All Presentations Are Available At www.slideshare.net/ffeldon
PEMDAS: Let’s Stop Making Excuses for Aunt Sally

This photo is NOT:

Jerry Tuttle
Univ. of Phoenix
We also need Order of operations in English.

The lady hit the man with an umbrella. (Is the lady using an umbrella to hit or is she hitting a man who is carrying an umbrella?)

Rachel Ray finds inspiration in cooking her family and her dog.

Did the lion eat Fred? Did the lion eat, Fred?

(Commas, preposition would have helped.)
There are ordering systems besides PEMDAS.

In Reverse Polish Notation (RPN), operators follow their operands. No need for parentheses, but user forces the correct order.

5 + ((1 + 2) × 4) − 3 is entered 5 1 2 + 4 × + 3 −
PEMDAS
Parentheses, Exponentiation, Multiplication, Division, Addition, Subtraction.

Besides Aunt Sally, we have:
- Please Email My Dad A Shark¹
- People Expect More Drugs and Sex¹
- Popcorn Every Monday Donuts Always Sunday²
- People Everywhere Made Decisions About Sums²
- Brackets, Orders, Divide, Multiply, Add, Subtract²

¹ https://xkcd.com/992/
² https://www.mathsisfun.com/operation-order-pemdas.html
Many students have a weak understanding of Order of Operations.

There is much more to Order of Operations than memorizing PEMDAS.
Who does BASIC Order of operations well?

Google search field - yes
iPhone default calculator - yes
Windows default calc. - yes
Excel - yes, but see exceptions, coming up
Wolfram Alpha - yes
Mathway & Photomath - yes
Many students ignore the equal precedence feature of the M and D of peMDas so that

\[ 30 \div 2 \times 15 \div 3 \times 4 \]

incorrectly becomes

\[ 30 \div (2 \times 15) \div (3 \times 4) = 1/12 \]

Excel gets this correct, as do most devices.
Try this:

\[ 1 \div \frac{1}{8} \times 8 \]

Is it:  
A. 1 ✔️
B. 64

The symbol \( \div \) is called an obelus.
Is it possible a student will interpret the D and A of pemDAs so that

\[
\frac{12 + 9}{4 + 3}
\]

becomes

\[12 + \frac{9}{4 + 3}\]

The horizontal bar is called a vinculum, and is a grouping symbol with same function as parentheses.

\[\sqrt{a^2 + b^2}\text{, this bar is also a vinculum.}\]
How does PEMDAS address Stacked Exponentiation?

\[ 4^{3^2} \]

Is it:  
A. \( (4^3)^2 = 64^2 = 4,096 \)

B. \( 4^{(3^2)} = 4^9 = 262,144 \)

Excel gets this incorrect.

But we all agree on \( \int e^{x^2} \, dx \)
How does PEMDAS address: Concatenations

Concatenations: positioning of symbols next to each other to imply an operation without a symbol for the operation:

\(-3^2\). The negative sign is called a unary operator because there is only 1 operand. Excel is wrong.

Scientific notation: 2.364E8. Exponentiation and multiplication are implied.

Additive inverse of mixed numbers: \(-8 \frac{1}{3}\). Some students would multiply. Others would add and get \(-24/3 + 1/3 = -23/3\).
How does PEMDAS address functions?

What about \( \sin(x)^2 \)? Is it \( \sin(x^2) \)?

How about \( \sin x + y \)? Is it \( \sin(x) + y \)?

\( \sin^{-1} x \) versus \( 1/\sin x \) is asking for trouble.

And could \( \sin^2(x) \) possibly equal composition function \( \sin(\sin x) \)?

Where does \( n! \) fit in with PEMDAS?
The slash symbol

We were OK with $1/\sin x$, right?

How about $ab/cd$? Some journals (e.g., *Physical Review*) interpret this as $ab/(cd)$ under the theory that “multiplication is of higher precedence than division with slash.”

## Technology Results

<table>
<thead>
<tr>
<th></th>
<th>PEMDAS1</th>
<th>PEMDAS2</th>
<th>Stacked Power</th>
<th>Unary</th>
<th>Mixed Fraction</th>
<th>What’s Squared?</th>
<th>No Parenthes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>iPhone</td>
<td>✔</td>
<td>✔</td>
<td>X</td>
<td>NA</td>
<td>NA</td>
<td>.25</td>
<td>NA</td>
</tr>
<tr>
<td>Windows</td>
<td>✔</td>
<td>X</td>
<td>X</td>
<td>✔</td>
<td>X</td>
<td>.25</td>
<td>✔</td>
</tr>
<tr>
<td>Excel</td>
<td>✔</td>
<td>NA</td>
<td>X</td>
<td>X</td>
<td>✔</td>
<td>.25</td>
<td>NA</td>
</tr>
<tr>
<td>Wolfram</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Mathway</td>
<td>✔</td>
<td>X</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>.25</td>
<td>NA</td>
</tr>
<tr>
<td>PhotoMath</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Improvements over PEMDAS:

1. Do operations within grouping symbols, inner to outer. Grouping symbols include parentheses, brackets, fraction bar, absolute value symbol, square root symbol (the bar in the square root symbol is the grouping symbol).

2. Do operations of exponents, upper right to lower left, when stacked.

3. Do unary operation of additive inverses.

4. Do operations of multiplication and division, left to right.

5. Do operations of addition and subtraction, left to right.

The above still omits functions.

