CSE 564
Visualization & Visual Analytics

Infographics Design

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Lecture	Topic	Projects
1	Intro, schedule, and logistics	
2	Applications of visual analytics, basic tasks, data types	
3	Introduction to D3, basic vis techniques for non-spatial data	
4	Data assimilation and preparation	Project #1 out
5	Data assimilation and preparation	
6	Bias in visualization	
7	Data reduction and dimension reduction	
8	Visual perception	Project #2(a) out
9	Visual cognition	
10	Visual design and aesthetics	
11	Cluster analysis: numerical data	
12	Cluster analysis: categorical data	Project #2(b) out
13	High-dimensional data visualization	
14	Dimensionality reduction and embedding methods	
15	Principles of interaction	
16	Midterm #1	
17	Visual analytics	Final project proposal call out
18	The visual sense making process	
19	Maps	
20	Visualization of hierarchies	Final project proposal due
21	Visualization of time-varying and time-series data	
22	Foundations of scientific and medical visualization	
23	Volume rendering	Project 3 out
24	Scientific and medical visualization	Final Project preliminary report due
25	Visual analytics system design and evaluation	
26	Memorable visualization and embellishments	
27	Infographics design	
28	Midterm #2	

What are Infographics?

A clipped compound of "information" and "graphics"

A graphic visual representations of information, data or knowledge intended to present information
- quickly
- clearly

Can improve cognition by utilizing graphics to enhance the human visual system's ability to see patterns and trends

DESIGN RULES TO CONSIDER

Graphical displays should

- show the data
- induce the viewer to think about the substance rather than about methodology, graphic design, the technology of graphic production, or something else
- avoid distorting what the data has to say
- present many numbers in a small space
- make large data sets coherent
- encourage the eye to compare different pieces of data
- reveal the data at several levels of detail, from a broad overview to the fine structure
- serve a reasonably clear purpose: description, exploration, tabulation, or decoration
- be closely integrated with the statistical and verbal descriptions of a data set.

VERY EARLY EXAMPLE

Minard's 1869 map of Napoleon's campaign to Russia
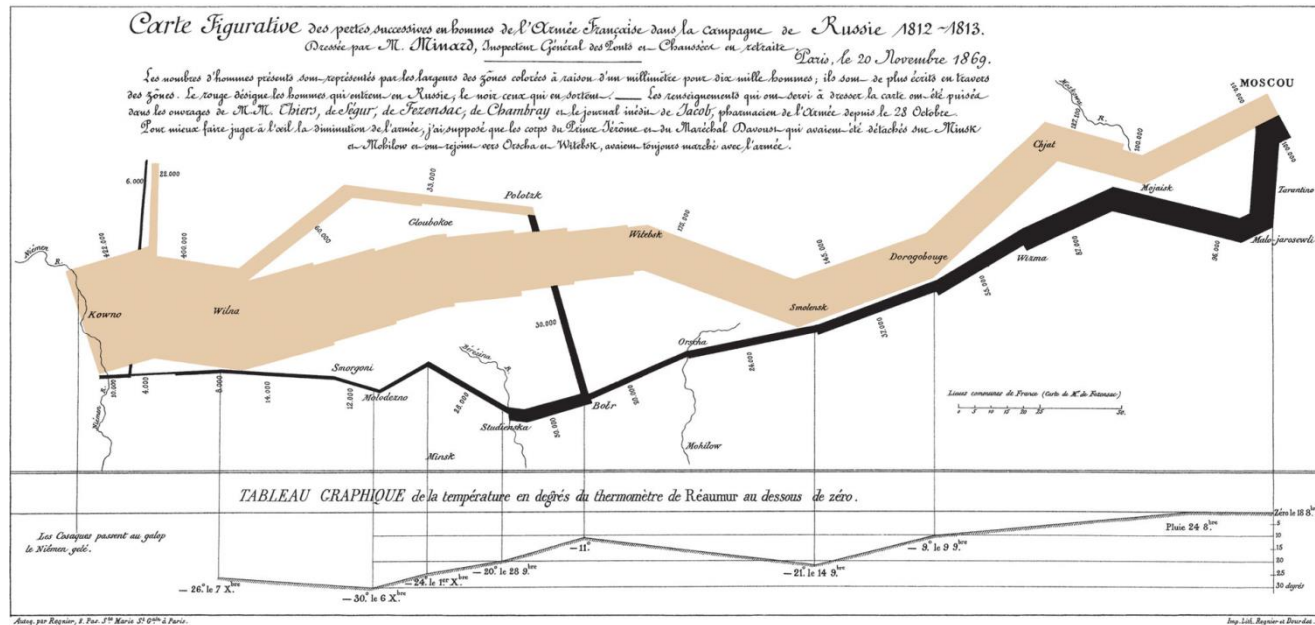
Shows 6 variables in one 2D visualization:

- number of Napoleon's troops, temperature
- distance traveled, direction of travel
- latitude and longitude, location relative to specific dates

Some More Random Examples ...

The Time We Spend on the Internet

ALMOST 5 BILLION videos are watched on Youtube every single day with an average viewing time of 40 minutes.

We send over **200 MILLION** emails per minute.

The average adult spends more than **20 HOURS ONLINE A WEEK...**

...which includes time spent on the Internet at work.

Stress in the Workplace

70% of American workers experience stress-related illnesses.

34% think they'll burn out on the job in the next two years.

33% more heart attacks are occurring on Monday mornings.

45% of entrepreneurs said they were stressed.

The Average Work Week

Mon Tue Wed Thu Fri Sat Sun

You get **168 HOURS** a week.

The average work week is closer to **50 HOURS** than 40.

Professionals and business leaders who carry mobile devices, like smartphones, tend to work more than **70 HOURS** a week.

The average commute time is **47 MINUTES** round trip.

MATTHEW MCNEW.

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mmcnew@mines.edu

Resume

🎓 Education

Colorado School of Mines

Major:
Computer Science

Minor:
Electrical Engineering

Minor:
Mathematics

May 2013

GPA: 3.7

Student Body President

Colorado School of Mines
2012-2013

← Campaign Logo

🐧 Skills

- Ruby
- Java
- C++
- HTML & CSS
- Javascript
- C
- PHP
- SQL
- Perl

Decent ——————————— Great

Windows **Linux** **Mac OS**

Internships:

2012
PIVOTAL LABS
Ruby on Rails
Agile Development
Pair Programming

2011
CableLabs
REVOLUTIONIZING CABLE TECHNOLOGY
Tested the Effectiveness
of Amazon Kindle's
Silk Browser

Volunteer:
Led A WWOOFing
Trip to Rural Brazil

June 2012 New Grad Position

Projects:

Freelance Programmer
Eagle Ridge Academy
After School Scheduling
PHP and MYSQL

Computer Science Field Session

Symplified
Designed and Implemented
Single Sign On Solution
With ASP.NET and IIS

School:
Graduated High School
as Valedictorian

Activities
- Math Counts Coach
- Tau Beta Pi
- Blue Key
- Student Government
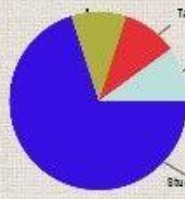
Interests
Organic Farming Soccer
Travel Entrepreneurship Comedy

➡ ➡
Number of Internships Completed

🏃🏃🏃🏃🏃🏃🏃
Number of Jobs Employed

🏃🏃🏃🏃🏃🏃
Number of Countries Traveled

WHAT ARE WE EATING?

