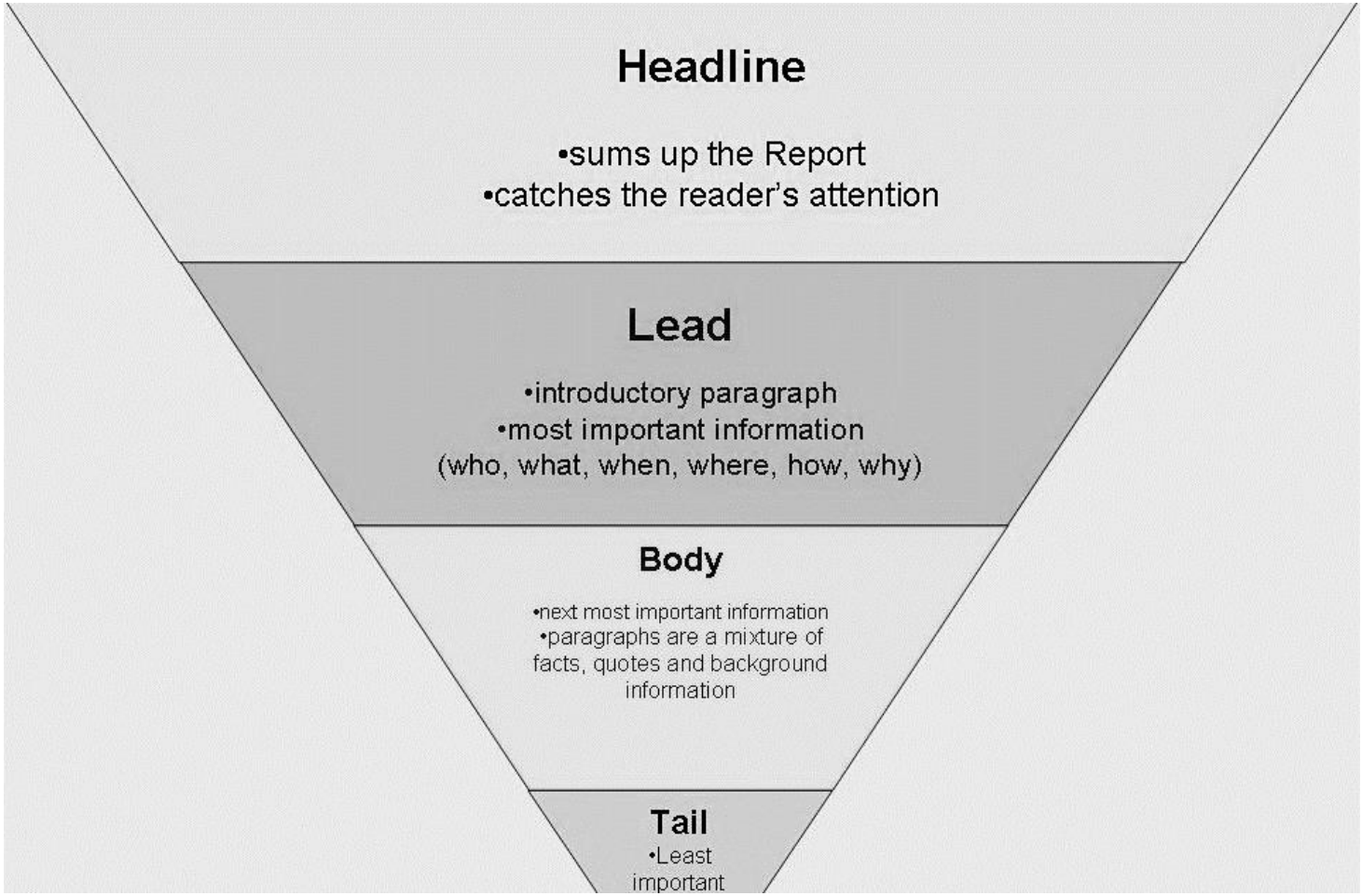
Narrative structure

Scientific paper



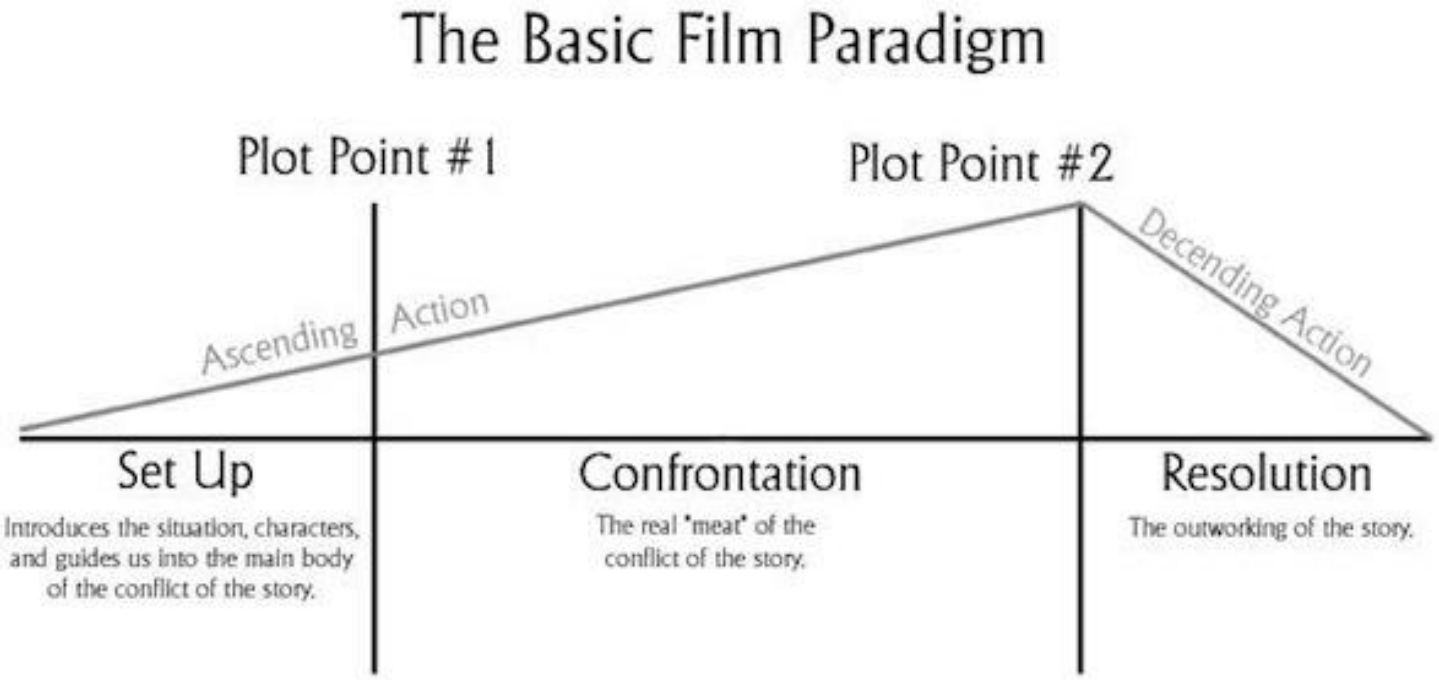
Narrative structure

News article



Narrative structure

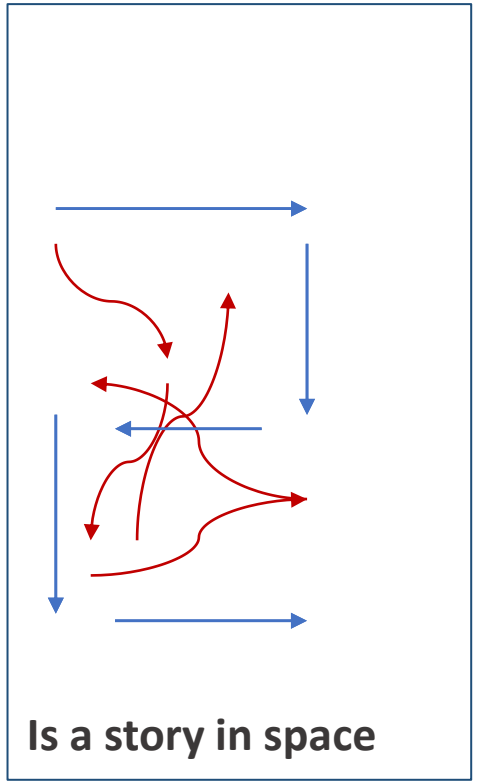
Documentary /Film /Play

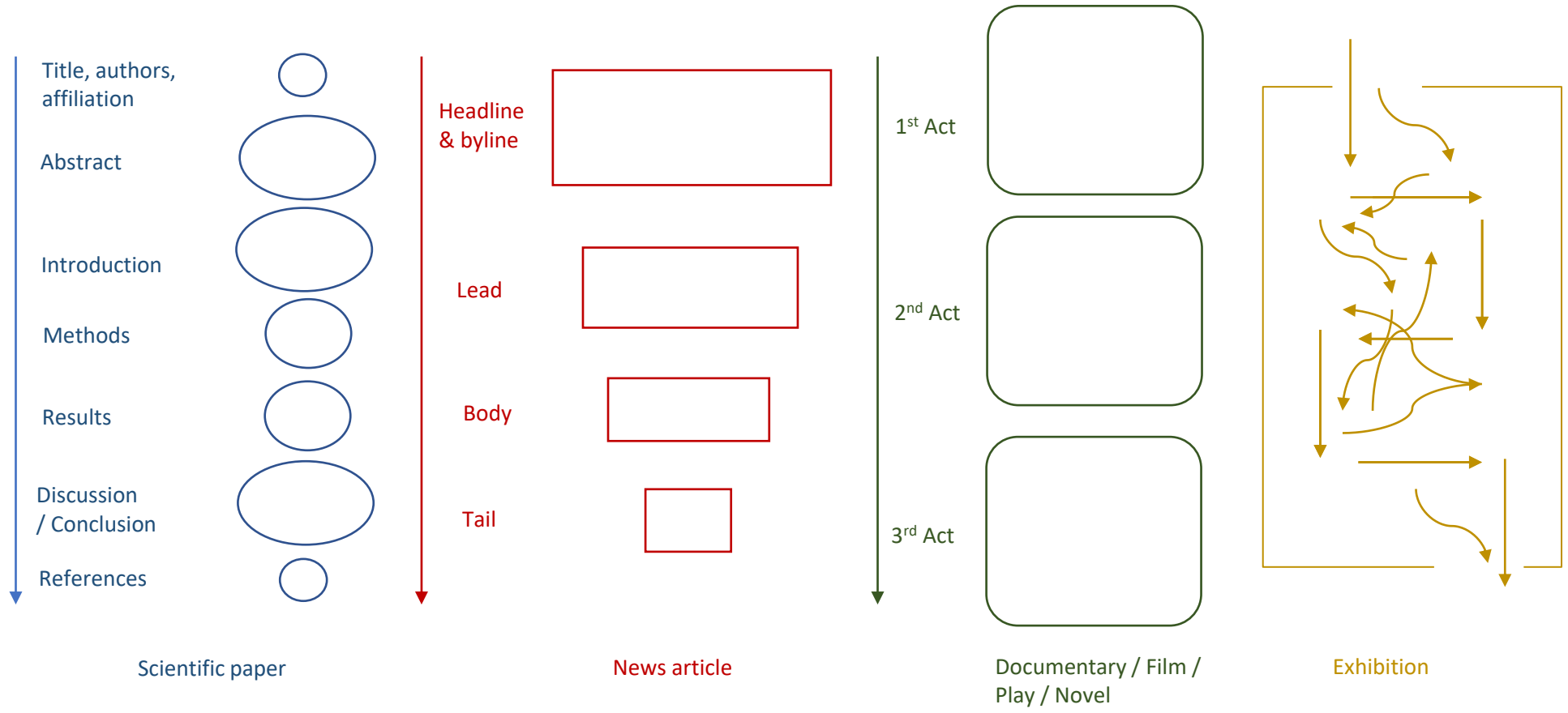


1st Act 2nd Act 3rd Act

Narrative structure

An exhibition





Scientific paper

News article

Documentary / Film / Play / Novel

