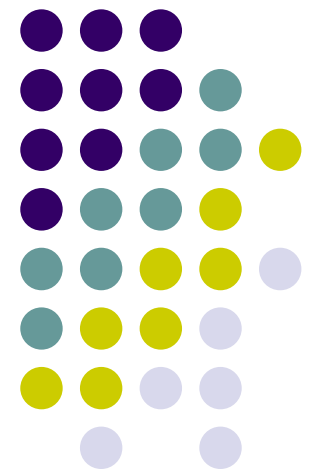


Laboratory and Data Management for Scientists

David L. Blum, Ph.D.
Research Assistant Professor
Department of Biochemistry





OUTLINE

- Project Management
 - Choosing the right project
 - Project Plans
 - Project Management tools
- Data Management
 - Record Keeping
 - Inventory
 - Number crunching

Project Management



“

Project management helps you efficiently use your research funds, personnel, and time to publish research papers, obtain funding, and be promoted.

—Milton Datta, Emory University School of
Medicine

”

Choosing the right project



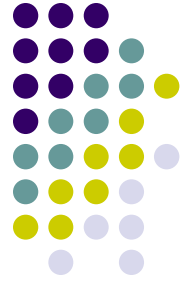
- Be publication oriented
- Keep goals/deliverables in mind
- Have a timeline, but be flexible
- Make sure key materials/resources are available
- Access to samples
- Capital equipment



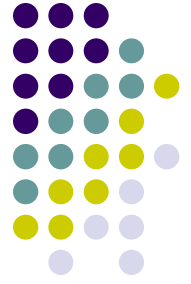
Statement of Work

- Purpose
 - Background
 - Scope of Work
- Objectives
 - Statement
 - Measures
 - Specifications
- Constraints
 - Limitations
 - Needs
- Assumptions

Audience - People affecting the success of your project



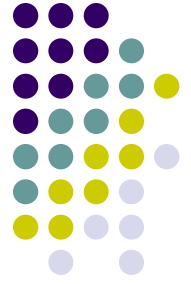
- Drivers - you, collaborators, editors
- Supporters - lab personnel
- Observers - colleagues



Project Plans

- To Gantt or not to Gantt?
- Critical Paths
- Deadlines (real or imaginary?)
 - Milestones
- Activities Plan
- Events Schedule
- Things not under your control
 - Plan for the worst hope for the best





GANTT charts

- Developed by Karol Adamiecki and published by Henry Gantt in 1910 (Harmonogram)*
- Allows users to map out project timelines and show dependency of tasks
- PERT (Program Evaluation and Review Technique) is another type of project management tool.
 - Activities represented by interconnected lines and nodes instead of horizontal lines (GANTT)