What the Average American Consumes in a Year

Fats & Oils 85.5 lbs

Red Meat 110 lbs

Poultry 73.6 lbs

Fish & Shellfish 16.1 lbs

Chicken 60.4 lbs

Eggs 32.7 lbs

Cheese 31.4 lbs

Fruits 273.2 lbs

Coffee, Cocoa & Nuts 24 lbs

Dairy Products (non-cheese) 600.5 lbs

The Average American

Age: 36.6

Height: 5'9" (m) 5'4" (f)

Weight: 190 lbs (m) 164 lbs (f)

1,996.3 LBS*

Vegetables 415.4 lbs

Corn 58 lbs

Corn Syrup

Wheat flour 134.1 lbs

Beverage Milks 181 lbs

Caloric Sweeteners

EDUCATION AROUND THE WORLD

There are **1.4 Billion** students on Earth.

Only 65.2 Million educators Globally.

THE CHALLENGE: *Too many children remain out of school, and those who are in school aren't learning the skills they need for life and work.*

Children leaving school before completing their Primary Education

11.07 Million
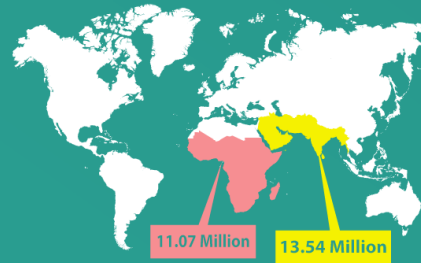
13.54 Million

In the Sub-Saharan, 11.07 million children leave school before completing their primary education. In South and West Asia, that number reaches 13.54 million.

Children out of primary school

61 Million children are still out of primary school.

32 Million of these children are Girls.

1 in 5 15 to 24 years old has not completed primary school and lacks skills for work.

An estimated **250** million children are not able to read or write.

The poorest and most marginalized are the most affected.

In some emerging economies, **3 in 10** youths cannot do basic arithmetic.

Fragile and conflict-affected countries account for more than **30%** of all children not completing primary school

In some developing countries, one quarter to one-half of youth who have graduated from primary school cannot read a single sentence.

OF THE 775 MILLION ILLITERATE ADULTS **TWO-THIRDS ARE WOMEN**

Connect. Inspire. Empower.

STUDENT BULLYING

STATES WITHOUT BULLYING LAWS

FIRST STATE WITH BULLYING LAW

280,000
STUDENTS ARE PHYSICALLY ATTACKED IN SECONDARY SCHOOLS EACH MONTH

160,000
STUDENTS MISS SCHOOL EACH DAY FOR FEAR OF BEING BULLIED

77%
OF STUDENTS ARE BULLIED MENTALLY, VERBALLY, & PHYSICALLY. CYBER BULLYING STATISTICS ARE RAPIDLY APPROACHING SIMILAR NUMBERS

43%
FEAR HARASSMENT IN THE BATHROOM AT SCHOOL

EFFECTS OF BULLYING

Bullying can have a significant impact on both child and teenage students. Students who are bullied often suffer from anxiety, fear, withdrawal, low self-esteem, and poor concentration. A bullied student will often avoid school, have lower grades, and become socially isolated. There have been numerous reports of suicide due to bullying.

MOST COMMON TYPES OF BULLYING:

HITTING, THREATENING, INTIMIDATING, MALICIOUSLY TEASING AND TAUNTING, NAME-CALLING, MAKING SEXUAL REMARKS, AND STEALING OR DAMAGING BELONGINGS OR MORE SUBTLE, INDIRECT ATTACKS (SUCH AS SPREADING RUMORS OR ENCOURAGING OTHERS TO REJECT OR EXCLUDE SOMEONE).

bul·lyi·ng

Physical, verbal, or psychological attacks or intimidation against a person who cannot properly defend himself or herself. It includes two key components: 1. Repeated harmful acts 2. Imbalance of power

EFFECTS ON BULLIES

Bullying is often a warning sign that children and teens are heading for trouble and are at risk for serious violence. Teens (particularly boys) who bully are more likely to engage in other antisocial/delinquent behavior (e.g., vandalism, shoplifting, truancy, and drug use) into adulthood. They are four times more likely than nonbullies to be convicted of crimes by age 24, with 60 percent of bullies having at least one criminal conviction.

PLAYGROUND SCHOOL BULLYING STATISTICS

EVERY 7 MINUTES A CHILD IS BULLIED

MORE YOUTH VIOLENCE OCCURS ON SCHOOL GROUNDS AS OPPOSED TO ON THE WAY TO SCHOOL

ADULT INTERVENTION: 11%   PEER INTERVENTION: 4%   NO INVERVENTION: 85%

WORST STATES TO LIVE IN FOR BULLYING K-12

1 OUT OF 4
STUDENTS WILL BE ABUSED BY ANOTHER YOUTH

1 OUT OF 5
ADMIT TO BEING A BULLY, OR DOING SOME "BULLYING"

SOURCES:
HTTP://WWW.COPS.USDOJ.GOV
WWW.KEEPSCHOOLSSAFE.ORG
WWW.BULLYPOLICE.ORG

PRODUCED BY:
BUCKFIRE & BUCKFIRE PC
WWW.BUCKFIRELAW.COM

http://bit.ly/studentbullyingfacts

How To Make Effective Infographic

Five steps (from Venngage.com)

1. Outline the goals of your infographic
2. Collect data for your infographic
3. Visualize the data for your infographic
4. Layout your infographic using an infographic template
5. Add style to your infographic design

STEP 1: OUTLINE YOUR GOALS

Use the question pyramid

1 Burning Problem
The main question the infographic will answer.

2-3 Supporting Questions
Questions to provide information (what, which).

1-2 Probing Questions
Questions to provide insight (why).

