

# EXPLORE: What is STEM and Why is it Important? What Role Does Mathematics Play?

Research in Mathematics Education (RME)  
Annual Conference  
February 15, 2013



SMU.

ANNETTE CALDWELL SIMMONS  
SCHOOL OF EDUCATION  
& HUMAN DEVELOPMENT

**CHANGING MINDS**




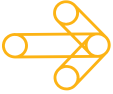


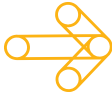
# **21<sup>st</sup> Century Workforce: *The STEM Challenge at AT&T***

Ken Fenoglio – President - AT&T University





# Business Challenges

-  Industry in transformation  
.....
-  Legacy vs. growth engines  
.....
-  New competitors  
.....
-  Shorter product lifecycles  
.....
-  Legislative and regulatory decisions





# Workforce Challenges

Demand for skilled workers is increasing; at the same time, availability of U.S. workers with required skills is dropping

- Globalization changing workforce composition
- .....
- Birth replacement rate in U.S. 2.0; 2.1 necessary to sustain population
- .....
- Demand increasing for imported talent
- .....
- High school dropout rate >30%; nearly 50% in some inner cities
- .....
- Students require remedial development in basic skills
- .....
- Increasing number of STEM degrees going to foreign-born students:
  - 33% engineering
  - 27% computers, math, statistics
- .....
- Women earning more than 50% of all college degrees; only 18.5% of all engineering degrees
  - Requires flexible policies to attract, retain, develop, promote







# STEM Demand and Challenges

- Many high-paying **STEM jobs go unfilled** as candidates lack necessary technical and math skills, training or post-secondary degrees. With millions unemployed, this skills gap is alarming.
- In the next six years:
  - STEM jobs are projected to grow by **17 percent** compared to fewer than 10 percent for other professions.
  - **2.8 million** STEM job openings are predicted.
- Juxtaposed to:
  - Nearly one-fourth of all students **fail to graduate** with their class.
  - STEM workers typically earn **26 percent** more than those in non-STEM positions.
- **STEM is a major focus** and priority in U.S. business





# AT&T's STEM Challenge and Response

- Today, **two-thirds of our student hires** begin their careers in a technology-centric area...IT, Labs, Network Engineering/Ops, and Technology Sales.
- In emerging areas such as mobility applications, cloud services, there is an **even greater need for STEM** skill sets.
- AT&T has invested more than **\$87 million to support community-based STEM initiatives**.
- Focus is on improving opportunities for **STEM learning in K-12 education** while helping at risk youth prepare for work in the 21st century.
- Through our **\$350 million Aspire program**, we're stepping up our commitment to education
- Aspire fuels the talent pipeline, helping ensure the future workforce will have qualified employees who have the hard skills – like STEM – that American businesses need to **remain competitive in the digital, global economy**.