Even greater Improvement over PEMDAS:
1. Use grouping symbols where appropriate.
2. Understand the math.

PEMDAS, like beloved Aunt Sally, is getting old. We are expecting PEMDAS to do too much. Let’s stop making excuses for Aunt Sally. There’s a lot more to Order of Operations than just PEMDAS.
And in conclusion:

$$25 \times 13 \times 4$$

makes more sense to do as

$$25 \times 4 \times 13.$$ 

So use the rules, unless it’s more efficient to ignore them!

Concepcion Molina, *The Problem with Math is English.*
Bibliography


MinutePhysics. (2013). The order of operations is wrong. [http://www.youtube.com/watch?v=y9h1oqv21Vs](http://www.youtube.com/watch?v=y9h1oqv21Vs)


- Sarah Miller
- Assistant Professor, Math Coordinator
- Community College of Baltimore County
We couldn’t function without our adjunct instructors.

- 40 Full Time Math Faculty.
- 120 Adjunct Math Faculty.
Great Introductions.

- New Adjunct Faculty Orientation Sessions.
- Regular Ongoing Trainings For Blackboard, SmartNotebook, SIMON, ALEKS, WebAssign, etc.
Just for Adjuncts!

- Semester Kickoff Adjunct Meetings.
- Yearly Adjunct Conference.
... at all Faculty Meetings.
Official Adjunct ↔ Full Time Faculty Liaison.

- He attends every faculty meeting.
- He creates a one page summary report to share with fellow adjuncts.
Pay for Attendance at Select Subsequent Trainings.
Ongoing Personal Support.

- New adjuncts are paired with an experienced faculty mentor.
- Every adjunct stays connected with Course Coordinators.
Clear Expectations.

- For coverage of curriculum.
- For using common final exams.
- For assessment and grading.
- For materials which need to be submitted at the end of the semester.
Keep Well Supplied!

- Anyone need overhead markers? A calculator? Graph paper?
Regular Correspondence.

Weekly email giving important announcements.
Paid days off.

- Every adjunct is allowed one sick day per semester without a pay deduction.
Formative Observations.

- Adjunct instructors must be observed at least every three semesters.
- Observers must follow up with techniques for improvement.
Promotions!

- 3 Pay Tiers.
- Adjunct instructors are eligible to advance to the next level after three semesters of teaching contingent upon good observation evaluations and regular attendance at professional development events.
Considerate Scheduling.

We try to accommodate requests for …

- Days of the week,
- Time of day,
- Number of classes,
- Courses,
- Etc.
Recognition for a job well done!

Written complements.
Written evaluations.
Repeated thanks.
Longevity Awards and Celebration.

Adjunct Instructors who have taught 5, 10, 15, 20+ are celebrated with a small gift and a banquet award dinner.
Adjunct Instructor of the Year.

Every department, including the math department, selects one outstanding adjunct educator to honor.
Celebrate!

... with individual pies on pie day!

... with invitations to faculty holiday parties,

... etc.
… because be their employment full time or part time…

“There is no profession more essential than that of an educator, and it’s time for all of us to embrace and celebrate their importance and contribution to America’s students.” - Queen Latifah
You Might Call It Magic... But I Call It Math: The Fastest Math Magic Show Ever

- Dr. Mike Long
- Howard Community College
- Columbia Maryland
First “Magic” Trick

- Everyone write down a three digit number with no digits repeating and find the sum of the digits.
- Write down all of the possible two digit combinations that can be made using the three digits in the number that you wrote down.
- Sum all of those two digit numbers and divide by the sum of the digits in the original three digit number.
First “Magic” Trick

- Everyone write down a three digit number with no digits repeating and find the sum of the digits.
- Write down all of the possible two digit combinations that can be made using the three digits in the number that you wrote down.
- Sum all of those two digit numbers and divide by the sum of the digits in the original three digit number.
The Big Reveal

Did you get this number?
Revealing the 1st “Math Trick”

- \((10x+y)+(10y+x)+(10x+z)+(10z+x)+(10y+z)+(10z+y)\)
- \(=10(2x+2y+2z)+(2x+2y+2z)\)
- \(=11(2x+2y+2z)\)
- \(=22(\frac{x+y+z}{x+y+z})\)
- \(=22\)
Second “Magic” Trick

- Toss the three dice;
- Pick one face and multiply the value by two; Add 5; Then multiply by 5;
- Add the value of another face; Multiply by 10;
- Add the value of the last face;
- Tell me the number;
Second “Magic” Trick

- Toss the three dice;
- Pick one face and multiply the value by two; Add 5; Then multiply by 5;
- Add the value of another face; Multiply by 10;
- Add the value of the last face;
- Tell me the number;
The Big Reveal

- Did we match?
Revealing the 2nd “Math Trick”

- $x$ (value of first face is “$x$”)
- $2x$
- $2x + 5$
- $5(2x+5) = 10x + 25$
- $10x + 25 + y$ (value of second face is “$y$”)
- $10(10x + 25 + y) = 100x + 250 + 10y$
- $100x + 250 + 10y + z$ (value of third face is “$z$”)
- $100x + 250 + 10y + z - 250 = 100x + 10y + z$
3rd “Magic” Trick