Exhibition

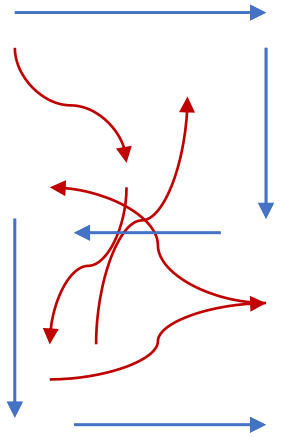
Narrative structure

An exhibition

Visitors become narrators

. Texts/panels are not read in a given order => one can't rely on what was said "previously" to build an argument

. even if all panels were read/visited, one can't assume info will be remembered

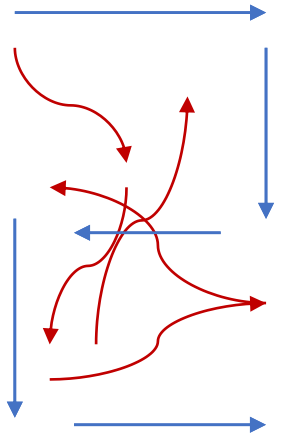


Is a story in space

where every text/panel must be a self-sufficient story.

Infographics

Are self-sufficient visual (short) stories



Is a story in space

where every text/panel must be a self-sufficient story.

Developing an infographic for an exhibition

EXHIBITION

15 mar—10 jun 2019

Main Gallery

Brain wider than the sky

https://gulbenkian.pt/en/agenda/brain-wider-than-the-sky/#:~:text=Brain%20%2D%20wider%20than%20the%20sky,the%20arts%20and%20the%20humanities.