Question Pyramid
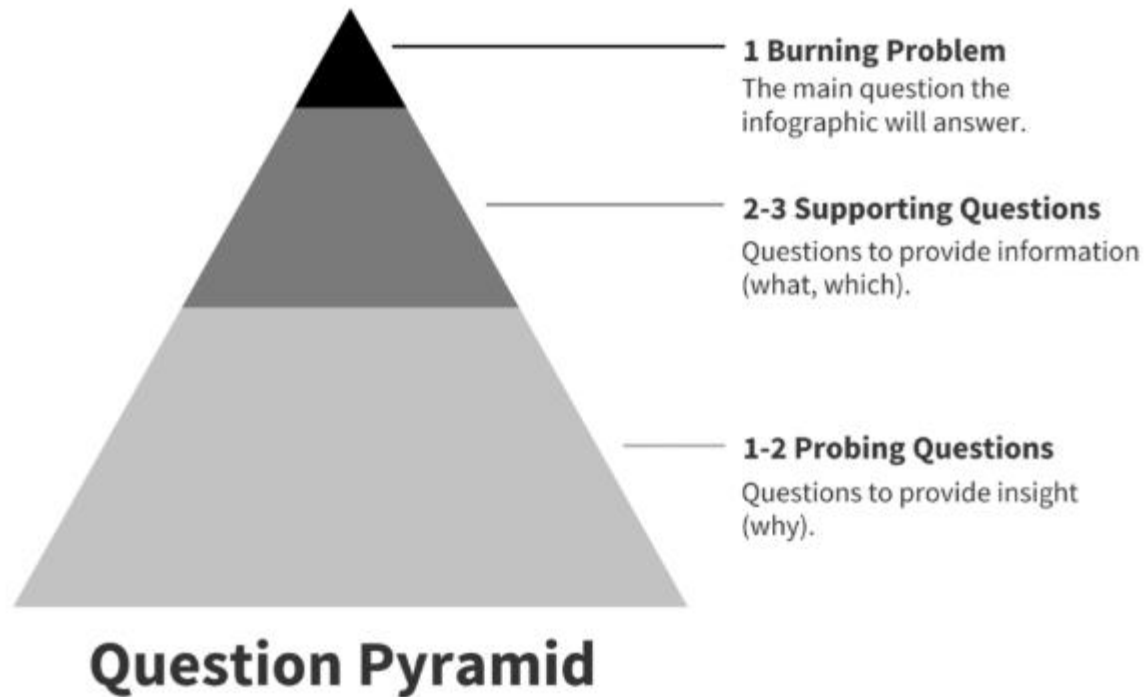
EXAMPLE: FOOD – WINE PAIRING

Burning Problem
How to pair food and wine

Supporting Questions
Which food components matter?
What are the types/categories of wine?
Which category works with each
component?

Probing Questions
Why do certain pairings work better?

INFOGRAPHIC

STEP 2: COLLECT THE DATA

We discussed this

Step 3: Visualize the Data

Decide what are your primary goals
- what data aspect do you want to convey

The ICORE method
- **I**nform,
- **C**ompare,
- **C**hange,
- **O**rganize,
- **R**eveal relationships, or
- **E**xplore.

Venngage.com

Inform

Convey an important message or data point that doesn't require much context to understand

Make a numerical stat stand out with large, bold, colorful text:

The brain makes

700

neural connections per second before the age of 5.

Demand extra attention by pairing icons with text:

4200 VACCINES ADMINISTERED

Highlight a percentage or rate with a donut chart or a pictograph:

25% WERE CHILDREN

25% WERE CHILDREN

COMPARE

Show similarities or differences among values or parts of a whole

BAR CHART **COLUMN CHART** **BUBBLE CHART** **BUBBLE CLOUD**

Use a pie chart, donut chart, pictograph, or tree map to compare parts of a whole.

PIE CHART **DONUT CHART** **PICTOGRAM** **TREEMAP**

Use a stacked bar chart or stacked column chart to compare categories *and* parts of a whole.
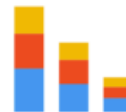
STACKED COLUMN CHART **STACKED BAR CHART**

Use a stacked area chart to compare trends over time.

STACKED AREA CHART

CHANGE

Show trends over time or space

Use a line chart or an area chart to show changes that are continuous over time.

LINE CHART   **AREA CHART**

Use a timeline to show discrete events in time.

TIMELINE

Use a choropleth map to show spatial data.

CHLOROPLETH MAP

Use a map series to show data that changes over both space and time.

MAP SERIES

ORGANIZE

Show groups, patterns, rank or order

Use a list to show rank or order when you want to provide extra information about each element.

LIST

1 —
2 —
3 —

Use a table to show rank or order when you want readers to be able to look up specific values.

TABLE

Cars	Motorcycles	Phones
BMW	Suzuki	Lenovo
Aston Martin	Yamaha	Samsung
Bentley	Harley Davidson	Huawei

Use a flowchart to show order in a process.

FLOWCHART

Otherwise, show rank or order with a bar chart, column chart, bubble chart, or pyramid chart.

BAR CHART   **COLUMN CHART**   **BUBBLE CHART**   **PYRAMID**

RELATIONSHIP

Reveal more complex relationships among things

Use a scatter plot when you want to display two variables for a set of data.

SCATTERPLOT

Use a multi-series plot when you want to compare multiple sets of related data.

MULTI-SERIES PLOT

Venngage.com
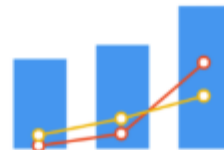
Explore

Add interaction

- filtering, sorting, and drilling down
- can't do with a static chart
- but useful for online infographics displays
- will discuss later

Step 4: layout

Create a natural flow

- could use the question pyramid to guide the layout
- burning question into header
- follow with charts to address the supporting questions
- finish with the probing questions

Use a grid layout

- guides the reader's eye
- symmetrical grid
- consider that people read
  - top to bottom
  - left to right

1 COLUMN   2 COLUMN   3 COLUMN   4 COLUMN

MULTI-ROW   3 SECTION   4 SECTION   5 SECTION
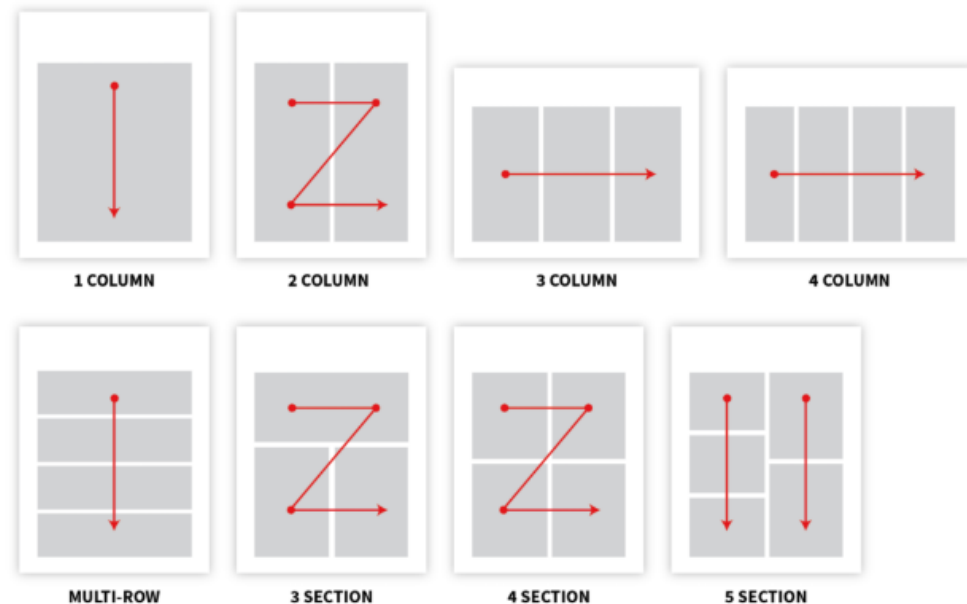
ONE COLUMN FOR LINEAR FLOW

Two Columns for Comparisons

Venngage.com

Two Column Example

Who Said What?