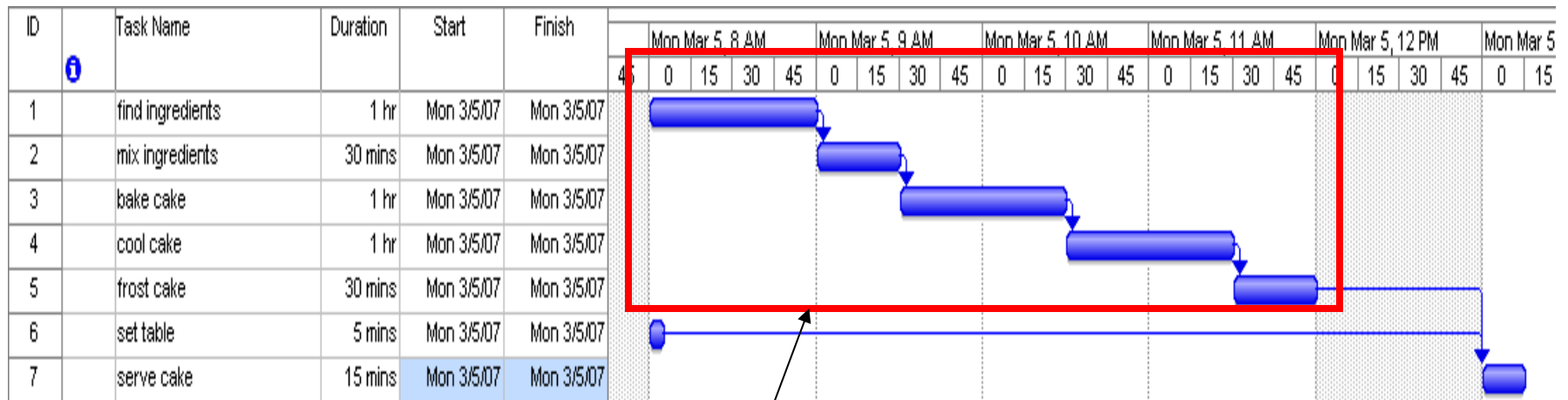
*<http://en.wikipedia.org/wiki/Gantt>



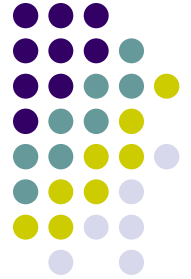
GANTT Chart Definitions

- Task - An action in a project plan
- Link - a way to visually show a connection between 2 adjacent tasks
- Critical Path - sequence of events denoted the minimum time to complete a project
- Milestone - event marking a significant change in development
- Finish to Start - Common way how 2 tasks are linked