- Write down two one digit numbers.
- Now begin adding them recursively where the next number in the sequence equals the sum of the previous two numbers. Do this until you have ten numbers in the sequence.
- Tell me the 7th number in your sequence when you get there.
- Now determine the sum of the ten numbers in the sequence.
3rd “Magic” Trick

- Write down two one digit numbers.
- Now begin adding them recursively where the next number in the sequence equals the sum of the previous two numbers. Do this until you have ten numbers in the sequence.
- Tell me the 7th number in your sequence when you get there.
- Now determine the sum of the ten numbers in the sequence.
3rd “Magic” Trick

๏ Write down two one digit numbers.
๏ Now begin adding them recursively where the next number in the sequence equals the sum of the previous two numbers. Do this until you have ten numbers in the sequence.
๏ Tell me the 7th number in your sequence when you get there.
๏ Now determine the sum of the ten numbers in the sequence.
The Big Reveal

- Do the paper and the sum match?
Revealing the 3rd “Math Trick”

<table>
<thead>
<tr>
<th>Numbers</th>
<th>Sums</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>B</td>
<td>A+B</td>
</tr>
<tr>
<td>A+B</td>
<td>2A+2B</td>
</tr>
<tr>
<td>A+2B</td>
<td>3A+4B</td>
</tr>
<tr>
<td>2A+3B</td>
<td>5A+7B</td>
</tr>
<tr>
<td>3A+5B</td>
<td>8A+12B</td>
</tr>
<tr>
<td>5A+8B</td>
<td>13A+20B</td>
</tr>
<tr>
<td>8A+13B</td>
<td>21A+334B</td>
</tr>
<tr>
<td>13A+21B</td>
<td>34A+54B</td>
</tr>
<tr>
<td>21A+34B</td>
<td>55A+88B</td>
</tr>
</tbody>
</table>
4th “Magic” Trick

- Everyone write down a three digit number with no digits repeating.
- Swap the digit in the hundreds and ones place. Now subtract the larger from the smaller... you should have a scenario like that. So you have a new three digit number. If your difference only has two digits, put a zero in the hundreds place.
- Do the same thing you did before to that number... swap the hundreds and units place.
- Now add the two numbers and immediately cover up the sum (after you look at it).
4th “Magic” Trick

• Everyone write down a three digit number with no digits repeating.

• Swap the digit in the hundreds and ones place. Now subtract the larger from the smaller... you should have a scenario like that. So you have a new three digit number. If your difference only has two digits, put a zero in the hundreds place.

• Do the same thing you did before to that number... swap the hundreds and units place.

• Now add the two numbers and immediately cover up the sum (after you look at it).
The Big Reveal

- Did you get this number?
Revealing the 4th “Math Trick”

\[
100(h-1) + 10(t+9) + (u+10) \\
100u + 10t + h \\
- \\
100(h-u-1) + 10(9) + u-h+10
\]
Revealing the 4th “Math Trick”

\[100(h-u-1) + 10(9) + (u-h+10)\]
\[100(u-h+10) + 10(9) + (h-u-1)\]

\[100(9) + 10(18) + (10-1)\]

\[900 + 180 + 9 = 1089\]
Thank You

- Remember this really was not magic... it was just math!
- Dr. Mike Long
- Associate Professor and Co-Chair of Mathematics at Howard Community College, Columbia MD
Meet Your AMATYC Board Up Close and Personal

- Jane Tanner
- Onondaga Community College
- Syracuse, NY

tannerj@sunyocc.edu
Who Are We?

- President
- President-Elect
- Past President
- Secretary
- Treasurer
- Eight Regional Vice Presidents
- Executive Director
- Conference Coordinator
Why Am I Doing This?

- Strategic Planning and Orientation Meeting exercise
- There is a fun side to us too!
- Encourage YOU to run for a board position
Jane Tanner
President
Jim Ham
President-Elect
Nancy Sattler
Past President
Terra CC
Walden University
David Tannor
Treasurer

Baker College Online
I Want Every Single Student to Succeed ~ Sadie Bragg

2016 ~ Dr. Sadie Bragg
Ernie Danforth
Northeast VP
Corning CC
Dan Fahringer
Mid-Atlantic VP

Harrisburg Area CC

2016
Nancy Rivers
Southeast VP

Where I’ve lived

2016
Jon Oaks
Midwest VP
Macomb CC
Nicole Lang
Central VP
North Hennepin CC

2016
Liz Hylton
Northwest VP

Central Oregon CC
Wanda Garner
Executive Director

Cabrillo College

35 AMATYC Conferences
California’s Online Education Initiative: There’s Something for Everyone

- Barbara Illowsky
- billowsky@cccOnlineEd.org
- @DrBSI
- http://ccconlineed.org
Goal: Increase student COMPLETION of transfer degrees by working together to increase access to quality online courses and support services for students.
Access / Quality / Completion

1. Providing resources to colleges to allow for the addition of quality online courses

2. Improve success and retention
   Prepared students
   Prepared faculty
   Quality course design and content resources

3. Providing students with opportunities to take classes when and where they need them
Three levels of opportunity for participation in the OEI.