Democrats | Number of times words were used | **Republican**

Democrats:
- Character:11
- Jobs:14
- War:9
- McCain:18
- God:6
- Bush:18
- Hurricane:8
- Iraq:12
- Economy:16
- Change:24

Republican:
- God:25
- Character:14
- Energy:18
- War:18
- Bush:6
- Economy:18
- Tax(es):22
- Terror:12
- Jobs:8
- Iraq:15
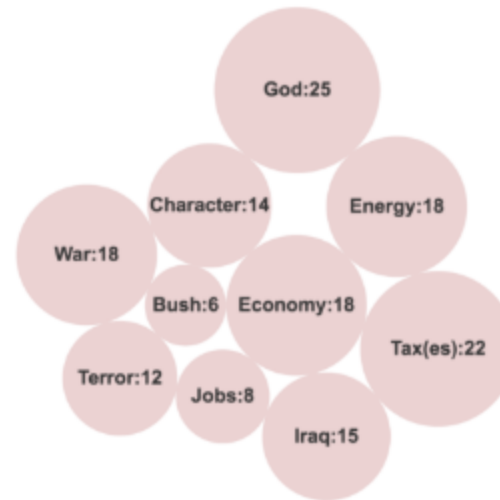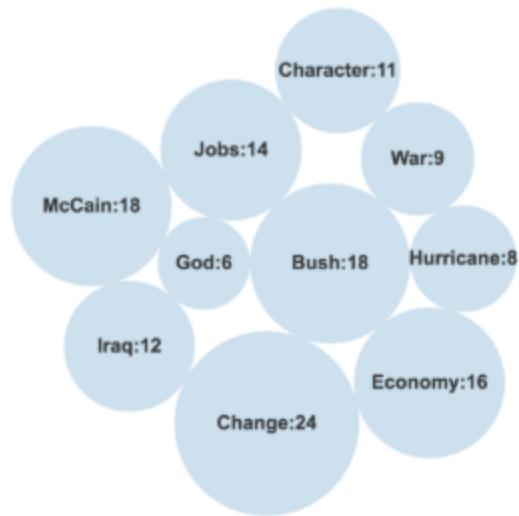
The Words They Used - Graphic - NYTimes.com

Three Column Example

CLEAN WATER SYSTEMS

2.64 Billion
people around the world do not have access to adequate sanitation

780 Million
people do not have access to improved water sources

Every $1
spent on water and sanitation generates at least $4 in increased productivity

SOURCE

Multi-Section Layout For Random Visual Access
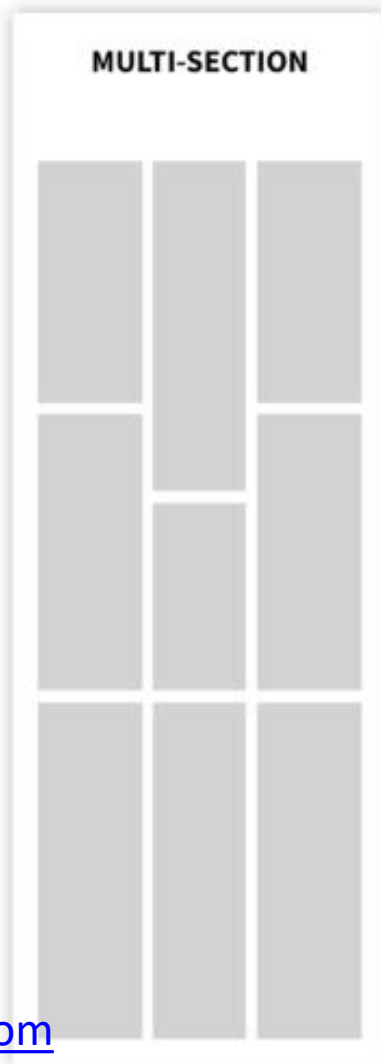
STEP 5: ADD STYLE

Overall goal
- make your infographics aesthetically pleasing
- make it easy to consume and understand

Minimize text
- should supplement the visuals
- short paragraphs (at most) at about a grade six reading level

Use font to point out importance
- readable font for the bulk of the text,
- amp up size and style of your main header, section headers, and data highlights
- make sure that the gist of your infographic is immediately apparent