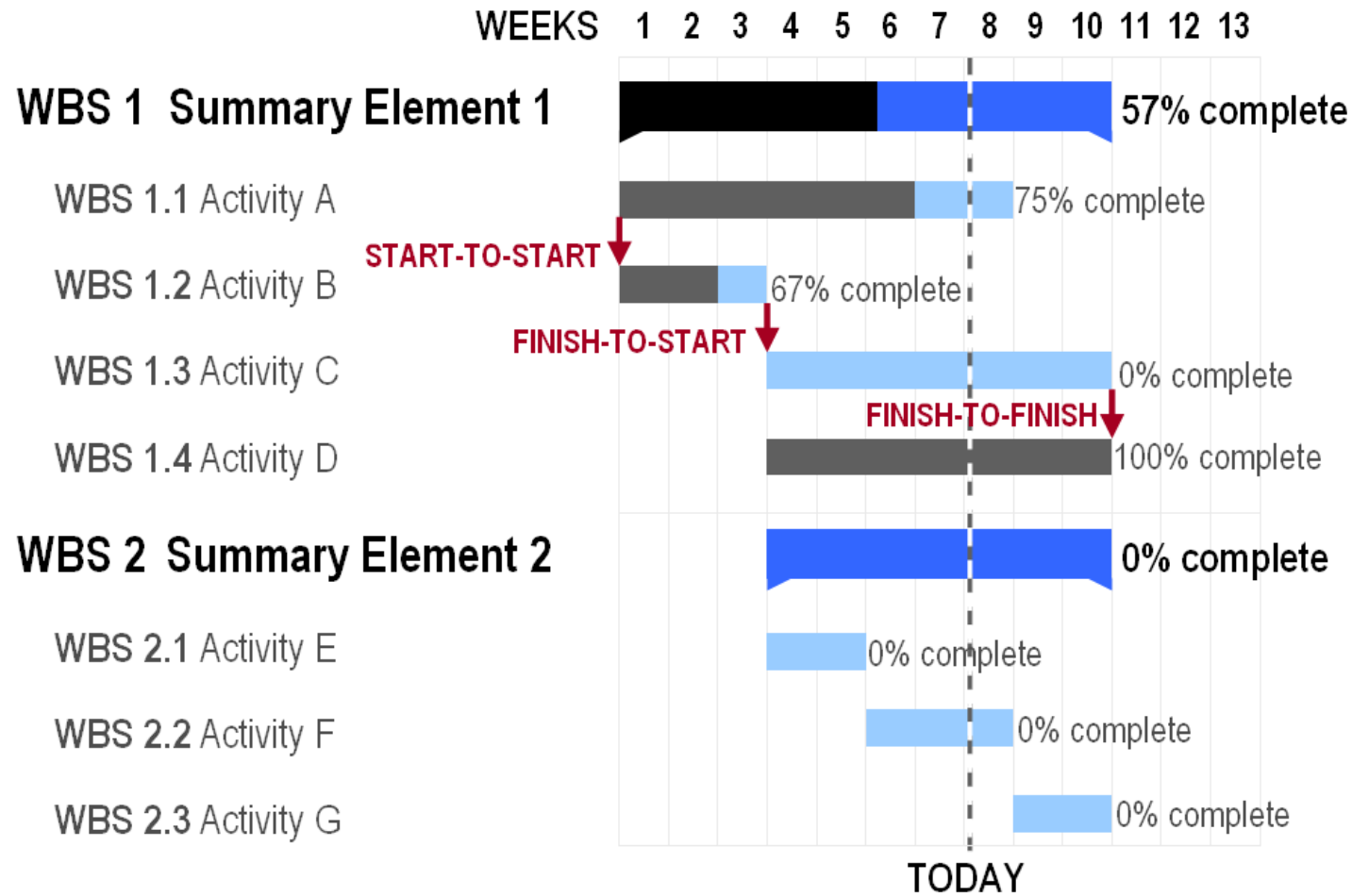
Simple GANTT Chart



Critical path



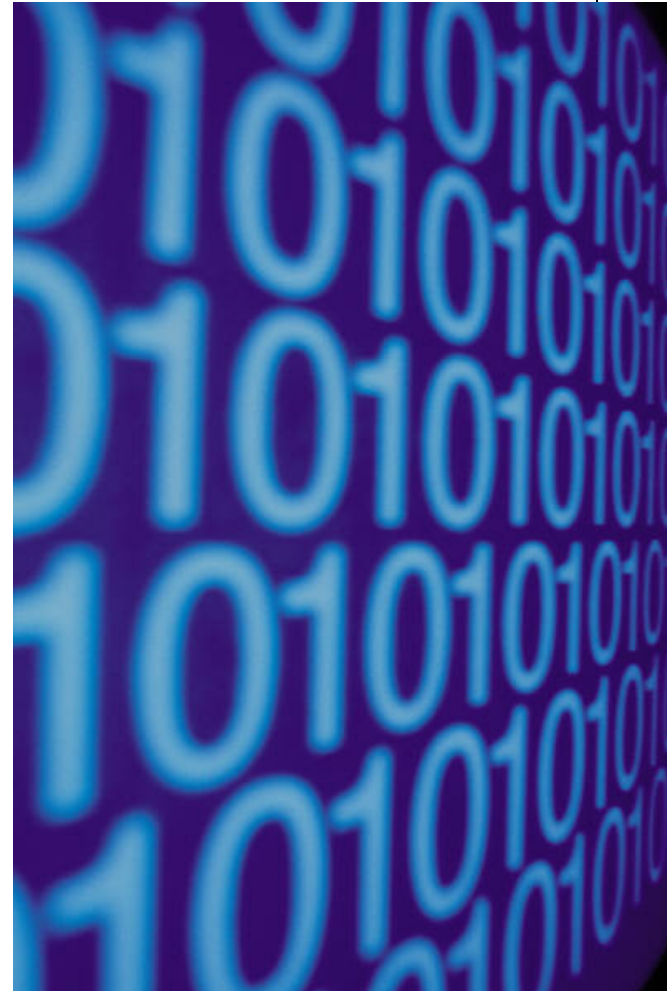
GANTT Chart



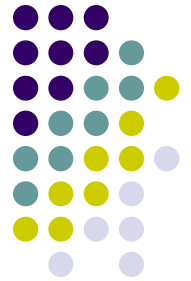
Project Management Software



- Gantt Charts
 - MS Project
 - OmniPlan (Mac)
 - ProPlanning (Mac)
 - MS Excel et al.
- Calendar or event schedulers (many)



Data Management



“

Enter all your work in a notebook—even procedures that did not work.