- Colleges Using OEI Resources
- Colleges Using OEI Resources & Canvas
- Colleges using Resources, Canvas, & Exchange
** 94 of 113 CCC choose Canvas!**

---

**College Participation in OEI - 99%!**

- Pilot: 21%
- Canvas Adoption: 81%
- Use OEI Resources: 92%
- Prof. Development: 96%
- Any Participation: 99%

---

Ignite AMATYC

O'Reilly
Online Learning Support Ecosystem

- Professional Development & Course Design
- Online Counseling Network & Platform
- Embedded Support for Underperforming Students
- Online Tutoring 24x7 & Platform
- Online Readiness (Quest Program)
- Recommended Library Services
- Online Test Proctoring Plagiarism Detection
- Accessibility Support & Universal Design

Common Course Management System
Online Learning Support Ecosystem

- Professional Development & Course Design Rubric
- Online Counseling Network & Platform
- Embedded Support for Underperforming Students
- Online Tutoring 24x7 & Platform
- Online Readiness (Quest Program)
- Recommended Library Services
- Online Test Proctoring Plagiarism Detection
- Accessibility Support & Universal Design
- Common Course Management System
ONLINE EQUITY GOALS

- Decrease success rate gaps in online courses
- Identify strategies to address inequities

Equality doesn't mean Equity.
Professional Development

Helping Faculty to:

• Apply Best Practices in **Online** Course Design and Accessibility
• Utilize **Online Tools for Student Success**
• Get the Most from **Canvas**
Professional Development

- 4-week Introduction to Teaching with Canvas
  - Free to faculty at OEL pilot colleges and colleges that have committed to Canvas
  - Self-paced version available NOW
  - “Train-the-trainer” events held
  - Creative Commons version available

- Canvas Faculty Support Calls
- Instructional Design help from @ONE
- CCC Community in Canvas
- Canvas Subscription Training Available
Online Student Readiness

No cost online student readiness modules now available to all colleges

Readiness modules combined with Smarter Measure assessment employed at pilot colleges
Academic Integrity

Proctoring
- Proctorio – online proctoring
- Systemwide network of proctoring sites in development

Plagiarism detection
- VeriCite online plagiarism detection pilot
- Negotiated rate for all colleges
Online Tutoring Capabilities

Students can:

- Meet with a live tutor (up to 24/7, depending on subject)
- Use “Question and Answer Center” 24/7 (asynchronous tutoring)
- Essay or paper review 24/7 via “Paper Center”
- Service funded for pilot colleges; Reduced cost for non-pilot colleges
WorldWideWhiteboard

- License for any CCC to use w/local tutors
- Longer term goal is to develop a CCC online tutoring consortium built upon the WWWB platform
- Currently working with ACTLA (Association of Colleges for Tutoring and Learning Assistance) to determine level of interest and feasibility in future features
Example – Economics

Find the equilibrium point for a supply/demand problem

**Problem:** student does not remember how to find intersection point of two lines

**Solution:** “*Need help with finding equilibrium points?*”

4-minute video by James Sousa

https://www.youtube.com/watch?v=he5HPPIIdVY
The average IQ score on an IQ test is 100. Standard deviations describe how data are dispersed in a population and give context to large data sets. The bell curve uses the standard deviation to show how all scores are dispersed from the average score (Figure). In modern IQ testing, one standard deviation is 15 points. …How would you describe a score of 115 and a score of 70?

*Psychology* by OpenStax College, CC BY
Supporting Online Counseling

Technology Platform – Cranium Café
Online meeting & collaboration platform that supports distance counseling

Network Structure and Approach
Partner with community colleges to establish a uniform approach
Create a community of online counselors trained in working with online students utilizing the same platform

Professional Development and Standards
Develop and deliver professional development training and materials
Align to the National Board of Certified Counselors standards for distance counseling professionals
Online Counseling Platform

- CC is an online meeting and collaboration platform designed specifically for online counseling.
- Synchronous online career, personal and educational counseling appointments
- Online academic advising appointments
- Online drop in / walk in sessions
- System-wide agreement for reduced cost to all 113 CCCs
Online Library Resources

- Workgroup established to identify areas for system-wide coordination for online library services/resources
- Partnership with Council of Chief Librarians, Academic Senate
- Identify best practices for CCC libraries in serving online students
- Evaluate various technologies and options for networking librarians across colleges (e.g., reference, information competency resources, stud. portfolios...)}
Online Course Exchange

- Simply put: Enhanced access for students to get a course needed for completion from another college in the consortium that they cannot get at their home college, without a lot of hassle.

Thank you!!!

billowsky@cccOnlineEd.org
colLABoration

- Luke Walsh
  Catawba Valley CC
- Hickory, North Carolina
  NCMATYC President

#colLABoration
Vanilla
(Ice)$^2$
Baby
Let’s make MATHEMATICS great again!
“Rolling in my 5.0...”
“Something grabs a hold of me tightly, flow like a harpoon daily and nightly.”
“If there is a problem, yo, I’ll solve it...”
“Check out the hook, while my DJ revolves it.”
Dunham Jackson
1926 MAA President
“Alright stop, colLABorate and listen, AMATYC is back with brand new vision!”

AMATYC-AMS-ASA-MAA-SIAM
NCMATYC INVITES THE GREAT 58 TO collaborate...