EXAMPLE

Repetition, Consistency, and Alignment

Repeat basic shapes to reinforce the underlying grid

Venngage.com
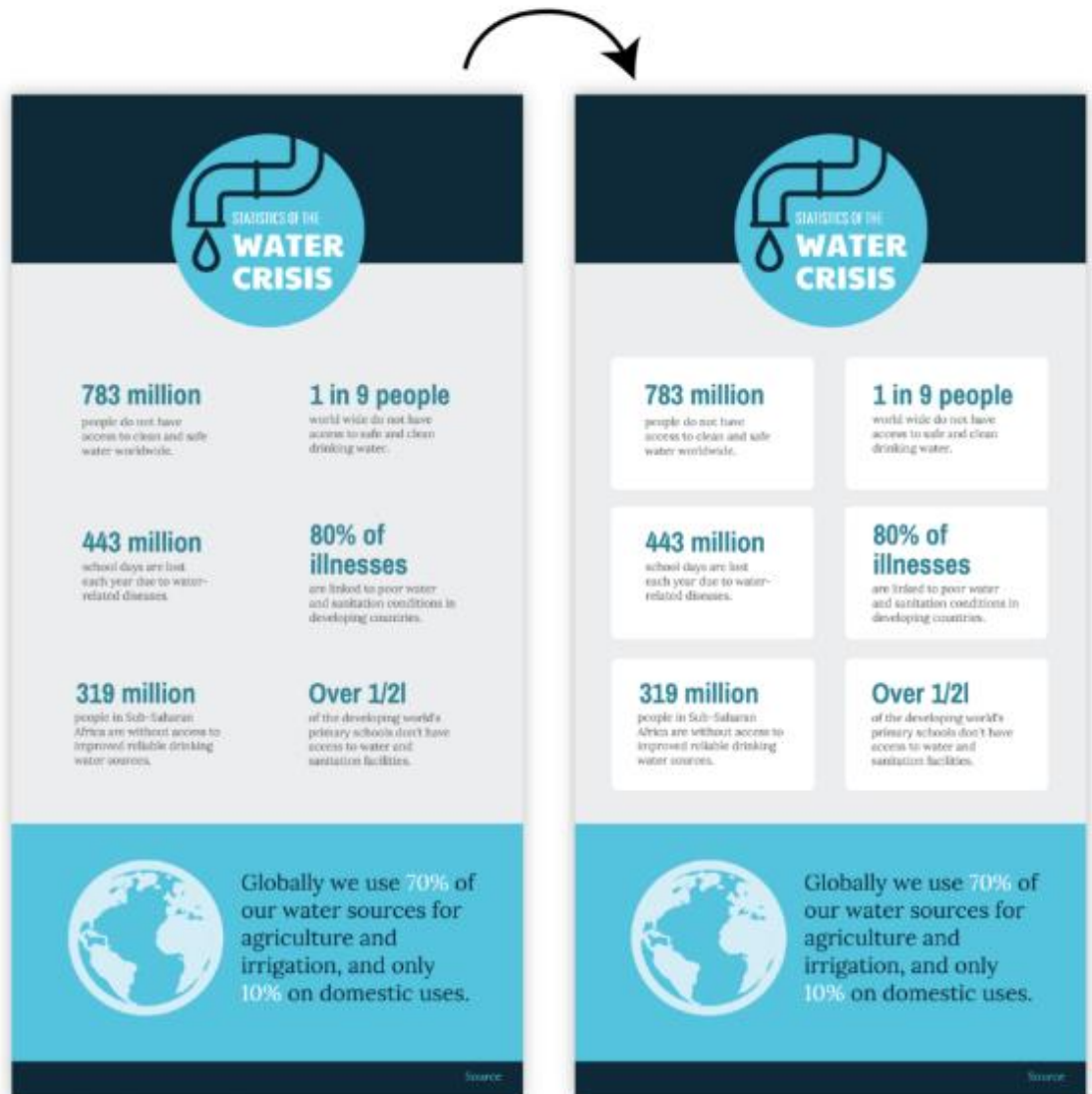
Emphasize Using Shapes

Use basic shapes to emphasize headers and list elements

Venngage.com

Use Icons

Add icons to reinforce important concepts in the text

- keep icon color, style, and size consistent
- pull everything together with extra background shapes
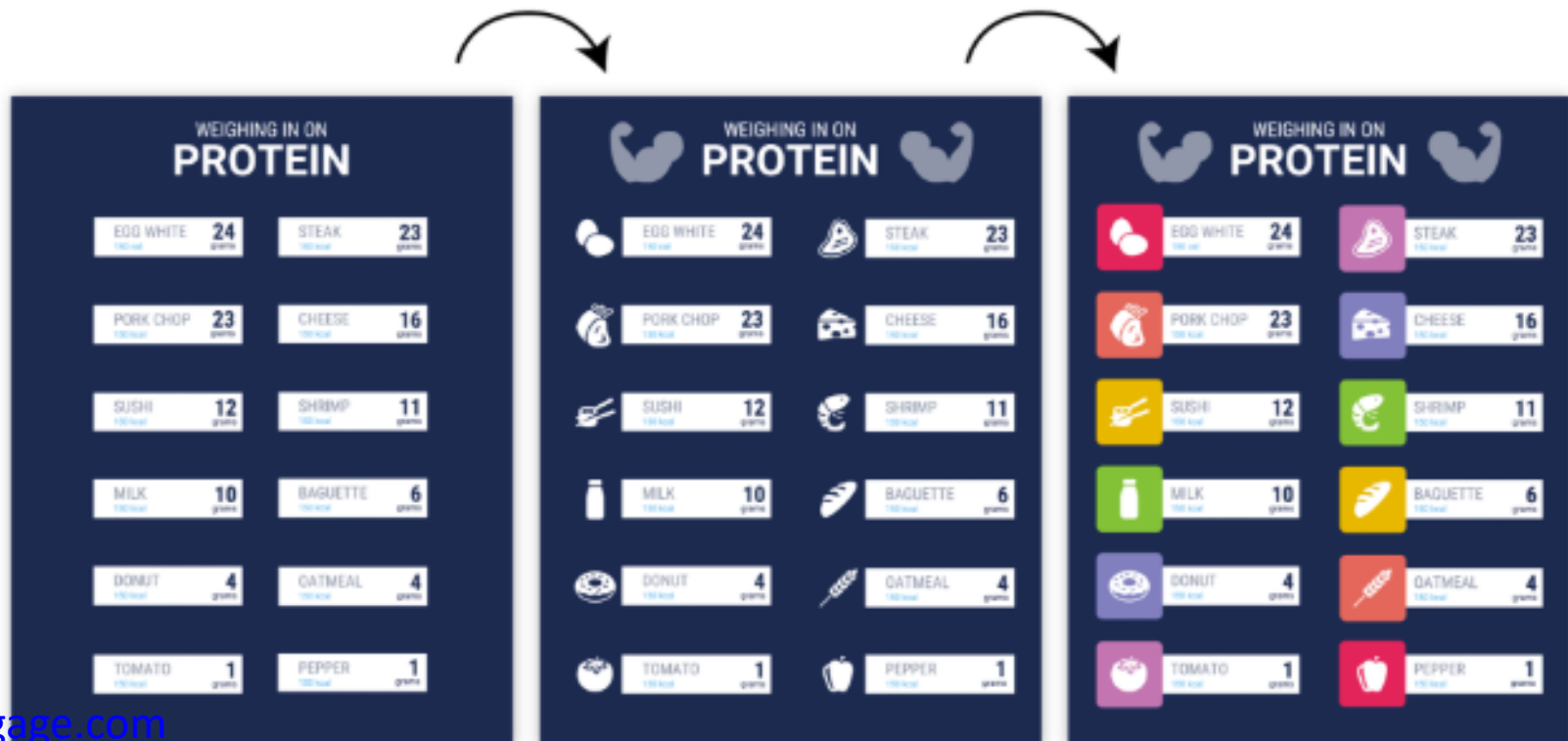
BE Diligent

