Teal–Amber Lab Palette

Figure Colour Specification and Style Guide · Version 1.0

1. Purpose

This document specifies the colour system used in all figures produced by the laboratory. It serves two functions. First, it fixes the exact colour values so that every figure, in every manuscript, poster and slide deck, is drawn from the same set — this visual consistency is what makes the laboratory's output recognisable. Second, it guarantees that figures remain readable for colour-vision-deficient readers and in greyscale reproduction, which is a requirement of most major journals.

The system is built on two anchor colours, deep teal and amber, that carry the laboratory identity. Six further categorical colours, five neutrals and three continuous ramps extend the system without compromising the accessibility guarantees documented in Section 5.

2. Palette overview

Categorical

Sequential — teal

Sequential — amber

Diverging — teal to amber

Neutrals

3. Derivation

The two anchor colours were fixed at the outset. The remaining six categorical colours were then selected by simulated annealing in CIELAB space, maximising the worst-case CIE76 colour difference across four vision models simultaneously — normal trichromatic, deuteranopic, protanopic and tritanopic (Viénot–Brettel–Mollon transform) — subject to two additional constraints: chroma held within C* 12–52, which keeps the colours muted enough for print, and a minimum lightness separation between adjacent colours to preserve greyscale legibility.

Both sequential ramps are linear in L*, so equal steps in the data correspond to equal perceptual steps in the figure. The diverging ramp is symmetric in L* about its neutral midpoint, so neither tail is visually weighted more heavily than the other.

4. Colour specifications

4.1 Categorical colours

Use these in the order listed. The first four are the most widely separated under all vision models; taking a subset from the middle of the list voids the accessibility guarantee.

Name	HEX	RGB	CMYK	HSL	CIE L*a*b*	L* C* h	Assigned role
teal	#0F6E6B	15 110 107	86 0 3 57	178 76% 25%	41.7 -25.8 -5.7	41.7 26.4 192.4	primary / control / baseline
amber	#E29A2D	226 154 45	0 32 80 11	36 76% 53%	69.1 18.2 63.6	69.1 66.2 74	secondary / treatment / highlight
rust	#BE654C	190 101 76	0 47 60 25	13 47% 52%	52.7 33.3 30	52.7 44.9 42	third condition / warning
skyblue	#5A91BE	90 145 190	53 24 0 25	207 43% 55%	58.2 -5.3 -29	58.2 29.4 259.7	fourth condition
sage	#83A462	131 164 98	20 0 40 36	90 27% 51%	63.6 -23.2 30.6	63.6 38.4 127.2	fifth condition
plum	#995A90	153 90 144	0 41 6 40	309 26% 48%	47.1 34.2 -18.9	47.1 39.1 331.1	sixth condition
graphite	#333F4A	51 63 74	31 15 0 71	209 18% 25%	26 -1.9 -8.3	26 8.5 257.3	axes, ticks, text, reference lines
sand	#DFC98F	223 201 143	0 10 36 13	43 56% 72%	81.5 -0.6 31.8	81.5 31.8 91	fills, backgrounds, CI bands

4.2 Neutrals

Neutrals carry all non-data ink. Pure black is deliberately excluded — it is heavier than necessary at print size and reduces the apparent salience of the data.

Name	HEX	RGB	CMYK	HSL	CIE L*a*b*	L* C* h	Assigned role
ink	#1C242B	28 36 43	35 16 0 83	208 21% 14%	13.7 -1.5 -5.8	13.7 6 255.9	body text, titles, labels
graphite	#333F4A	51 63 74	31 15 0 71	209 18% 25%	26 -1.9 -8.3	26 8.5 257.3	axes, ticks, tick labels, reference lines
slate	#66727C	102 114 124	18 8 0 51	207 10% 44%	47.4 -2.2 -7	47.4 7.4 252.6	secondary text, captions, annotations
mist	#B9C1C6	185 193 198	7 3 0 22	203 10% 75%	77.6 -1.8 -3.5	77.6 3.9 242.8	gridlines, minor rules
paper	#F3F0EB	243 240 235	0 1 3 5	38 25% 94%	94.9 0.1 2.8	94.9 2.8 87.1	panel backgrounds, table banding

4.3 Recommended subsets

Groups	Colours to use
2	teal, amber
3	teal, amber, rust
4	teal, amber, rust, skyblue
5	teal, amber, rust, skyblue, sage
6	teal, amber, rust, skyblue, sage, plum
7–8	all eight, in listed order — add a redundant channel (see 6.3)

4.4 Sequential ramp — teal

For unsigned magnitude: intensity, density, abundance, expression, probability. Low values light, high values dark. L* is linear from 97 to 23.