2017 NCMATYC CONFERENCE
March 9-10 at Durham Tech
TVM Calculator

PV: $0
PMT: $PD
FV: $GROWTH
Rate: 2.718281%
Periods: 365

PV | PMT | FV | Rate | Periods
---|-----|----|------|--------
0  | PD  | GROWTH | 2.718281 | 365

2016 @lukeselfwalker
Is this your PD distribution?
Is your PD a PD curve?

Professional

I will, no I can’t, I will…

Paranormal Distribution

2016

@lukeselfwalker
#CalculatorCrutch

I THINK, THEREFORE, YOU DON'T.

2016
What holds up your PD?
Make PD Uniform!

colLABorate with 58:
5 days a month, 8 minutes a day
Let's turn PD into Professional Discussion.

http://ncmatyc.matyc.org/collaborate/collaborate-in-slack/
• I taught differentiation today. #AutoMATYC
• This lab was an epic fail. #AutoMATYC
• My students know Algebra! #AutoMATYC
• Marbleslides is a game changer. #AutoMATYC
• My midterm is only an hour :-( #AutoMATYC
• I am nervous about multiple measures. #AutoMATYC
• No more conference coma for me. #AutoMATYC
• Let’s make PD great again! #AutoMATYC
• Vanilla Ice is my go to PD guide. #AutoMATYC
• See ya later conference crutch. #AutoMATYC
• PD is not simple, so make it compound. #AutoMATYC

#AutoMATYC
My Main Mathematical Mentors

Gregory D. Foley
Ohio University

Their actions have inspired me to dream more, learn more, do more, and become more.

(from John Quincy Adams’s definition of a leader)
Sr. Gemma Glutz (1926–2013)
Grade 6 Mathematics
St. Albert the Great School
Kettering, Ohio

Sr. Gemma created an environment for me to do mathematics. And encouraged me when I did mathematics.
Alvin K. Funderburg (1916–2013)
Grades 11–12: Alg III/Trig; Calculus
Fairmont West High School
Kettering, Ohio

Mr. Funderburg let me bypass Algebra II, taught me elementary functions, coordinate geometry, computer programming, trigonometry, and calculus.
Efraim Armendariz
(1938–2013)
Undergraduate Analysis
The University of Texas at Austin

Prof. Armendariz had me read and report on a paper from the American Mathematical Monthly.
Leonard Gillman  
(1917–2009)  
Bachelor’s and Master’s  
The University of Texas at Austin

Prof. Gillman taught me to write mathematical proofs and let me teach his calculus class when he was away. (I was 20.)
Michael Starbird (1948–)
Bachelor’s and Master’s
The University of Texas at Austin

Mike taught me to construct and present mathematical proofs to the class.
Dr. Eaton opened the worlds of mathematical research and geometric topology to me.
Joe A. McMillian (1930– )
My first boss
North Harris County College (Lone Star College) Houston

Joe Mac hired me at age 21 and promoted me to program coordinator the next year. He had faith in me and helped me to set my sights high.
W. T. Guy, Jr. (1919–2011)
Master’s and PhD
The University of Texas at Austin

Dr. Guy gave me an appreciation for applied mathematics and was a master at the art of problem posing.
Stephen B. Rodi
My second boss
Austin Community College

Steve got me involved in AMATYC and scheduled my classes so that I could pursue my PhD in mathematics education. He helped me spread my wings.
E. Glenadine Gibb  
(1919–1984)  
PhD program  
The University of Texas at Austin  

Dr. Gibb convinced me to enter the PhD program in mathematics education, taught me learning theory, and served on my qualifying exam committee.
L. Ray Carry (1932–2015)
PhD supervising professor
The University of Texas at Austin

Ray guided me in becoming a mathematics education researcher.
Al introduced me to scores of mathematics educators and taught me to write grant proposals.
Frankenlin Demana (1938– )
The Ohio State University
Columbus

Frank has taught me the power of hard, thoughtful, caring work. He encourages me to focus on what matters and to do my best.
Bert K. Waits (1940–2014)
The Ohio State University
Columbus

Bert inspired me and many others to dream big and to follow through.
James E. Schultz
The Ohio State University
Ohio University

Jim helps me to see the world from a fresh and optimist perspective.
Joan R. Leitzel
The Ohio State University
Columbus

Joan leads by example. She inspires me to work hard and help others.
Lynn Arthur Steen  
(1932–2015)  
St. Olaf College  
Northfield, Minnesota

Lynn helped me to view the work of our community from a perspective that encompasses mathematics, education, and literacy.
Thomas R. Butts (1944– )
The University of Texas at Dallas

Tom has enriched my understanding of problem solving and helps me to remember to laugh, especially at myself.
My Main Mathematical Mentors

"Do all the good you can. By all the means you can. In all the ways you can. In all the places you can. At all the times you can. To all the people you can. As long as ever you can."