## Math Skills at AT&T

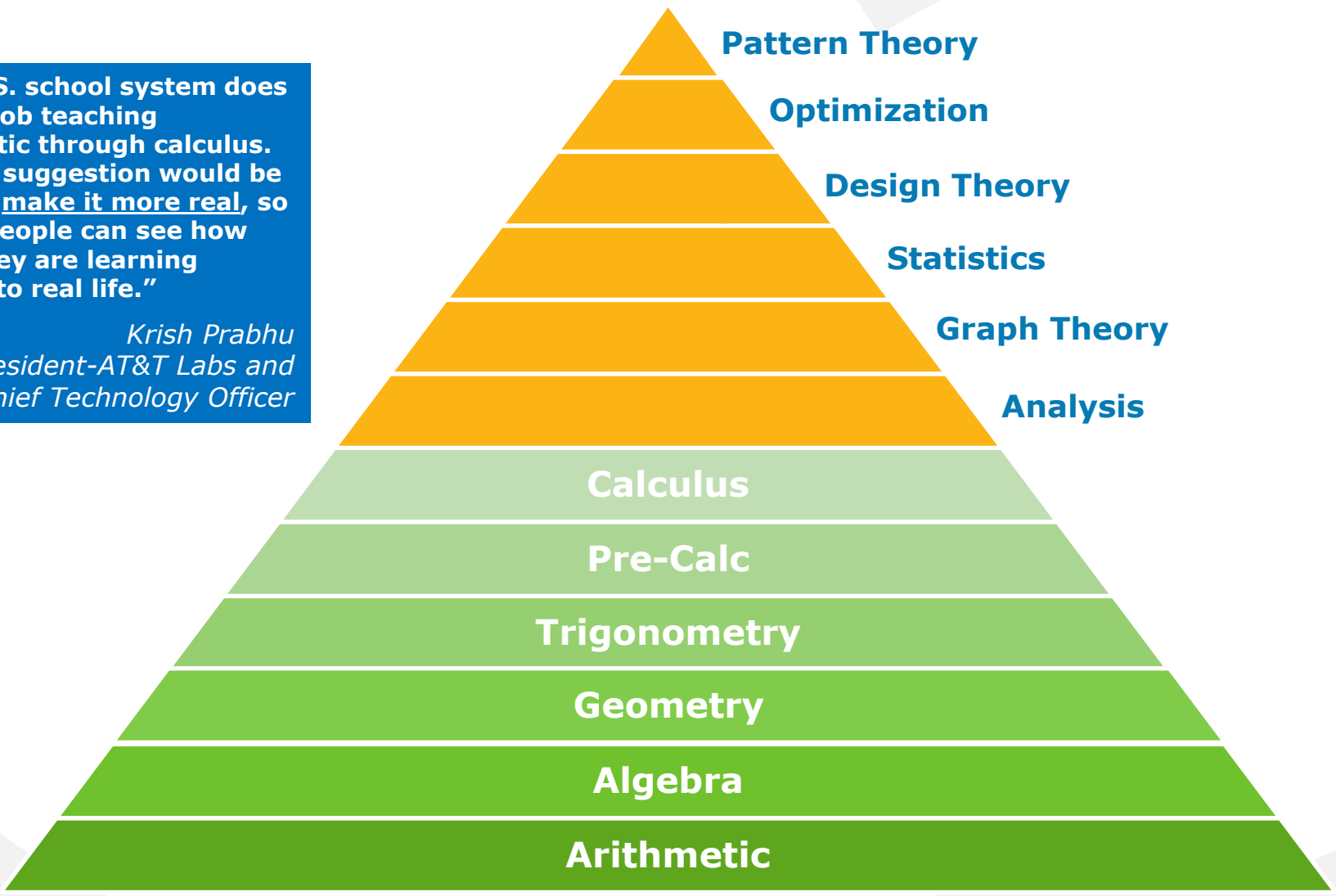
- **40,000 Advanced Math Professionals**
  - 15,000 Network engineers
  - 15,000 IT professionals
  - 5,000 Network designers
  - 5,000 Lab scientists



# Our Math Landscape

**Our U.S. school system does a good job teaching arithmetic through calculus. My only suggestion would be that we make it more real, so young people can see how what they are learning applies to real life."**