Stop	HEX	RGB	CMYK	CIE L*a*b*	L*
1 / 9	#EDF9FA	237 249 250	5 0 0 2	97.1 -3.7 -1.9	97.1
2 / 9	#B8E4E7	184 228 231	20 1 0 9	87.7 -13.5 -6.2	87.7
3 / 9	#85CED2	133 206 210	37 2 0 18	78.3 -21.7 -9.2	78.3
4 / 9	#51B7BC	81 183 188	57 3 0 26	68.9 -27.9 -11.5	68.9
5 / 9	#009FA3	0 159 163	100 2 0 36	59.4 -32.5 -12	59.4
6 / 9	#00888A	0 136 138	100 1 0 46	51.2 -29.5 -9.9	51.2
7 / 9	#006F70	0 111 112	100 1 0 56	42.1 -25.7 -8.2	42.1
8 / 9	#005756	0 87 86	100 0 1 66	32.9 -22.3 -5.9	32.9
9 / 9	#003F3D	0 63 61	100 0 3 75	23.3 -18.4 -4	23.3

4.5 Sequential ramp — amber

A second, independent magnitude channel — use when two sequential quantities must appear in one figure, or when a warm ramp better matches the subject. L* is linear from 98 to 26.

Stop	HEX	RGB	CMYK	CIE L*a*b*	L*
1 / 9	#FDF9EE	253 249 238	0 2 6 1	98 -0.5 5.7	98
2 / 9	#F3DEA8	243 222 168	0 9 31 5	89 -0.6 29.2	89
3 / 9	#E4C27C	228 194 124	0 15 46 11	79.9 3 39.6	79.9
4 / 9	#D5A656	213 166 86	0 22 60 16	70.9 8.4 47.3	70.9
5 / 9	#C58A33	197 138 51	0 30 74 23	61.9 14.6 53.2	61.9
6 / 9	#B46F0C	180 111 12	0 38 93 29	53.1 20.9 57.8	53.1
7 / 9	#A35200	163 82 0	0 50 100 36	44 29.3 53.3	44
8 / 9	#923400	146 52 0	0 64 100 43	35.1 37.7 46.8	35.1
9 / 9	#810800	129 8 0	0 94 100 49	26.3 46.8 38.8	26.3

4.6 Diverging ramp — teal to amber

For signed quantities with a meaningful zero: $\log_2$ fold change, z-score, difference from control, residuals. Stop 6 is the neutral midpoint and must be mapped to zero.

	Stop	HEX	RGB	CMYK	CIE L*a*b*	L*
	1 / 11	#007372	0 115 114	100 0 1 55	43.5 -27 -7.3	43.5
	2 / 11	#008C8B	0 140 139	100 0 1 45	52.5 -31.1 -8.5	52.5
	3 / 11	#53A6A5	83 166 165	50 0 1 35	63.2 -25.4 -7.3	63.2
	4 / 11	#86C0BF	134 192 191	30 0 1 25	73.9 -18.8 -5.5	73.9
	5 / 11	#B6D9D9	182 217 217	16 0 0 15	84.3 -11.5 -3.9	84.3
	6 / 11	#F3F0EB	243 240 235	0 1 3 5	94.9 0.1 2.8	94.9
	7 / 11	#ECCF9F	236 207 159	0 12 33 7	84.5 3.3 27.6	84.5
	8 / 11	#DDAD68	221 173 104	0 22 53 13	73.7 9.4 41.9	73.7
	9 / 11	#CC8C36	204 140 54	0 31 74 20	63.2 16.7 53.5	63.2
	10 / 11	#BA6A00	186 106 0	0 43 100 27	52.7 26.1 60.3	52.7
	11 / 11	#A84500	168 69 0	0 59 100 34	42.1 38.1 52.6	42.1

5. Accessibility validation

Minimum pairwise CIE76 colour difference across the eight categorical colours, computed after transforming the palette through each vision model. A difference above 10 is generally taken as reliably distinguishable at figure scale.

Vision model	Minimum pairwise dE	Limiting pair	Threshold	Result
Normal trichromatic	28.7	graphite / teal	> 20	pass
Deuteranopia (~6% of males)	13.9	skyblue / plum	> 10	pass
Protanopia (~2% of males)	14.9	rust / sage	> 10	pass
Tritanopia (rare)	16.5	teal / skyblue	> 10	pass
Greyscale (min dL*)	5.4	skyblue / sage	> 4	pass

The binding constraint is the skyblue / plum pair under deuteranopia. These are the fourth and sixth colours in the order, so they co-occur only in figures with six or more groups; at that point Section 6.3 requires a redundant channel in any case.

6. Usage manual

6.1 Semantic assignment

Consistency of meaning, not the colours themselves, is what makes a palette an identity. Fix the following assignments and apply them across every figure the laboratory produces. A reader who has seen one of your figures should be able to read the next one without consulting the legend.