John Wesley
A Really Crappy Example for Your Trigonometry Class

- Pat Riley
- Hopkinsville Community College (KY)
Math CSI: Forensics in the Mathematics Classroom
DETERMINING SPEED FROM SKID MARKS
How Bloodstain Pattern Analysis Works

Area of convergence

Blood splatter

©2008 HowStuffWorks
How Bloodstain Pattern Analysis Works

angle of impact = \arcsin \frac{\text{width}}{\text{length}}

Blood droplet

(opposite side)

Width

Angle of Impact \( \theta \)

(hypotenuse)

Length

Surface

©2008 HowStuffWorks
\[
\sin \theta = \frac{\text{width}}{\text{length}}
\]
\[
\sin \theta = \frac{opp}{hyp} = \frac{18}{45} = 0.4
\]

\[
\theta = \sin^{-1}(0.4) \approx 23.6^\circ
\]
\[
\sin 30 = \frac{\text{opp}}{60}
\]

\[
60 \cdot \sin 30 = \text{opp}
\]

\[
30 \text{ ft} = \text{opp}
\]
\[ \sin \theta = \frac{3}{6.4} = 0.47 \]

\[ \theta = \sin^{-1}(0.47) \approx 28^\circ \]
PLZ CAN I HAZ EXTRA CREDIT?
Every View Has Value

- Fenecia Foster
- Southeast Technical Institute
Overview

- Low Tech Activity
- Connects the 4 Views of a Function
- Challenges students to identify the value of each view

<table>
<thead>
<tr>
<th>Verbal (Words)</th>
<th>Algebraic (Equation/Formula)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual (Graph)</td>
<td>Numerical (Table)</td>
</tr>
</tbody>
</table>
Context

- College Algebra or PreCalculus Course
  - Terminal Math course on our campus
- Beginning of the Intro to Functions unit
  - Follows expressions, solving equations and inequalities, generating equations of lines
Students’ Prior Knowledge

- Can generate a table of values given an equation
- Can generate a graph given a table of values
- Have had a discussion about graphical representations of various scenarios
Activity Overview

- Small groups (2-4 students)
- Sort out the corresponding words, equation, table and graph views for 8 scenarios.
- Use the cards to answer a set of related questions.
Scenarios

An electrician charges a fixed fee for a house call and then a fixed amount per hour on top of this.

A small airplane flies on a direct route from one town to another.

The amount of medication in your system after you take an aspirin.

The blood pressure of an average person over a period of time.

You get two tickets free, but then you get charged a fixed rate per ticket.

An internet café charges a fixed amount per minute to use the internet.

A punter kicks the ball.

The amount of money you have in an account after a period of time if the interest is compounded continuously.
Part 1: 4 Views Card Sort
Part 1: 4 Views Card Sort
Part 1: 4 Views Card Sort

- Set-up Recommendations
  - Use a different color paper for each view
  - Bags
  - Laminate
  - Table values are strategic
  - Add an Independent and Dependent Variable Card or a Domain and Range Card
Part 1: 4 Views Card Sort

- Facilitation Notes
  - Include various types of functions, but fairly common situations
  - Challenge students with unfamiliar functions
  - Challenge students to avoid technology
  - Let students struggle
  - My students typically take 20-30 minutes
Part 2: Activity Grid

<table>
<thead>
<tr>
<th>Ind Var: Time in hours</th>
<th>Independent Var: Distance from town A in miles</th>
<th>Dep Var: Total cost in dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>x (hours)</td>
<td>f(x) (miles)</td>
<td>x (dollars)</td>
</tr>
<tr>
<td>0</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>110</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>170</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>230</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>350</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var: Medication in milligrams</th>
<th>Dep Var: Distance from town B in miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>x (milligrams)</td>
<td>x (miles)</td>
</tr>
<tr>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>5</td>
<td>150</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var: Blood pressure in mmHg</th>
<th>Dep Var: Total money spent in dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>x (mmHg)</td>
<td>x (dollars)</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dep Var: Cost in dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var: Number of tickets</th>
<th>Dep Var: Time in seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>x (tickets)</td>
<td>x (seconds)</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dep Var: Time in minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var: Height of the ball in feet</th>
<th>Dep Var: Cost in dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>x (feet)</td>
<td>x (dollars)</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dep Var: Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var: Time in years</th>
<th>Dep Var: Total money spent in dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>x (years)</td>
<td>x (dollars)</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dep Var: Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var: Time in minutes</th>
<th>Dep Var: Total money spent in dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>x (minutes)</td>
<td>x (dollars)</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dep Var: Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>5</td>
</tr>
</tbody>
</table>

**Equations:**

- \( f(x) = 60x + 50 \)
- \( f(x) = 400(0.71)^x \)
- \( f(x) = -x + 150 \)
- \( f(x) = 22.48 + (22.87x) + 9.48 \)
- \( f(x) = 8x - 16 \)
- \( f(x) = 80x - 16x^2 \)
- \( f(x) = 1.5x \)
- \( f(x) = 500e^{0.2x} \)
Part 2: Activity Grid

- Helpful for checking work
- Students can use it for the question set

<table>
<thead>
<tr>
<th>Independent Var:</th>
<th>Dep Var:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time in hours</td>
<td>Total cost in dollars</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var:</th>
<th>Dep Var:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time in hours</td>
<td>Distance from town A in miles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var:</th>
<th>Dep Var:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from town B in miles</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var:</th>
<th>Dep Var:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time in seconds</td>
<td>Number of tickets</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var:</th>
<th>Dep Var:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure in milligrams</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var:</th>
<th>Dep Var:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of tickets</td>
<td>Total money spent in dollars</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var:</th>
<th>Dep Var:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of the ball in feet</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var:</th>
<th>Dep Var:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time in seconds</td>
<td>Cost in dollars</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var:</th>
<th>Dep Var:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time in years</td>
<td>Distance from town A in miles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var:</th>
<th>Dep Var:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from town B in miles</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var:</th>
<th>Dep Var:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of tickets</td>
<td>Time in minutes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var:</th>
<th>Dep Var:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of the ball in feet</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Independent Var:</th>
<th>Dep Var:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost in dollars</td>
<td></td>
</tr>
</tbody>
</table>
Part 3: Question Set

4 Views of a Function Question Set

Math 1207

Use the 4 Views of a Function Activity Grid to answer the following questions.

