UNDERSTANDING LUNAR CYCLES

NODAL PRECESSION
18.6 YEARS

APSIDAL PRECESSION
8.9 YEARS

PHASE
29.5 DAYS

DISTANCE
27.5 DAYS

EARTH-MOON RELATIVE SIZE

LUNAR SHAPE

SQUARE

CIRCLE

LUNAR MOOD

GOOD

BAD

PHASE × DISTANCE

SUPERMOON

SUPER BLOOD MOON

DIRE MOON

TWO-WEEK WINDOW IN WHICH ASTROLOGY WORKS

HARVEST MOON

BLUE MOON

SKINNY JEANS POPULAR

GOLDEN AGE OF TV

TOTAL ECLIPSE OF THE SEA

(imgs.xkcd.com/comics/lunar_cycles.png)
Hi.

I’m Alyssa Goodman.

Robert Wheeler Willson Professor of Applied Astronomy at Harvard
co-Director for Science at the Radcliffe Insitute for Advanced Study
PI of the WWT Ambassadors Program

Visualization Devotee

and to “see” where you’re coming from...

pollev.com/alyssagoodma791

or

SMS ALYSSAGOODMA791 to 37607, then ABC
Why am I so devoted to (good) visualization?
"Visualization-Poor" vs "WWT/Visualization-Rich"

"Cooler than ‘Call of Duty’"
Better than Call of Duty for Exploring and Explaining Data
Data in Context & Storytelling with Data

worldwidetelescope.org
Galileo’s 3D thinking, in WorldWide Telescope

Notes for & re-productions of Siderius Nuncius

On the third, at the seventh hour, the stars were arranged in this sequence. The eastern one was 1 minute, 30 seconds from Jupiter; the closest western one 2 minutes; and the other western one was 10 minutes removed from this one. They were absolutely on the same straight line and of equal magnitude.

On the fourth, at the second hour, there were four stars around Jupiter, two to the east and two to the west, and arranged precisely on a straight line, as in the adjoining figure. The easternmost was distant 3 minutes from the next one, while this one was 40 seconds from Jupiter. Jupiter was 4 minutes from the nearest western one, and this one 6 minutes from the westernmost one. Their magnitudes were nearly equal, the one closest to Jupiter appeared a little smaller than the rest. But at the seventh hour the eastern stars were only 30 seconds apart. Jupiter was 2 minutes from the nearer eastern one, while he was 4 minutes from the next western one, and this one was 1 minute from the westernmost one. They were all equal and extended on the same straight line along the ecliptic.

On the fifth, the sky was cloudy. On the sixth, only two stars appeared flanking Jupiter, as is seen in the adjoining figure. The eastern one was 2 minutes and the western one 3 minutes from Jupiter. They were on the same straight line with Jupiter and equal in magnitude. On the seventh, two stars stood near Jupiter, both to the east, arranged in this manner.
Galileo’s New Order, A WorldWide Telescope Tour by Goodman, Wong & Udomprasert 2010

WWT Software Wong (inventor, MS Research), Fay (architect, MS Research), et al., now open source, hosted by AAS

see wwtambassadors.org for more on WWT Outreach

Data in Context & Storytelling with Data
Data in Context & Storytelling with Data
Historical Images on the Sky (see also adsass.org)

Data in Context & Storytelling with Data
Orion, Viennese Style
a WorldWide Telescope Tour to accompany the physical 3D model of Orion created collaboratively by expert astrophysicists at 'Orion (Un)Plugged,' held at the University of Vienna, July 2015

with original medieval harp musical 'interdimensional' tribute to Orion by Scott Wallace

Data in Context & Storytelling with Data
Technology is only ONE tool (which is often best when it complements analog approaches).
Visualization “Types”

DATAGRAPHICS

INFOGRAPHICS

DASHBOARDS

Q. How much interactivity is optimal in what setting?
DATAGRAPHICS

WorldWide Telescope

Between Series in an Excel XY Chart
mrexcel.com

Scatter plot

XY Scatter chart with quadrant
taylyn.com

Extracting points from a Graph (X-Y...)
youtube.com

simple XY Scatter Chart in PowerPoint
free-power-point-templates.com

X and Y axis in scatter chart ...
extendedoffice.com

tensionX = 0.9
tensionY = 1

Screenshot
<table>
<thead>
<tr>
<th></th>
<th>LHR</th>
<th>BOS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flight</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Airport</strong></td>
<td>London Heathrow</td>
<td>Boston</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>Mon, 8 July</td>
<td>Mon, 8 July</td>
</tr>
<tr>
<td><strong>Departed</strong></td>
<td>17:13</td>
<td>19:23</td>
</tr>
<tr>
<td><strong>Terminal</strong></td>
<td>5</td>
<td>E</td>
</tr>
<tr>
<td><strong>Gate</strong></td>
<td>B35</td>
<td></td>
</tr>
<tr>
<td><strong>Scheduled departure</strong></td>
<td>16:55</td>
<td>19:35</td>
</tr>
</tbody>
</table>

Sources: FlightStats, OAG
$100 for an FBI file?
Mars Rover data in (glue-like, linked-view) “CODAP” from Concord Consortium, intended for K12
Visualization “Types”

DATAGRAPhICS

INFOGRAPHICS

DASHBOARDS

Q. How much interactivity is optimal in what setting?
In 1687, Isaac Newton published his *Principia Mathematica* and inaugurated a revolution in physics that would reign supreme until the introduction of Einstein’s relativity in the early 20th century. Even though relativity shakes some of the foundations of Newtonian gravity, its modifications are negligible in nearly all Earth-bounded situations.