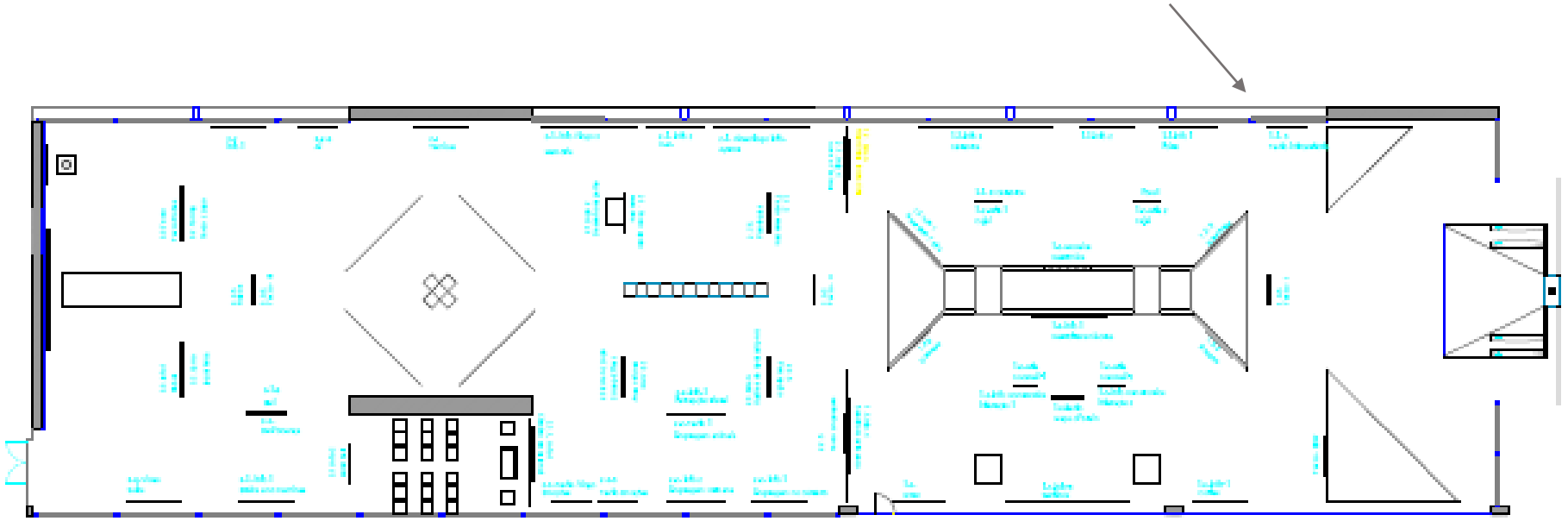
Exhibition

Brain – wider than the sky

The evolution of brains (part 1/3)

The evolution of CNS

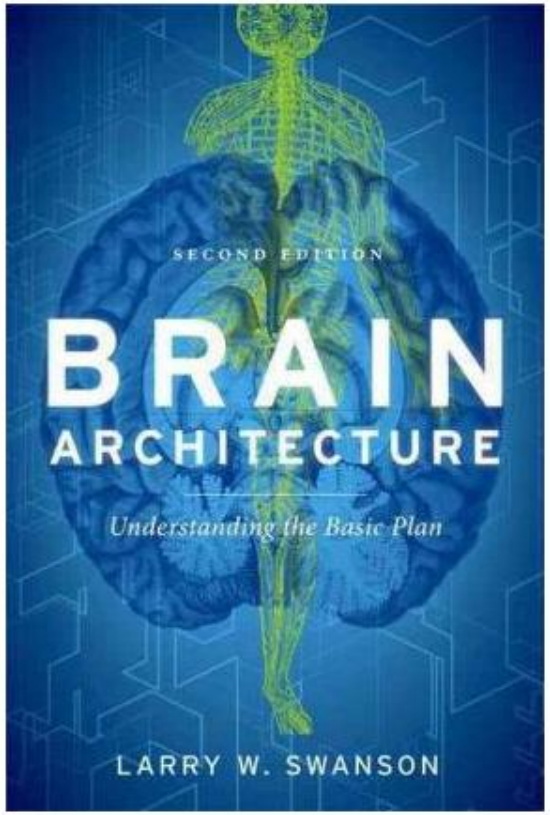
The evolution of nerve nets in invertebrates



Exhibition

Brain – wider than the sky

The evolution of brains (part 1)
The evolution of CNS
The evolution of nerve nets in invertebrates