1. How much does the electrician charger per hour?
   View referenced:
   Justification:

2. How many hours did the electrician work if you received a bill for $350?
   View referenced:
   Justification:

3. How many milligrams of medication did you take?
   View referenced:
   Justification:

4. What happens to the amount of medication in your system over a period of time?
   View referenced:
   Justification:

5. About how long does it take for the medication to disappear from your system?
   View referenced:
   Justification:

6. How far apart are the towns?
   View referenced:
   Justification:

7. What would be an appropriate domain and range for this function?
   View referenced:
   Justification:

8. What is the highest blood pressure?
   View referenced:
   Justification:
Part 3: Question Set

9. What is the lowest blood pressure? _____________
   View referenced: _______________________
   Justification: _______________________

10. What do you notice about a person’s blood pressure over a period of time? _____________
    View referenced: _______________________
    Justification: _______________________

11. How much does each ticket cost? _____________
    View referenced: _______________________
    Justification: _______________________

12. Explain why the equation and the table do not match for all values of x.

13. How high did the ball go? _____________
    View referenced: _______________________
    Justification: _______________________

14. How long was the ball in the air? _____________
    View referenced: _______________________
    Justification: _______________________

15. How much does the internet café charge per minute? _____________
    View referenced: _______________________
    Justification: _______________________


Part 3: Question Set

16. How many minutes can you use the internet for $15? __________
   View referenced: ______________________
   Justification: ________________________

17. How much money did you initially invest? ______________________
   View referenced: ______________________
   Justification: ________________________

18. Compare the amount of interest you earned in years 0–5 with the amount you earned in years 5–10. Why are the amounts not equal?

19. Give an example of when it would be beneficial to use each view.
   a. Words: __________________________
   b. Table: ____________________________|
   c. Equation: _________________________
   d. Graph: __________________________

20. What did you learn from this activity?
Part 3: Question Set

- Challenges students to analyze each of the scenarios
- Questions are intentional
- Have students justify the view they choose to answer the question
Why do I use this activity?

- There isn’t a procedure, students have to engage in reasoning and sense-making
- Awesome discussions
- Cards are movable
Why do I use this activity?

- Emphasizes the connections between the 4 Views
- Helps students begin to understand how to analyze functions with and without technology
- Students experience the value of each view and thus are more apt to use all of the views going forward
Adapting and Extending

- Specific Types of Functions
  - Linear Functions
  - Quadratic Functions
  - Exponential Functions
  - Trigonometric Functions

- Update scenarios with realistic and current data
Questions?

Fenecia Foster
fenecia.foster@southeasttech.edu
Exit Tickets: All Aboard for Extra Credit!
Brianna McGinnis

- Assistant Professor of Mathematics
  - Transitional and credit-level mathematics
- Carroll Community College
  - Westminster, Maryland
The Dilemma

- Some students were arriving late to class
- leaving class early
- not paying attention

- No immediate accountability
The Solution: Exit Tickets!!

- Two questions given at the end of class
- Correct work and answers count toward extra credit
What are Exit Tickets?

- Students use their own half-sheet of paper
- Two questions given during the last five minutes of class
What are Exit Tickets? (continued)

- Students can use their notes, text, and calculator but **may not collaborate** or ask me questions

- Showing work/steps is required
What are Exit Tickets?
(continued)

- Each question is worth 0.5 point EXTRA CREDIT
  - up to 1 point possible
  - Maximum of 2% of grade or ~20 points
Benefits of Exit Tickets

- Accountability and incentive for students to
  - Arrive to class on-time
  - Take good notes
Benefits of Exit Tickets (continued)

- Pay attention
- Ask clarifying questions during class
- Stay the entire class time
Benefits of Exit Tickets (continued)

- Informal assessment
- Get to know your students a little more
Exit Ticket Question Ideas

- Most frequently used:
  - Answer a basic question or solve a basic problem related to the day’s lecture
Exit Ticket Question Ideas (continued)

- Copy Warm-Up Problem #1 from start to finish
- Recall an informational item that was announced
  - “When is the next test?”
Exit Ticket Question Ideas (continued)

- Get to know your students
  - “What is your favorite food?”
  - “What are your plans for the weekend?”
Student Sample +1 Credit

\[ \log_b 5 \times^4 \]

1. Expand \( \log_b 5 \times^4 \)
2. Solve \( \log x = 4 \)

\[
\frac{\log_b 5 + \log_b x^4}{\log_b 5 + 4 \log_b x}
\]

\[
\frac{10^{4.1} = x}{x = 12589.2541}
\]
Math 099 10-13-16

1. Expand
   $\log_b 5 x^4$
   $\log_b 5 + \log_b x^4$

2. Solve
   $\log x = 4.1$
   $10^{4.1} = x$
   $x = 12589.2541$

Student Sample +0.5 credit
0 \log_{10} 65 \times 4 \times 10 \log_{10} 65 \times \frac{4}{4} x = 0

0.612 \times 10^{4.1} \approx 12,589.2541
Sample Record Sheet

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- talk

2016

O'Reilly
Additional Information

- I do not give Exit Tickets on test days

- Variation: Entrance Ticket
Draw-Back

- Time
  - ~ 5 minutes for grading and recording after each class
Exit tickets can benefit both you and your students. Give them a try!