Make sure the repeated elements you add are aligned!
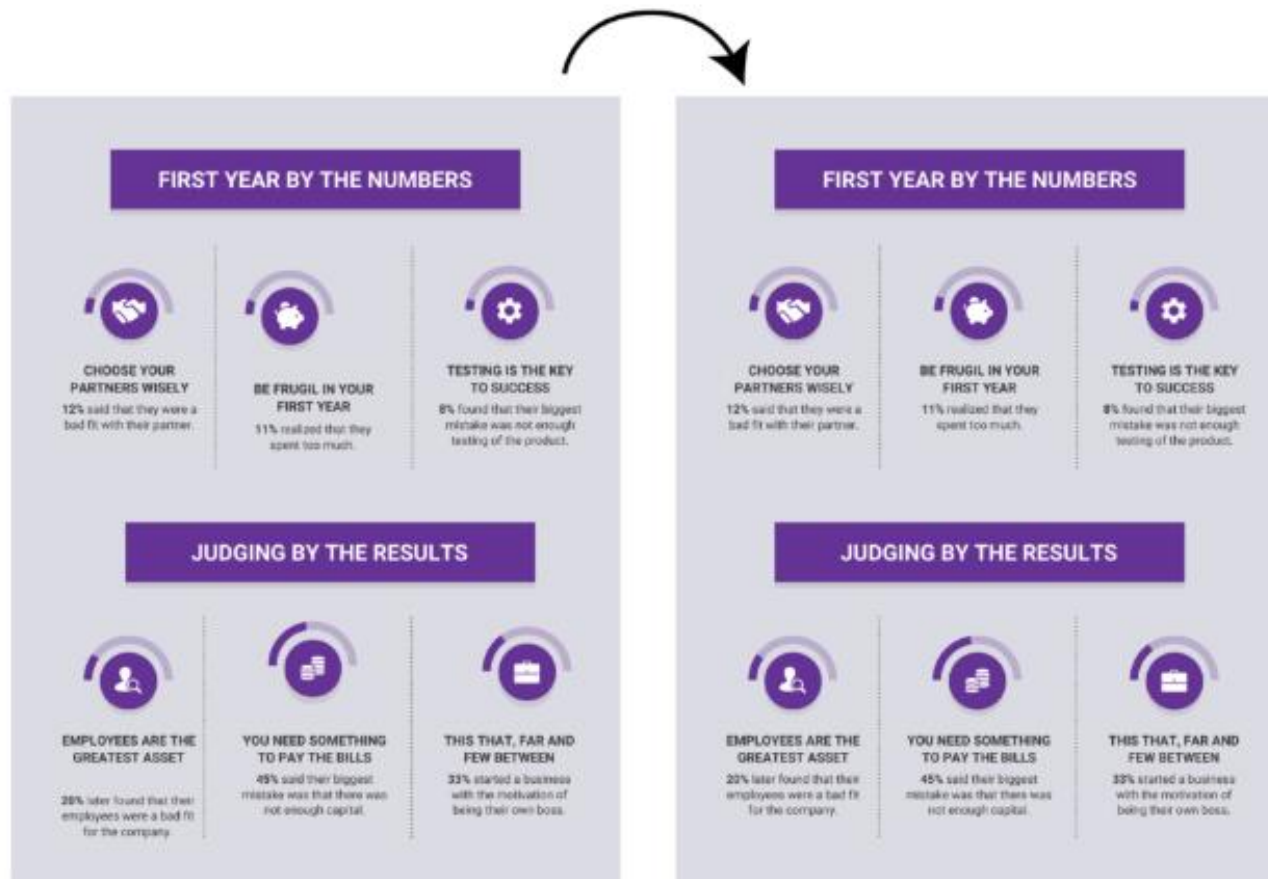
NEGATIVE SPACE

Negative (white) space is often used in advertising

- the space around and between the subject of an image
- helps to define a subject
- helps emphasizing a message

Negative Space in Infograpics

Just as important as any other element of a design

- simplest negative space are margins around the graphics
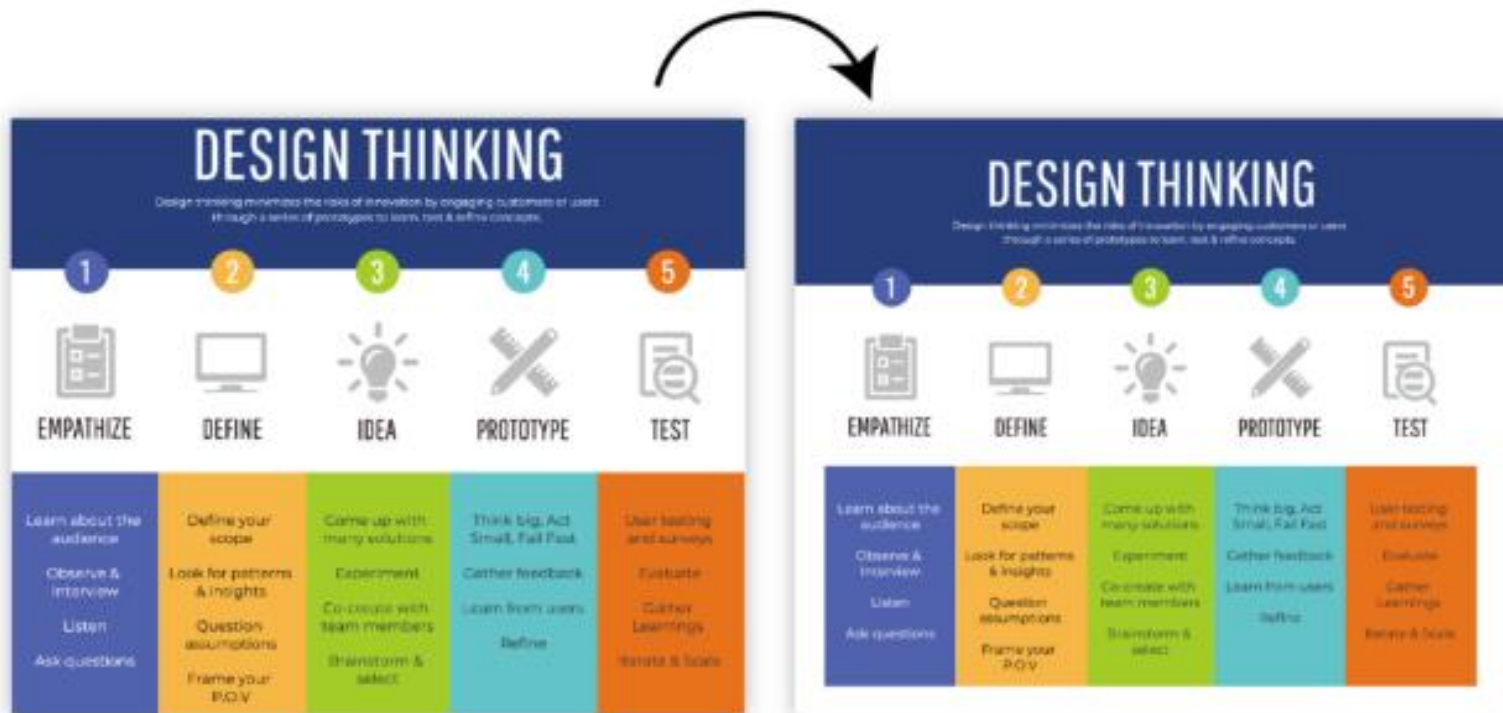
Negative Space: Gaps