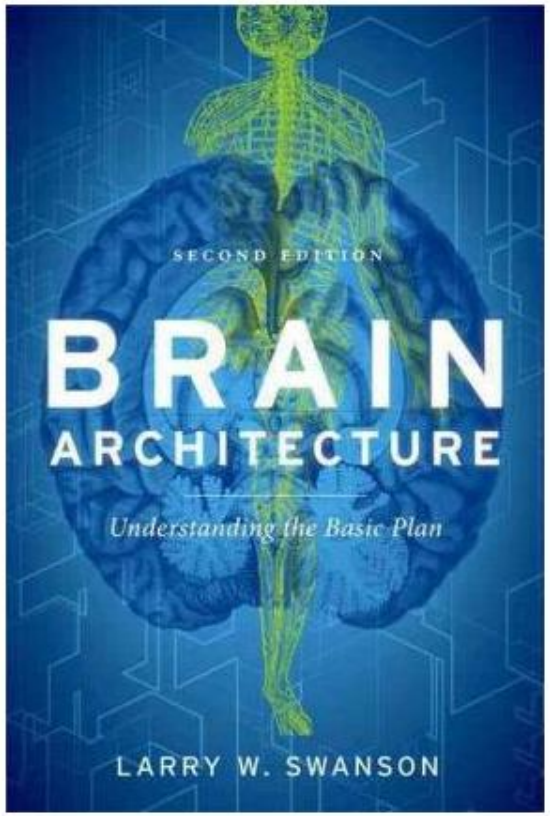


Book

Brain Architecture, Understanding the Basic Plan

Chapters 3 and 4: Neurons, Nerve Nets, and Behavior; Centralization and Symmetry: Ganglia and Nerves
Hydra, flatworms, octopus…

Animals
Behavior, movement, ecology
Evolution of architecture, not building blocks



Exhibition

Brain – wider than the sky

The evolution of brains (part 1)

The evolution of CNS

The evolution of nerve nets in invertebrates

Book

Brain Architecture, Understanding the Basic Plan

Chapters 3 and 4: Neurons, Nerve Nets, and Behavior; Centralization and Symmetry: Ganglia and Nerves