*Krish Prabhu  
President-AT&T Labs and  
Chief Technology Officer*



# What We Need

## in young people

The right fundamental skills, work ethic and values

STEM degrees and math skills

Solid writing and presentation skills

Ability to collaborate and work on a team

Critical thinking skills for high velocity business environment

Emotional maturity; good citizens

Commitment to diversity and sustainability





# **21<sup>st</sup> Century Workforce: *The STEM Challenge at AT&T***

Ken Fenoglio – President - AT&T University



# What is STEM & why is it important?

## What role does math play?

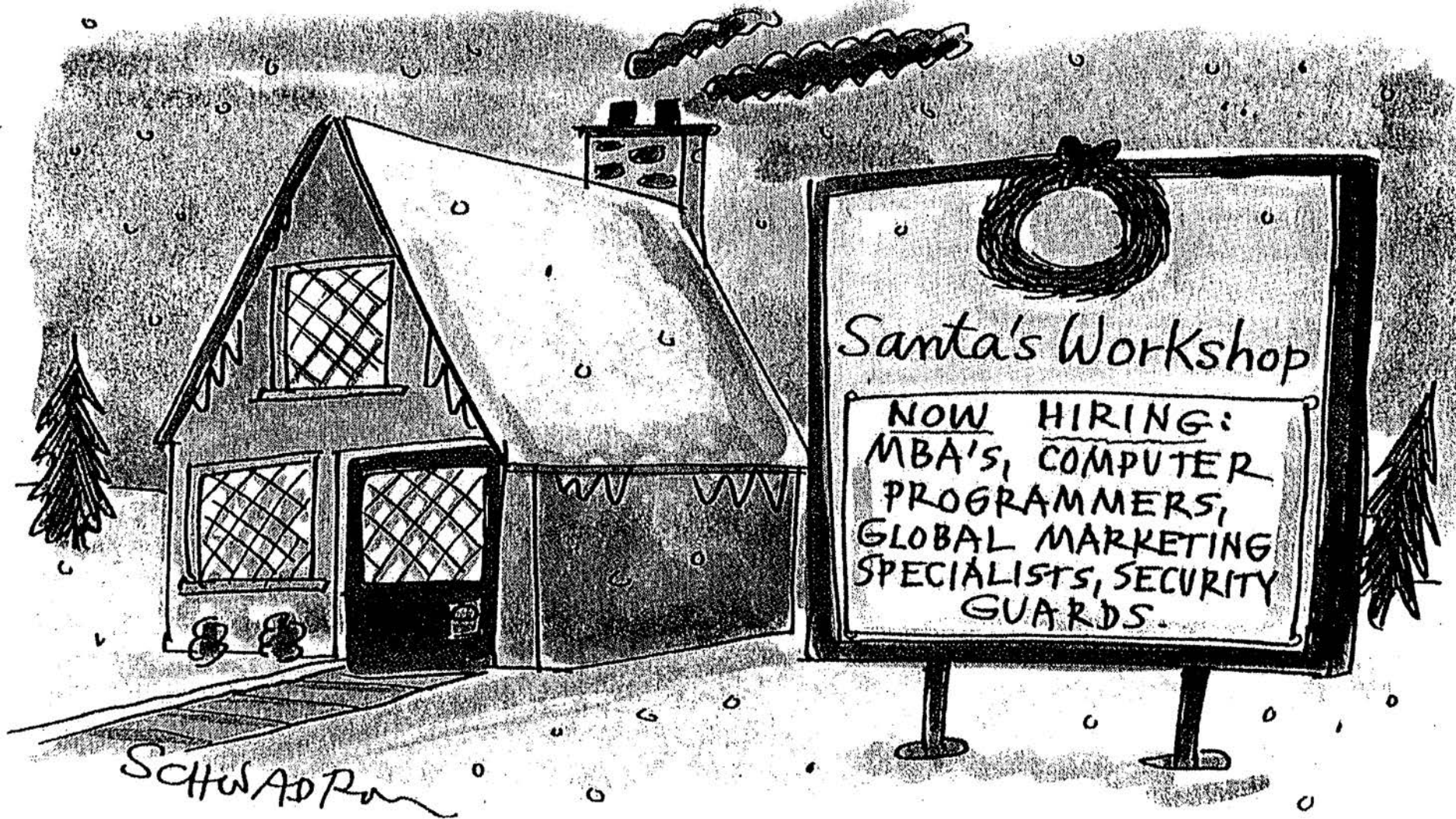


**Fredrick Olness**  
**Professor & Chair**  
**SMU Physics Department**



For people with STEM skills:

# Get a Job



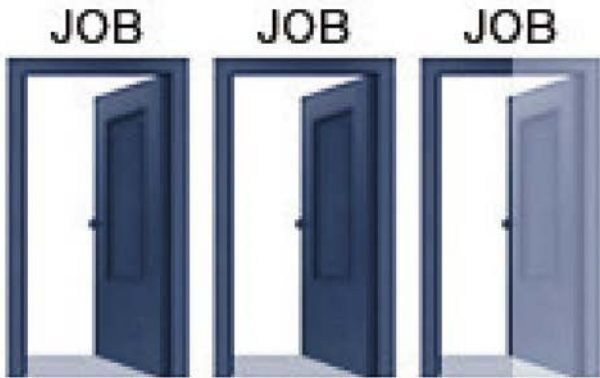


# STEM SKILLS ARE IN DEMAND

In Texas, STEM skills have stayed in demand even through the economic downturn.