Colour	HEX	Reserved for
teal	#0F6E6B	Control, baseline, wild-type, untreated, reference condition
amber	#E29A2D	The effect of interest — treatment, intervention, mutant, the result the figure is about
rust	#BE654C	Third experimental condition
skyblue	#5A91BE	Fourth experimental condition
sage	#83A462	Fifth experimental condition
plum	#995A90	Sixth experimental condition
graphite	#333F4A	Axes, ticks, tick labels, reference and threshold lines. Never pure black.
sand	#DFC98F	Confidence bands, shaded fills, non-data background regions
sequential teal	ramp	Unsigned magnitude — intensity, density, abundance, expression
diverging	ramp	Signed quantity centred on zero — $\log_2$FC, z-score, difference

6.2 Mandatory rules

#	Rule
R1	Draw categorical colours in the listed order. Do not select colours by preference or by subject matter; the ordering encodes the accessibility optimisation.
R2	Never encode a continuous variable with categorical colours, and never encode an unordered category with a ramp.
R3	Centre the diverging ramp on a meaningful zero. In practice this means setting the colour limits symmetrically (vmin = -vmax) or supplying an explicit midpoint. An off-centre diverging ramp misrepresents the data.
R4	Use graphite for all axis furniture and ink for text. Reserve saturated colour for data.
R5	Minimum line width 1.5 pt and minimum marker size 4 pt in the final printed figure. Below these sizes hue is not resolvable and the palette provides no separation.
R6	Add a redundant channel — marker shape, line style, direct labelling — whenever more than four groups appear in a single panel.
R7	Export vector (PDF or EPS) wherever the journal permits it; otherwise raster at 600 dpi or above.
R8	Do not apply transparency below alpha 0.6 to categorical colours. Blending toward the background collapses the lightness separation the palette depends on.

6.3 Common errors

Problem	Correction
Rainbow or jet colormap inherited from an older script	Replace with the teal sequential ramp; jet is not perceptually uniform and creates artefactual banding
Diverging ramp with default auto-scaled limits	Set symmetric limits so the neutral midpoint falls on zero
Ten or more categories in one panel	Facet, aggregate the tail into "other", or label directly. No eight-colour palette resolves ten categories
Red / green pairing carried over from a previous figure	Replace with teal / amber. Red-green is the single most common accessibility failure in the literature
Colour used decoratively on bars that are already labelled	Use a single colour; reserve hue for information the reader cannot otherwise recover

7. Implementation

7.1 Python — matplotlib and seaborn

Place `labpalette.py` beside your analysis script or on the PYTHONPATH. Calling `apply()` sets the colour cycle, default colormap, fonts, axis styling and 600 dpi export in one step.

```
import labpalette as lp
lp.apply() # house style

ax.plot(x, y1, label="control") # cycles teal, amber, rust, ...
ax.plot(x, y2, label="treated")

lp.cat(4) # ['#0F6E6B', '#E29A2D', '#BE654C', '#5A91BE']
lp.C["amber"] # '#E29A2D'

ax.imshow(Z, cmap=lp.cmap("teal")) # sequential
ax.imshow(D, cmap=lp.cmap("diverging"), # diverging, centred on zero
vmin=-3, vmax=3)

import seaborn as sns
sns.set_palette(lp.cat(5))
```

7.2 R — ggplot2

```
source("labpalette.R")

ggplot(df, aes(x, y, colour = group)) +
  geom_line(linewidth = 0.6) +
  scale_colour_lab() +
  theme_lab()

# continuous fills
+ scale_fill_lab_c("teal")
+ scale_fill_lab_c("diverging", mid = 0)

ggsave_lab("fig1.pdf", width = 85) # 85 mm single column, 180 mm double
```

7.3 Adobe Illustrator, Photoshop, InDesign, Affinity

Swatches panel → panel menu → Open Swatch Library → Other Library → select `lab_palette.ase`. The file contains all 41 colours: eight categorical, five neutrals and every ramp stop.

7.4 Inkscape and GIMP

Copy `lab_palette.gpl` into `~/.config/inkscape/palettes/` (Inkscape) or the equivalent GIMP palettes directory, restart the application, and select the palette from the dropdown at the lower right of the colour bar.

7.5 LaTeX, TikZ and pgfplots

```
\input{lab_palette.tex} % defines labteal, labamber, ...

\draw[labteal, line width=1.5pt] plot coordinates {...};
\addplot[labamber, mark=*] table {data.dat};
```

7.6 Web, posters and HTML supplements

```
<link rel="stylesheet" href="lab_palette.css">

.control { stroke: var(--lab-teal); }
.treated { stroke: var(--lab-amber); }
```

8. Files in this release

File	Contents
lab_palette_guide.pdf	This document — specification and style guide
lab_palette_sheet.pdf / .png	One-page reference sheet for printing and pinning up
lab_palette.html	Interactive reference — click to copy, live CVD and greyscale simulation

File	Contents
labpalette.py	Python module: colormaps, colour cycle, house style
labpalette.R	R module: ggplot2 scales and theme_lab()
lab_palette.ase	Adobe Swatch Exchange, 41 swatches
lab_palette.gpl	GIMP / Inkscape palette, 41 swatches
lab_palette.css	CSS custom properties
lab_palette.tex	xcolor definitions for LaTeX
palette.json / specs.json	Machine-readable definitions and full colour-space specifications

9. Extending or revising the palette

If a figure appears to need a ninth categorical colour, the problem is almost always the figure rather than the palette: consider faceting, aggregating minor categories, or labelling series directly. If a new colour is genuinely required, it must be selected by re-running the optimisation with the existing eight held fixed, and the validation table in Section 5 must be recomputed. Colours chosen by eye will silently break the accessibility guarantees. Any revision increments the version number on the cover of this document, and figures already published under a previous version are not restyled.