Hydra, flatworms, octopus…

Sea anemone

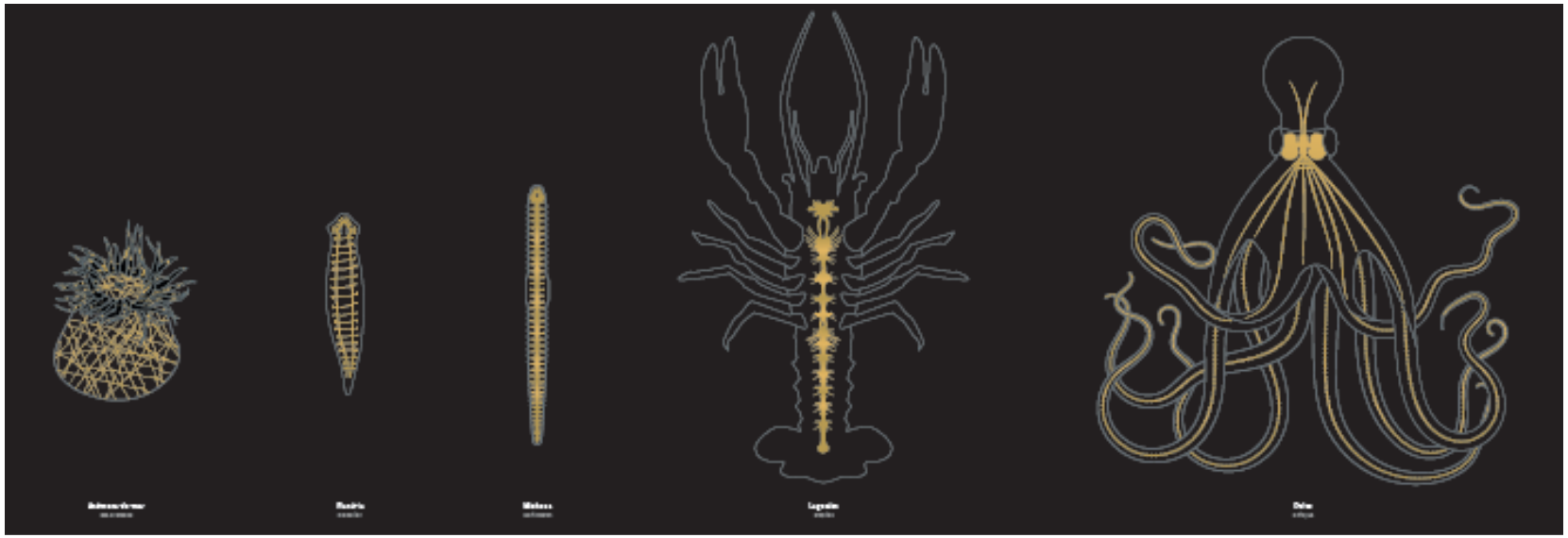
Earthworm

Planarian

Crayfish

Octopus

Animals

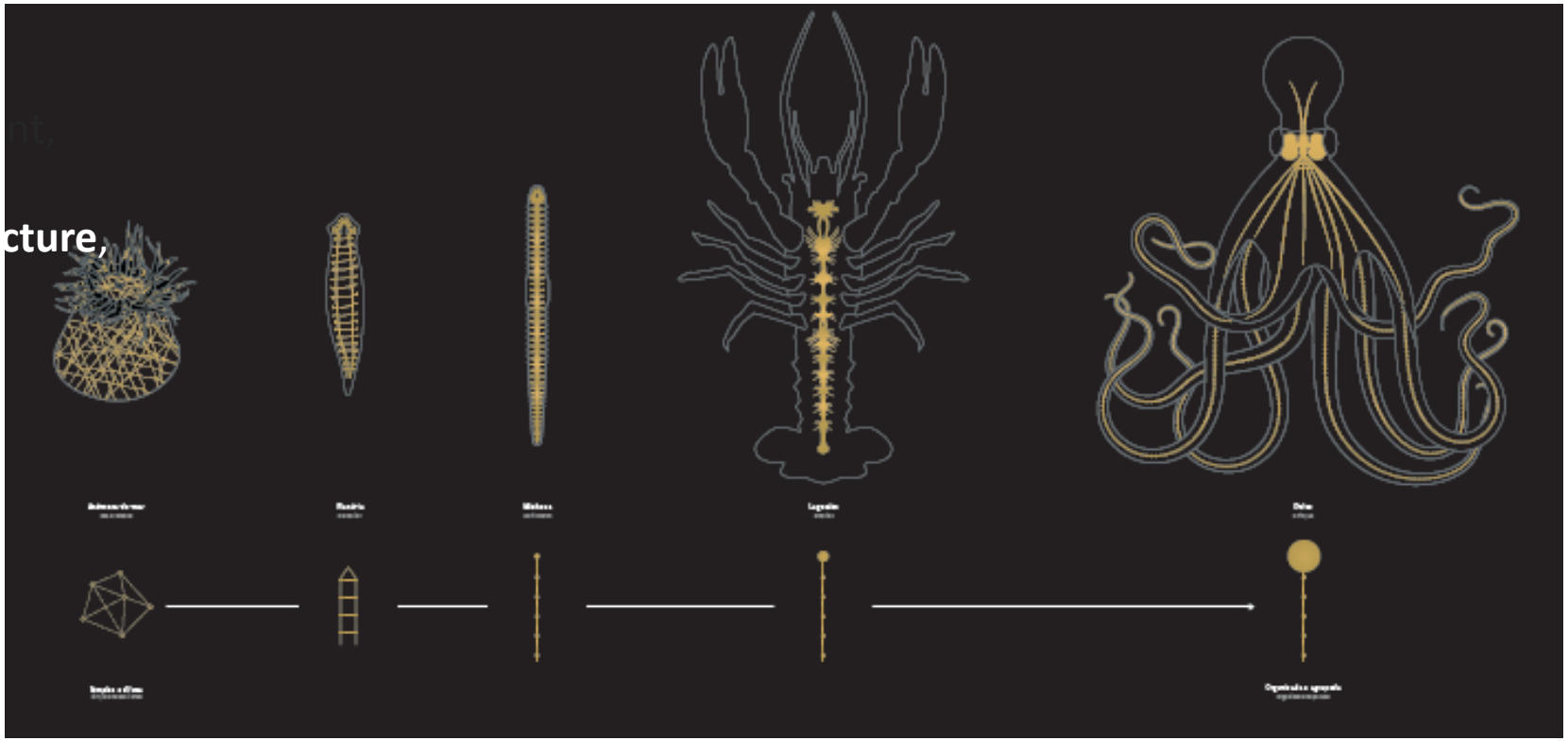


Evolution of **architecture**,
not building blocks

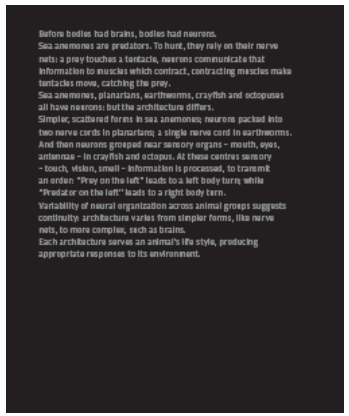
Simple and scattered neural networks → Organized and packed neural networks