Use gaps between unrelated elements

- makes it easier to immediately understand which elements are grouped together

Venngage.com

Negative Space: Color Interaction

Much easier to make colors play nicely with each other by adding a little whitespace
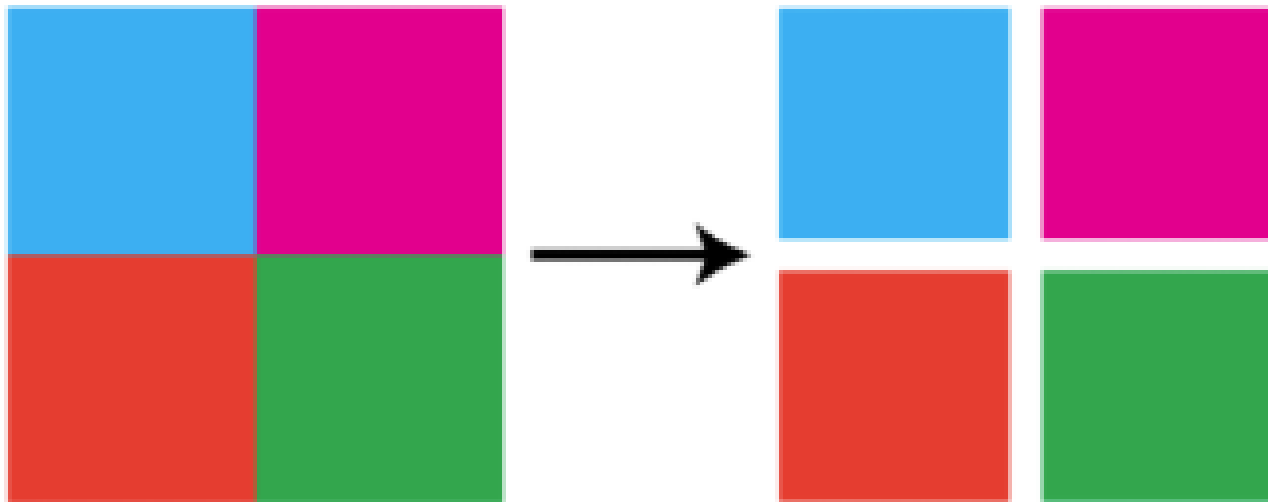
Color for Highlighting

Use color to highlight important information

Color for Grouping

Use color to group related elements together

NEUTRAL COLORS

Use neutrals to offset bright colors

- helps put together a composition
- can group in a more subtle way
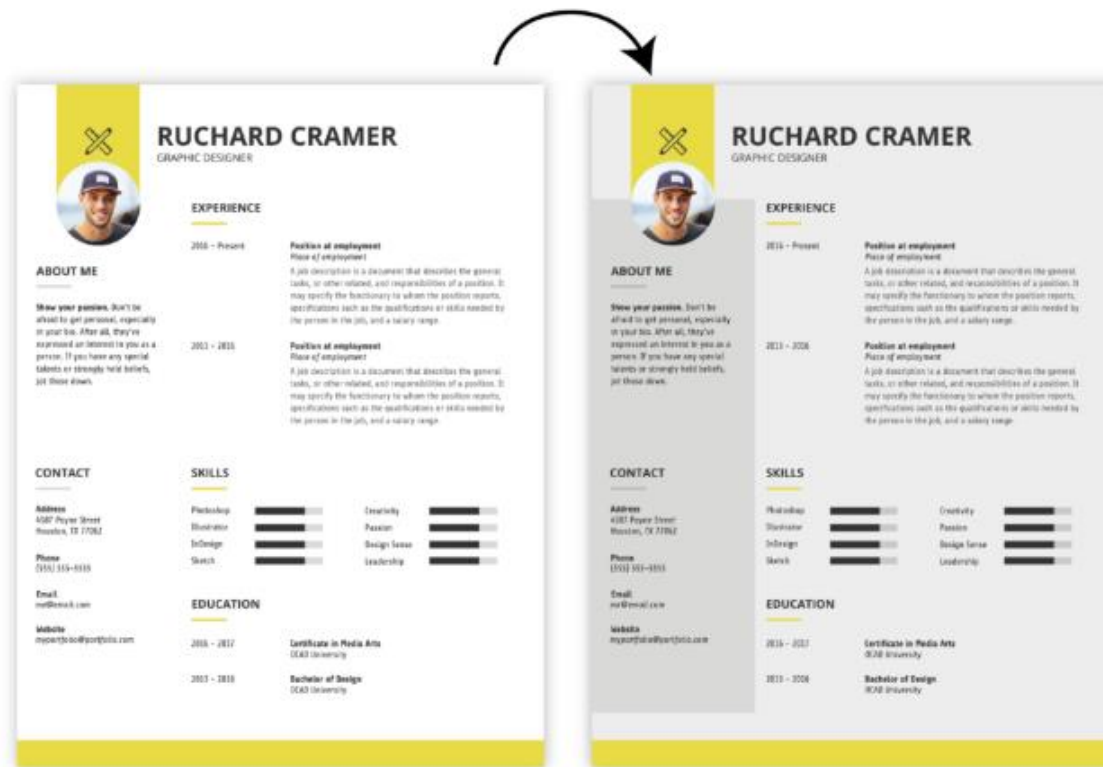
COLOR PALETTES

rich & polished

#B42F32	#DF6747	#E3E3CD	#878D92	#49494D

brilliant blues

#37AFA9	#2D8E87	#0C695D	#E0F2F2	#152329

baroque luxury

#A11E22	#E8A631	#E0C098	#E5E4DA	#BFB0B3

gracefully modern

#FAAC77	#C9C9BD	#F0EFEE	#606B6F	#333C3E

sunny & warm

#DA5526	#F6893D	#FEBC38	#D8C6B4	#697F90

classic & trustworthy

#CA3542	#27647B	#849FAD	#AEC0C9	#57575F

Venngage.com
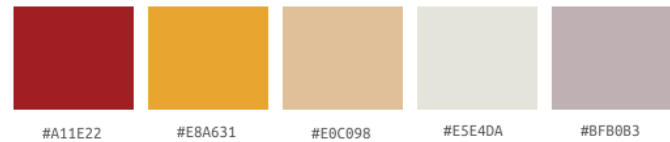
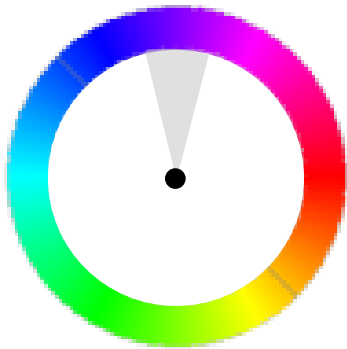# There are Templates on the Web
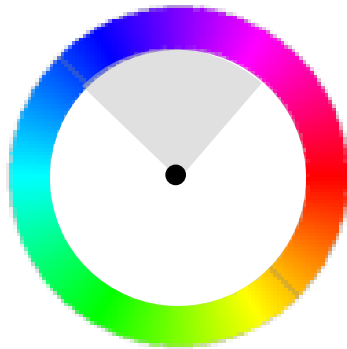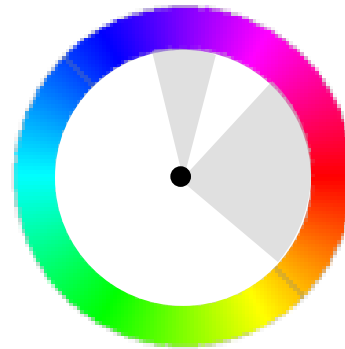
Color Harmony