—David Adams, Duke University Medical Center

Reading notebooks is a nonconfrontational way to keep current with your students' and postdocs' work, and notebooks are critical when these lab members leave.

—Joseph Vinetz, University of Texas Medical
Branch—Galveston

”



Record Keeping

- Notebooks
 - Electronic
 - Paper
 - Paper towel
- Journaling - The Lab Diary
- Protocols
- US Patents - first to invent
 - Cosigning of lab notebooks critical for establishing invention ownership



Electronic v. paper Notebooks



Electronic

- Initial software purchase
- Easy to search
- Can be shared remotely
- Resolves issues of poor handwriting
- Not all allow digital signing for patents
- Implementation and cost can be issue depending on the notebook

Paper

- Easy to use, but hard to search (requires TOC)
- Patent ready
- Scanned backups necessary in case of theft or damage
- Cost can be an issue depending on the notebook and number of projects



Lab notebook guidelines

- Use a permanently bound book and ink
- Use a table of contents
- Enter all observations and data directly into the notebook. Prettiness is not important.
- Each experiment should stand on its own
- Explain nonstandard abbreviations
- Periodically scan notebooks in case of loss or damage
- Cross through blank pages and large spaces



Notebook signing

- U.S. patent assignment - First to invent (FTI)
- ROW - First to file

Notebook witnessing

- Industry - all pages signed and witnessed
- Academia - learn what to sign
- Find out what works best for your lab



Patent dispute settlements

- Monsanto v. UC - UC awarded \$100 million
 - Bovine Somatotropin
- Genentech v. UC - UC awarded \$200 million
 - Human Growth Hormone
- Many Others
 - Inventorship timing based on when your notebook was cosigned not when you signed it!

Anatomy of a “Good” Lab Notebook

- Title for TOC
- Projects kept in separate notebooks
- Link to pages
- Verified (cosign)
 - Person not on same project
- Recorded by and date (FTI)

<http://www.snco.com/>

Page format for #3001
Book dimensions are 9.25 * 11.25 inches

TITLE _____ Project No. _____
Book No. _____ 25

From Page No. ____

Recorded by,	Date	Verified by,	Date	To Page No. ____
--------------	------	--------------	------	------------------

ELN software

Dedicated ELN software

- Kalabie
- SmartTea
- Contur
- ACS
- NeuroSys

Note taking programs

- MS OneNote
- MS Word/Excel
- NoteTaker/NoteShare



NoteTaker/NoteShare Software



example 3

My Electronic Notebook
2007 - Experiment 1A4

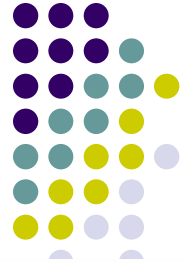
1 2 3 100% [tools]

- Monday, February 26, 2007 12:03:05 PM
- Purpose: Brief description of what I am trying to do
- Materials
 - Everything I need
 - Other stuff
 - more stuff for this experiment
 - B2643 Biotinamidohexanoic acid N-hydroxysuccinimide ester**
Sigma ≥98% (TLC), powder

O=C1NC(=O)N1CCCCCNC(=O)CCCCCCCC(=O)ON2C(=O)CCCC2=O

- Methods
 - Step 1
 - Step 2
 - Step 3
 - Step 4
- Results
 - | Sample | Sample 1 | Sample 2 | Sample 3 | Sample 4 | Sample 5 | Sample 6 |
|--------|----------|----------|----------|----------|----------|----------|
| 1 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 2 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 3 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 4 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 5 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 6 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 7 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 8 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 9 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 10 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 11 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 12 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 13 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 14 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 15 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 16 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.15 |
| 17 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.60 |
| 18 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.40 |
| 19 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.45 |
| 20 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.30 |
| 21 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.25 |
| 22 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.25 |
| 23 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.35 |
| 24 | 0.18 | 0.15 | 0.18 | 0.15 | 0.18 | 0.30 |
- [Link to more data](#)
- Conclusion
 - My experiment worked. Now I need to work on that Nobel Prize speech