## STEM:

**2.5 jobs** for every  
**1 unemployed person**



## Non-STEM:

**3.3 unemployed people** for every **1 job**



# And they pay

**\$74,958**

Average annual compensation of  
STEM occupations 2005-2008

# Compare with

**\$49,646**

The median family income for  
Texas, and

**\$24,870**

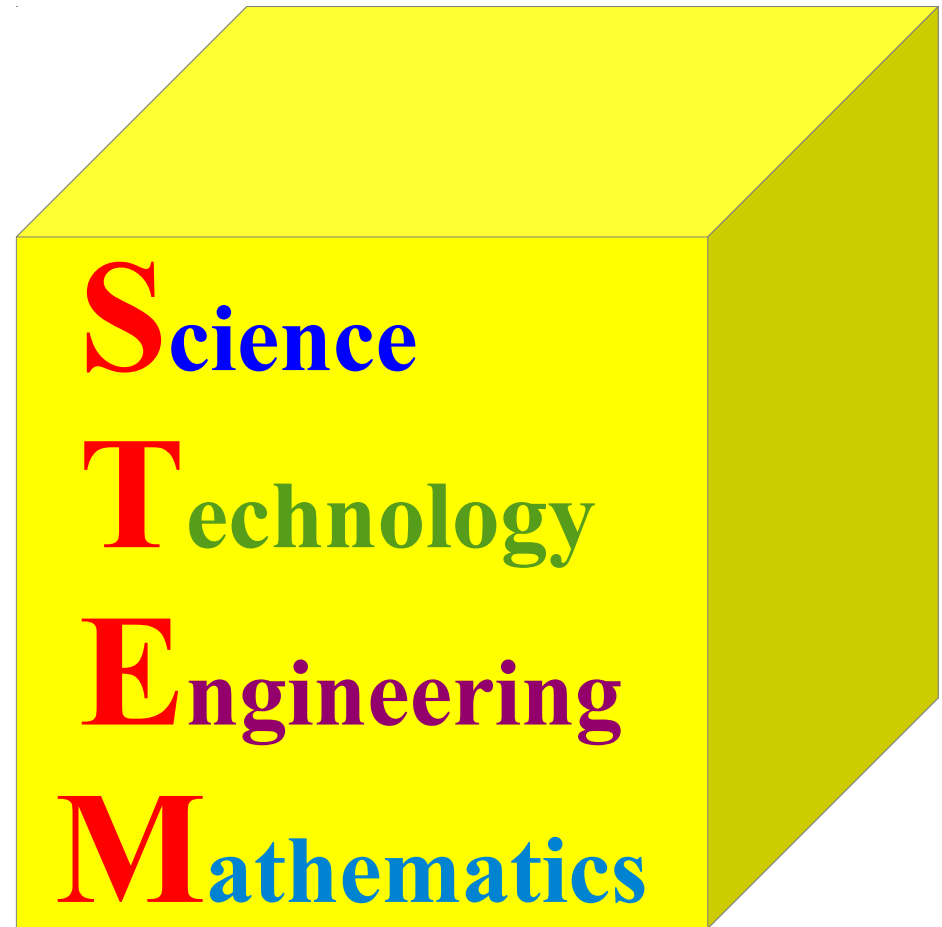
The per capita income for Texas

For people in general:

# Keep a Job

*Feedback on an introductory physics course.*

“I am going to be an architect, so I don't care about the tidal forces of the moon unless they are going to pull the roof off the house I design.