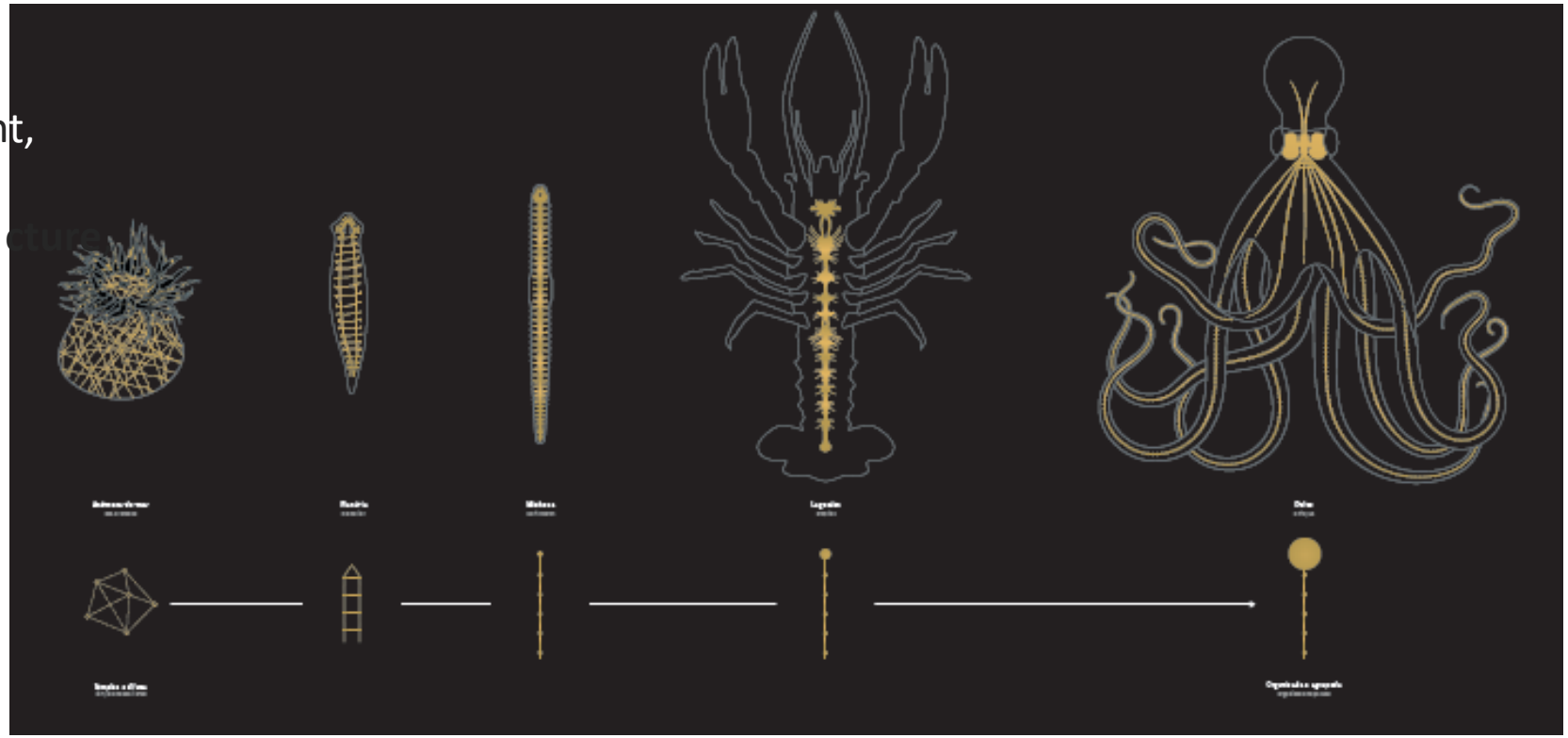
Animals

Evolution of **architecture**,
not building blocks

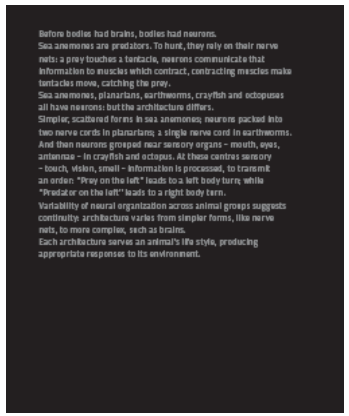


Behavior, movement, ecology





Animals
Behavior, **movement**, **ecology**
Evolution of **architecture**, not building blocks



"Before bodies had brains, bodies had neurons.

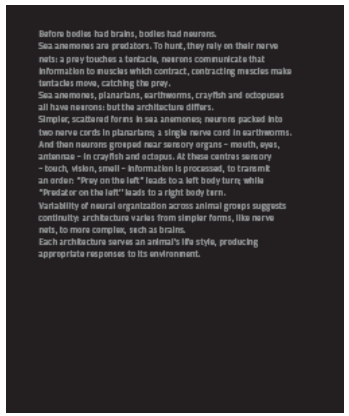
Sea anemones are predators. To hunt, they rely on their nerve nets: a prey touches a tentacle, neurons communicate that information to muscles which contract, contracting muscles make tentacles move, catching the prey.

Sea anemones, planarians, earthworms, crayfish and octopuses all have neurons: but the architecture differs.

Simpler, scattered forms in sea anemones; neurons packed into two nerve cords in planarians; a single nerve cord in earthworms. And then neurons grouped near sensory organs – mouth, eyes, antennae – in crayfish and octopus. At these centres sensory – touch, vision, smell – information is processed, to transmit an order: "Prey on the left" leads to a left body turn; while "Predator on the left" leads to a right body turn.