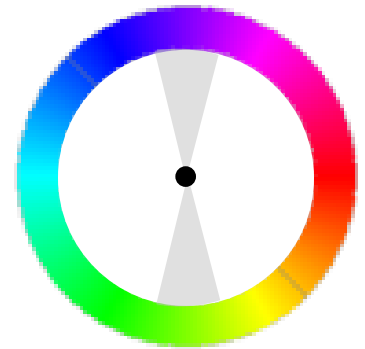Non-harmonic colors
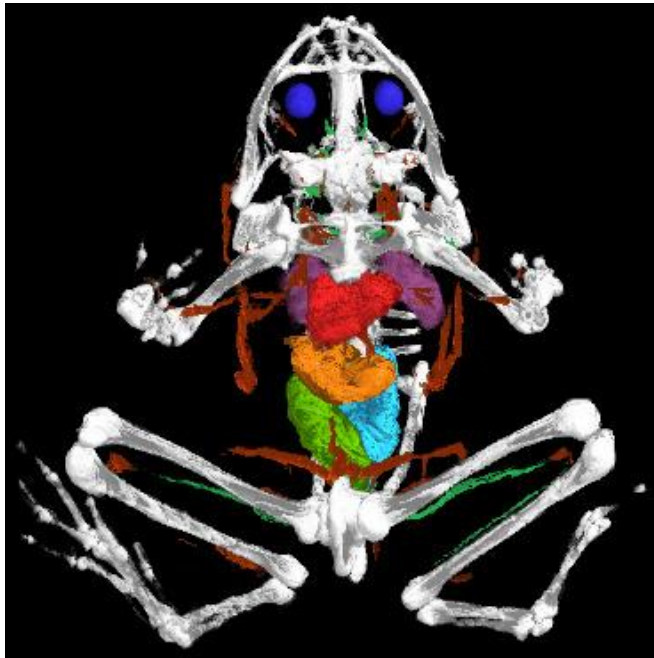
Harmonic colors
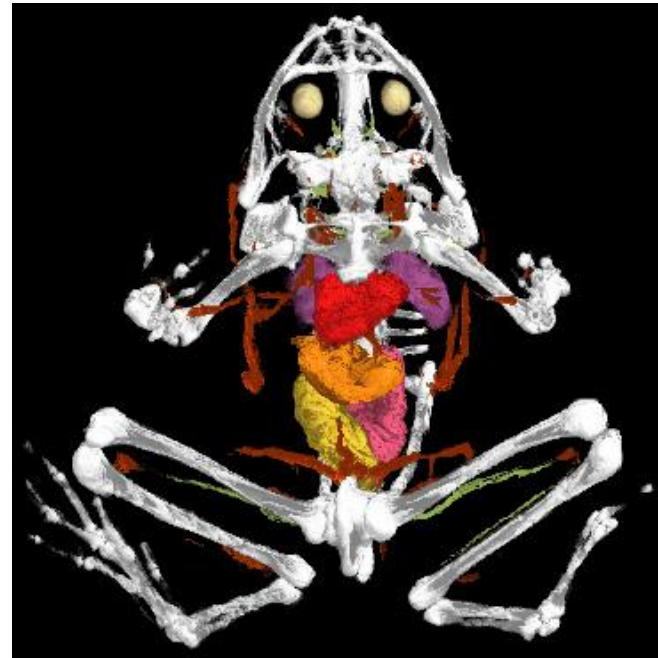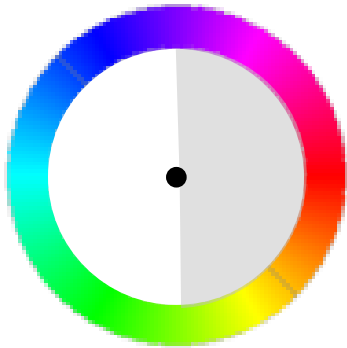

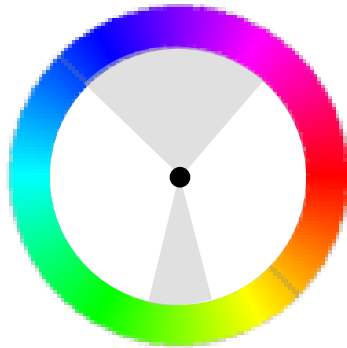Hue wheel:
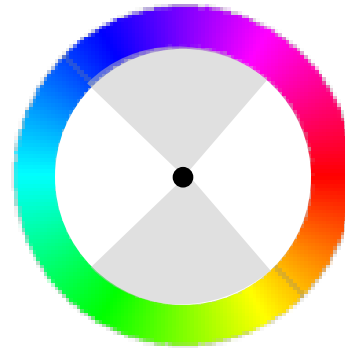
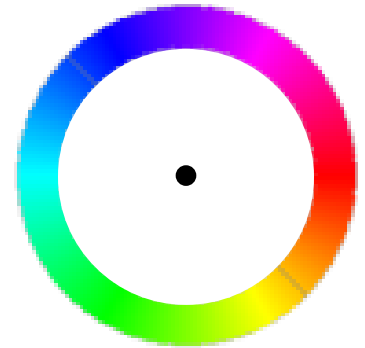# Harmonic Color Schemes

i type

V type

L type

I type

T type

Y type

X type

N type

COLOR HARMONIZATION PROCEDURE (1)

Given arbitrary hue histogram H(p) for image X, find the closest harmonic template T_m

- minimize the distance of the histogram to template coverage (delineated by template edges E)
- use an optimization procedure for this
- also find the orientation angle α

$$F(X(m,\alpha)) = \sum_{p \in X} \| H(p) - E_{T_m(\alpha)}(p) \| \cdot S(p)$$

non-harmonic   harmonized
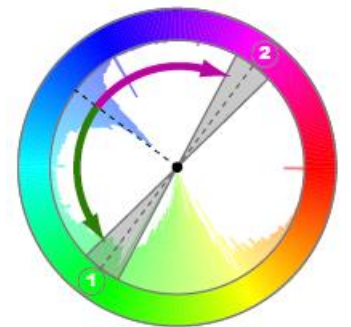
from Cohen '08

Color Harmonization Procedure (2)

Given closest template and α has been found (user may specify other template)

- shift all hues H(p) to the closest harmonic template position H'(p) with width w

- a Gaussian G controls the clustering of the hues around the sector mean C of the template (greater σ clusters more, we use w/2)

$$H'(p) = G(p) + \frac{w}{2}(1 - G_\sigma(\|H(p) - C(p)\|))$$

This may break up coherent regions into disjointly colored regions

- to avoid this, may embed a graph-cut labeling into the shifting procedure

from Cohen '08

Color Harmonization: Example

Collage harmonization (from Cohen '06):

non-harmonic   harmonized (T type)

COLOR HARMONIZATION: EXAMPLE

Collage harmonization (from Wang '08):