Information Management

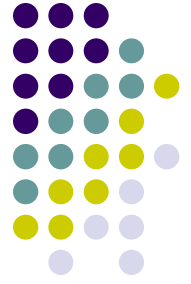


Track collaborators,
samples, chemicals, etc.

- Excel Spreadsheet
- Databases
 - Filemaker Pro (Mac&PC)
 - Access (PC only)
 - Alpha Five (PC only)
 - Paradox (PC only)
- Find out what works for you (benefit per time & effort)



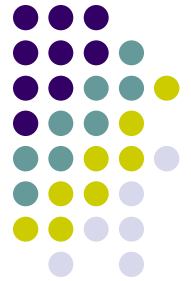
"We can't be out of mustard. I'm showing two bottles in the pantry, top shelf, on the left."



Relational Databases

- Collection of “related” tables
- Queries (searches) used to combine data from different tables
- Large tables (Excel has limits)
- Customizable forms for data entry
- Calculations
- Retail databases can be used for LIMS
- Only as good as the information in them
 - Be persistent
 - Make data entry part of lab culture

Database - Forms with Flair



Inventory

Browse

Layout: Form View

Record: 0

Total: 0

Unsorted

Inventory

View Inventory Report

New Delete Find

Item:

Category:

Location:

Serial #:

Note:

Picture

Acquired Info

Purchased: Age In Years:

From:

Cost: Inventory ID:

100 Browse

Database - Forms with Flair



lab-db

Contact Management

View Contact List | View Address Labels

New Delete Find Save as PDF Save as Excel

Record: 5
Total: 9
Unsorted

First Name: _____
Last Name: _____
Title: _____
Company: _____
Phones: _____
Email: _____
Notes: _____

Insert Picture
Export Picture

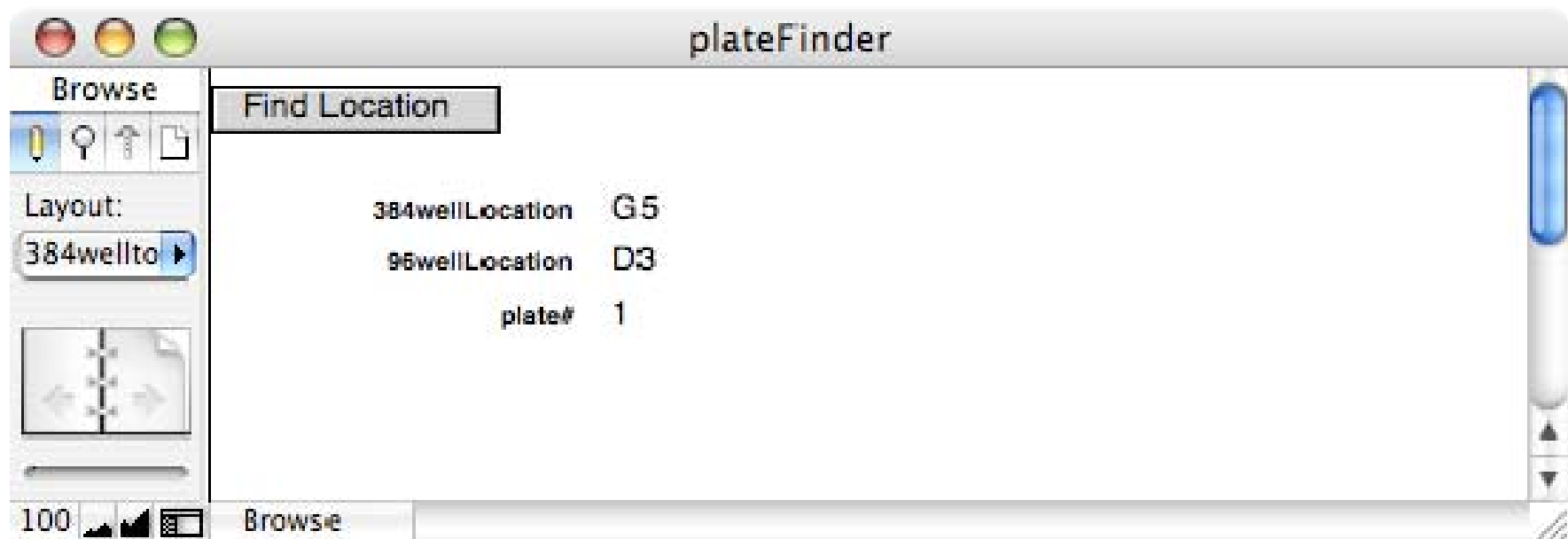
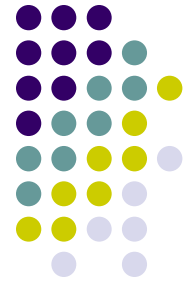
Main Address Second Address Related Contacts