To this day, in classrooms all around the world, Newton’s principles and physics continue to be taught and undergird fundamental assumptions about how the universe works.

At the heart of Newton’s work was a rigorous definition and mathematical description of force. Up until this point, force was theorized qualitatively and used as a noun to describe something being acted upon by something else; however, with Newton, force became an entity unto itself. Since the days of...
Visualization “Types”

DATAGRAPHICS

INFOGRAPHICS

DASHBOARDS

Q. How much interactivity is optimal in what setting?
Visualization “Types”

DATAGRAPHICS

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Q. How much interactivity is optimal in what setting?
Q. How much interactivity is optimal in what setting?

The 10 Questions

1. **Who**  | Who is your audience? How expert will they be about the subject and/or display conventions?
2. **Explore-Explain**  | Is your goal to explore, document, or explain your data or ideas, or a combination of these?
3. **Categories**  | Do you want to show or explore pre-existing, known, human-interpretable, categories?
4. **Patterns**  | Do you want to identify new, previously unknown or undefined patterns?
5. **Predictions & Uncertainty**  | Are you making a comparison between data and/or predictions? Is representing uncertainty a concern?
6. **Dimensions**  | What is the intrinsic number of dimensions (not necessarily spatial) in your data, and how many do you want to show at once?
7. **Abstraction & Accuracy**  | Do you need to show all the data, or is summary or abstraction OK?
8. **Context & Scale**  | Can you, and do you want to, put the data into a standard frame of reference, coordinate system, or show scale(s)?
9. **Metadata**  | Do you need to display or link to non-quantitative metadata? (Including captions, labels, etc.)
10. **Display Modes**  | What display modes might be used in experiencing your display?

Now, visit the 10QViz conversation! There’s so much more to talk about.

Curious about the **origins** of 10QViz? Try the **About** page.
Want to learn **how best to use** and **participate** in 10QViz? Try the **How to** page.
Want to read about the **scholarship** behind 10QViz.org’s questions? Try Coltekin & Goodman 2018.
For students who like to program, there are many open-source options to enable javascript interactivity, e.g. Google Charts (or d3, Vega, DASH ...)

https://developers.google.com/chart/interactive/docs/more_charts

Additional Charts Gallery

Our gallery provides a variety of charts which are optimized to address your data visualization needs. These charts are based on pure HTML5/SVG technology (adopting VML for old IE versions) so no plugins are required. Adding these charts to your page can be done in a few simple steps.

The main Gallery page can be found here.

Links below point to demonstrations of each chart. These charts are not necessarily HTML5 compliant. Note that links to third-party visualizations will take you off the Google site.

Annotated Time Line

An animated time series chart.

By: Google

CHAP Links Library

The CHAP Links Library is a web based visualization library for displaying graphs, networks, and timelines. The tools are developed as Google Charts for Javascript and GWT.

By: Almende

Drastic Treemap

A dynamic treemap in Flash.

By: DrasticData
# A Periodic Table of Visualization Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data Visualization</strong></td>
<td>Visual representations of quantitative data in schematic form (either with or without axes)</td>
</tr>
<tr>
<td><strong>Strategy Visualization</strong></td>
<td>The systematic use of complementary visual representations in the analysis, development, formulation, communication, and implementation of strategies in organizations.</td>
</tr>
<tr>
<td><strong>Information Visualization</strong></td>
<td>The use of interactive visual representations of data to amplify cognition. This means that the data is transformed into an image, it is mapped to screen space. The image can be changed by users as they proceed working with it.</td>
</tr>
<tr>
<td><strong>Metaphor Visualization</strong></td>
<td>Visual Metaphor position information graphically to organize and structure information. They also convey an insight about the represented information through the key characteristics of the metaphor that is employed.</td>
</tr>
<tr>
<td><strong>Compound Visualization</strong></td>
<td>The complementary use of different graphic representation formats in a single schema or frame.</td>
</tr>
</tbody>
</table>

**Processes and Visualizations**

- **Cy**: Process Visualization
- **Hy**: Structure Visualization
- **Overview**: Overview
  - Detail
  - Detail AND Overview
- **Divergent thinking**: Edgeworth box
- **Convergent thinking**: Portfolio diagram

Note: Depending on your location and connection speed it can take some time to load a pop-up picture.

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THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION

The classic book on statistical graphics, charts, tables. Theory and practice in the design of data graphics, 250 illustrations of the best (and a few of the worst) statistical graphics, with detailed analysis of how to display data for precise, effective, quick analysis. Design of the high-resolution displays, small multiples. Editing and improving graphics. The data-ink ratio. Time-series, relational graphics, data maps, multivariate designs. Detection of graphical deception: design variation vs. data variation. Sources of deception. Aesthetics and data graphical displays.

This is the second edition of The Visual Display of Quantitative Information. Recently published, this new edition provides excellent color reproductions of the many graphics of William Playfair, adds color to other images, and includes all the changes and corrections accumulated during 17 printings of the first edition.
The Path to Newton

Alyssa Goodman,
Jais Brohinsky,
Drew Lichtenstein
& Katie Peek

on behalf of Harvard University

tinyurl.com/aas-path-to-newton