Variability of neural organization across animal groups suggests continuity: architecture varies from simpler forms, like nerve nets, to more complex, such as brains.

Each architecture serves an animal's life style, producing appropriate responses to its environment."



"Before bodies had brains, bodies had neurons.

Sea anemones are predators. To hunt, they rely on their nerve nets: a prey touches a tentacle, neurons communicate that information to muscles which contract, contracting muscles make tentacles move, catching the prey.

Sea anemones, planarians, earthworms, crayfish and octopuses all have neurons: but the architecture differs.

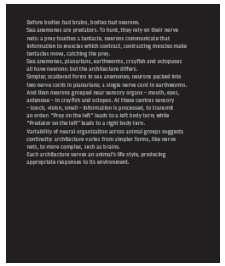
Simpler, scattered forms in sea anemones; neurons packed into two nerve cords in planarians; a single nerve cord in earthworms. And then neurons grouped near sensory organs – mouth, eyes, antennae – in crayfish and octopus. At these centres sensory – touch, vision, smell – information is processed, to transmit an order: "Prey on the left" leads to a left body turn; while "Predator on the left" leads to a right body turn.

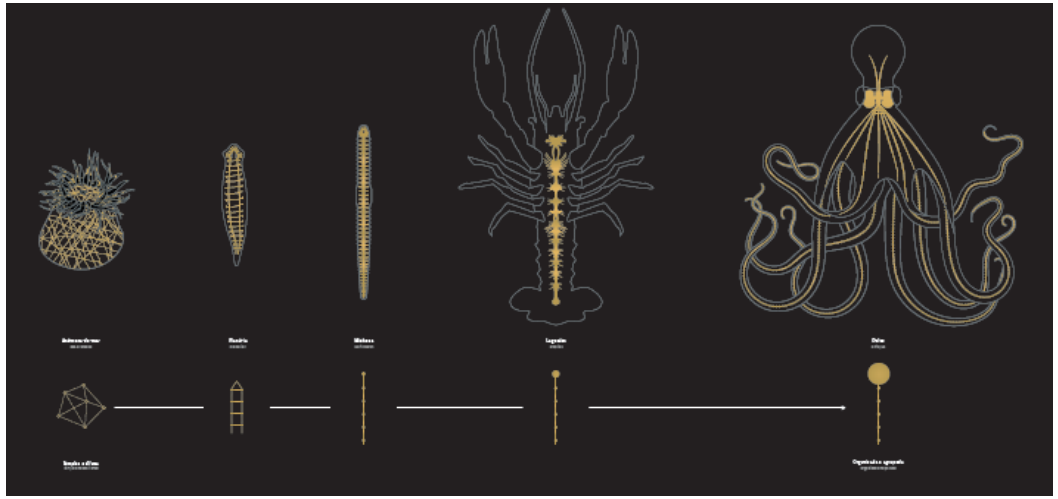
Variability of neural organization across animal groups suggests continuity: architecture varies from simpler forms, like nerve nets, to more complex, such as brains.

Each architecture serves an animal's life style, producing appropriate responses to its environment."

PS. I read that infographics have on average 227-230 words... This one had 166.

The evolution of nerve nets in invertebrates





This infographic condensed information by allowing an “intuitive” reading of a very complex process to a lay audience:

1st, we identified the main message (“it’s the architecture that evolves”)

2nd, we identified the elements to be used – symbols that people relate to or recognize: animals, “net structures” (for architecture), an arrow for increasing complexity; and only two colours – bodies & neural nets

3rd, we complemented the story with text – text adds detail to a message that should be there already (run a clarity test: if text is removed, the infogrphc should lose detail but not meaning)

Graphic and text elements for an infographic

Exercise for the afternoon discussion

Sketch your own story

Work in groups of 4

Choose between 2 possible infographic projects

Adaptive radiation of cichlid fish in lake Tanganyika

The evolution of SARS-CoV-2 variants

Infographics should focus on the **process** (not its end result)

Sketch your own story

1st Identify your story's main message – we would like the exercise to focus on a process: the evolutionary process, or the way data was collected, or how you draw/read a phylogenetic tree…

2nd Identify the elements in the story – main and secondary components (if any); visual/graphic and text items for each

3rd Add detail with text – write drafts of the text for each element

(sometimes, it also works backwards: start with text – usually too long and dense – then polish, simplify, and cut text by illustrating it)

4th Arrange graphic and text elements in a schematic (may be hand) drawing

These slides were used on a workshop organized by COST Action “Building on scientific literacy in evolution towards scientifically responsible Europeans” (EuroScitizen), CA 17127 supported by COST (European Cooperation in Science and Technology).

COST is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation.

www.cost.eu

2021