Questions?

bmcginnis@carrollcc.edu
My Students (And Yours) Do Not Understand Graphs

Rob Eby

Blinn College – Bryan Campus
Project ACCCESS – Cohort
jeby @ blinn.edu

@robebymathdude
ALL YOU NEED IS

\[ y = \frac{1}{x} \]

\[ x^2 + y^2 = 9 \]

\[ y = |-2x| \]

\[ x = -3|\sin y| \]
\[ L(x) = \begin{cases} \frac{1}{x} & \frac{1}{4} \leq x \leq 4 \\ 0 & \text{otherwise} \end{cases} \]

\[ \left( \frac{15}{8} \right)^2 = \left( y - \frac{15}{8} \right)^2 + \left( x - \frac{51}{8} \right)^2 \]

\[ V(x) = \begin{cases} -2(x - 10) & 8 \leq x \leq 12 \\ 0 & \text{otherwise} \end{cases} \]

\[ \left( 14 - 3|\sin(t)|, \frac{2t}{3} \right), 0 \leq t \leq 2\pi \]
Inspiration

A Tool to Use the First Day of Calculus

Frances Van Dyke and Alexander White

HANDOUT

Primus, Volume XIV, Number 3, September 2004
Question 2

2. Consider the equation along with its graph shown.
   a) I see no obvious integer values that satisfy the equation.
   b) To find integers that satisfy the equation, it is necessary to put the equation in \( y = mx + b \) form.
   c) Obvious integer values that satisfy the equation \( 3x - 7y = 29 \) are \( x=1, y=12 \)
   d) For any solution it MUST be true that \( x > 0 \).
   e) None of the above are correct
12. Consider the following graph of the line $y = 7x + 3$. Given that the horizontal segment has length 4, consider the vertical segment at which the arrow is pointing. Which of the following statements is true?

- a) The length of this vertical segment cannot be determined from the information given.
- b) The length of the vertical segment is 7.
- c) The length of the vertical segment is 28.
- d) The length of the vertical segment is 31.
- e) None of the above are correct.
13. To the right is the graph of the function 
\[ f(x) = x^3 - 5x^2 - 22x + 56 \]

Consider the equation 
\[ x^3 - 5x^2 - 22x + 56 = -40 \]

Choose all that apply:

a) I see no obvious solution to the equation.
b) To find a solution to the equation I will need to take a cube root.
c) An obvious solution to the equation is (0,50)
d) If x is a solution, then x < 0.
e) None of the above are correct

Rob’s Students 33%
Rob this sem. 40%, 23% answered (b)
4. Consider the function $f(x) = x$ along with its graph that is shown. Choose the one sentence which best describes the graph.

a) This function is always increasing
b) This function is always decreasing.

c) This function has both an interval of increase and an interval of decrease.

d) This function is constant
e) None of the above are correct.

Almost 1/3 each for (a), (c), and (d)!

Rob’s Students 44%

Rob this sem. 71%, 23% answered (d)
7. Consider the graph of the function $f(x)$, on the right. Which of the following statements is true? (There is only one)

a) The equation $f(x) = 2$ has no solutions.

b) The equation $f(x) = 2$ has at least 3 solutions.

c) The equation $f(x) = 2$ has only 1 solution.

d) Nothing about the solutions of $f(x) = 2$ can be determined from the graph that is shown.

e) None of the above are correct.

Rob’s Students 51%  Rob this sem. 63%
23% answered (c)
The Biggest Surprise!

I read graphs from left to right like a book:

a) It does not matter which direction
b) Rarely
c) Sometimes
d) Often Rob’s Students 54% - (e)
e) Always

Rob this sem. 42% said (e) 23% (d)
a) 25%
Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write.

H. G. Wells.
Pictorial Superiority Effect

10% Text or Audio Only

65% Text + Picture
Brain Rules – John Medina

- To move from short term to long term, repeat, repeat, repeat.
- Use online homework to your advantage.
- Have refresher quizzes all during the semester.
“…lack of empirical evidence that learning styles are useful in producing student achievement,

... the use of learning styles in the classroom could lead students to develop self-limiting implicit theories about themselves that could become self-fulfilling prophecies that are harmful....”

Kris Vasquez – Chapter 5 of Getting Culture: Incorporating Diversity Across the Curriculum
The Plural of Anecdote is **Not** Data

\[ f(x) = \frac{x - 4}{(x - 1)^2} \]
What makes a data visualization memorable?
The Plural of Anecdote is **Not** Data
My Students (And Yours) Do Not Understand Graphs

Rob Eby

Blinn College – Bryan Campus
Project ACCCESS – Cohort 2
jeby @ blinn.edu
@robebymathdude
robebymathdude.blogspot.com
DENVER 2016
Math at a Mile High

5-Minute Intermission
...Come Right Back!

Ignite®
AMATYC

enlighten us, but make it quick