Address Type: _____
Street: _____
City: _____
State: _____
Postal Code: _____

Swap with Second Address

100 Browse

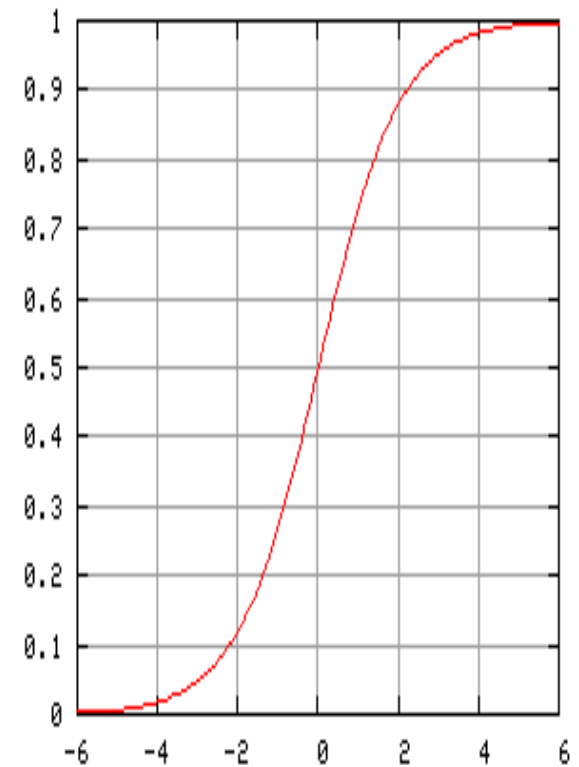
A Simple Database



Number Crunching

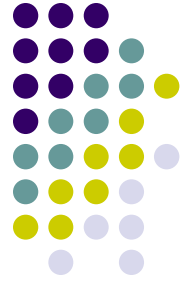


- Use Excel to make “templates” for analyzing the same type of experiment
 - Protein assays
 - ELISAs
- Use Prism (GraphPad) or SigmaPlot if you have sophisticated kinetics or other data patterns that don't fit a linear regression
 - Binding curves
 - Kinetics



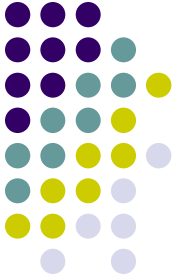


Making templates for repetitive tasks



- Use “paste link” function to copy data from 1 sheet to another
- Pasted data can be manipulated using graphs, formulas, etc.
- New data can be pasted without recreating graphs or formulas

Making templates for repetitive tasks



The screenshot shows an Excel spreadsheet with three columns of data. The first column (A) is labeled 'raw data' and contains values from 1.458 down to 0.085. The second column (G) is labeled 'analyzed data' and contains values from 0.692 down to 0.1. The third column (M) is labeled 'Sheet3' and contains values from 0.57 down to 0.101. A callout box highlights the value 1.458 in cell A1. The spreadsheet title is '061026SDS.xls'.

raw data	analyzed data	Sheet3
1.458	0.692	0.57
1.628	0.418	1.049
2.007	0.402	1.629
1.996	0.507	1.556
1.944	0.407	1.448
1.281	0.378	1.349
0.943	0.207	0.928
0.417	0.258	0.459
0.246	0.315	0.587
0.123	0.164	0.205
0.103	0.109	0.119
0.09	0.123	0.132
0.099	0.099	0.109
0.088	0.093	0.125
0.092	0.099	0.115
0.085	0.088	0.101
0.09	0.1	0.101
	0.101	
	0.099	
	0.114	
	0.103	
	0.114	
	0.121	
	0.095	
	0.122	
	0.106	
	0.106	
	0.103	
	0.103	

raw data analyzed data Sheet3

Slide 15 of 15



Using “Paste Link”

The screenshot shows an Excel spreadsheet with a table of data and a line graph. The table has columns for [Ab], GP Fab, Normal Fab, and GP-Norm. The graph shows ELISA signal on the y-axis (0 to 2.5) and Ab concentration on the x-axis (0.00000 to 3.00000). The 'Paste Special' dialog box is open, and the 'Paste Link' button is circled in red.

	A	B	C	D	E
1		[Ab]	GP Fab	Normal Fab	GP-Norm
2	A1	6.25000	1.458	0.57	0.888
3	B1	3.12500	2.007	1.049	0.579
4	C1	1.56250	2.007	1.629	0.378
5	D1	0.78125	1.996	1.556	0.44
6	E1	0.39063	1.944	1.448	0.496
7	F1	0.19531	1.281	1.349	-0.068
8	G1	0.09766	0.943	0.928	0.015
9	H1	0.04883	0.417	0.459	-0.042
10	I1	0.02441	0.246	0.587	-0.341
11	J1	0.01221	0.123	0.205	-0.082
12	K1	0.00610	0.103	0.119	-0.016
13	L1	0.00305	0.09	0.132	-0.042
14	M1	0.00153	0.099	0.109	-0.01
15	N1	0.00076	0.088	0.125	-0.037
16	O1	0.00038	0.092	0.115	-0.023
17	P1	0.00019	0.085	0.101	-0.016
18	A2	6.25000	0.273	0.154	0.119
19	B2	3.12500	0.238	0.149	0.089
20	C2	1.56250	0.223	0.16	0.063
21	D2	0.78125	0.142	0.15	-0.008
22	E2	0.39063	0.129	0.13	-0.001
23	F2	0.19531	0.112	0.131	-0.019
24	G2	0.09766	0.093	0.101	-0.008
25	H2	0.04883	0.092	0.116	-0.024
26	I2	0.02441	0.093	0.1	-0.007
27	J2	0.01221	0.076	0.098	-0.022
28	K2	0.00610	0.085	0.102	-0.017
29	L2	0.00305	0.089	0.119	-0.03
30	M2	0.00153	0.089	0.104	-0.015
31	N2	0.00076	0.092	0.124	-0.032
32	O2	0.00038	0.088	0.109	-0.021
33	P2	0.00019	0.088	0.108	-0.02
34	A3	6.25000	0.813	0.364	0.449
35	B3	3.12500	0.902	0.409	0.493
36	C3	1.56250	0.782	0.383	0.399
37	D3	0.78125	0.767	0.273	0.144

Reorganize data for calculations or graphs

Subsequent data can be formatted without having to create a new graph

Acknowledgment

- Ray Mernaugh, Ph.D.
- Vanderbilt Institute of Chemical Biology