$A \sin \theta$

$A \cos \theta$

$A$

$\theta$

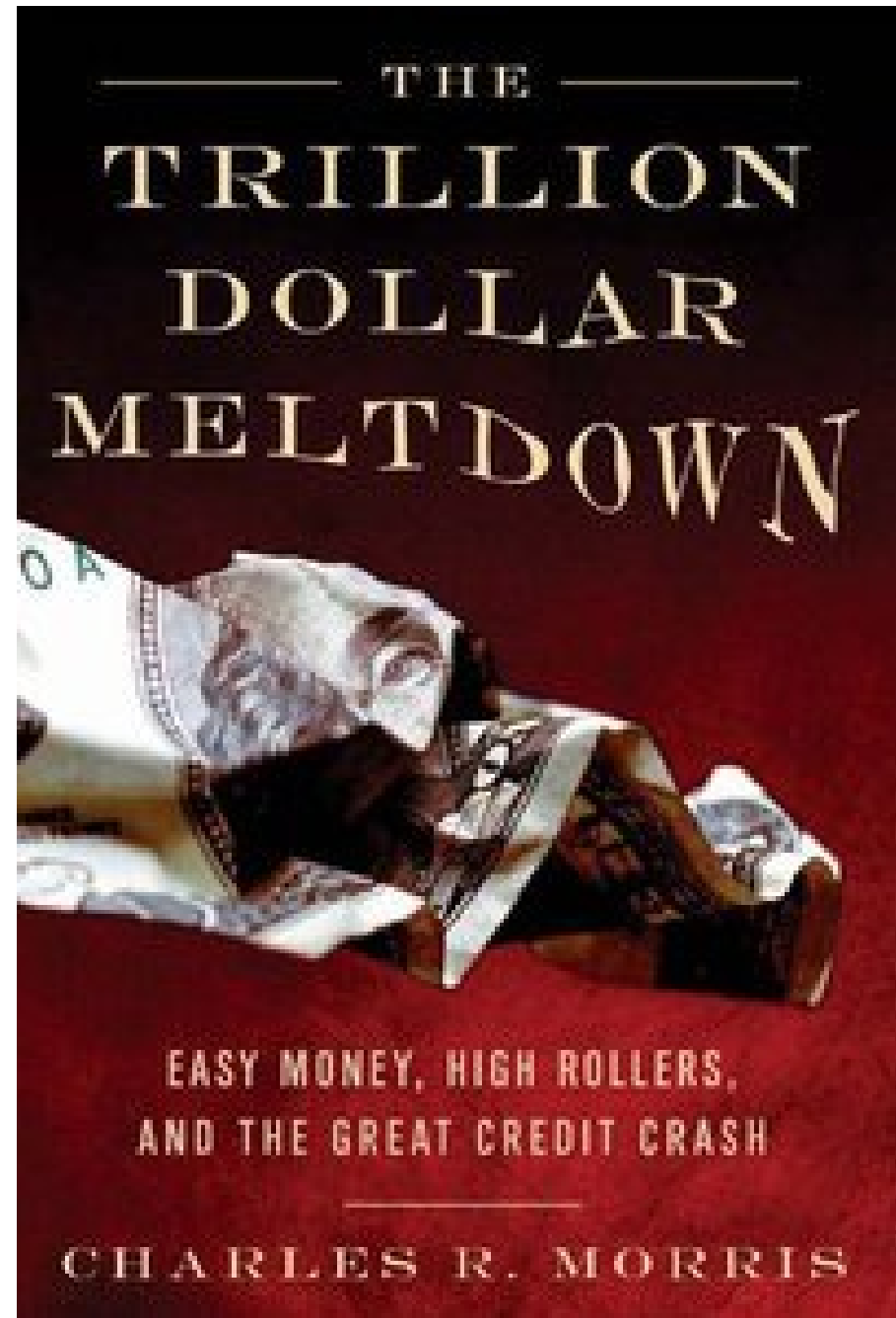
# 2008 Subprime Mortgage Crisis

IMF estimates \$4 Trillion Dollars of write-downs on global exposures



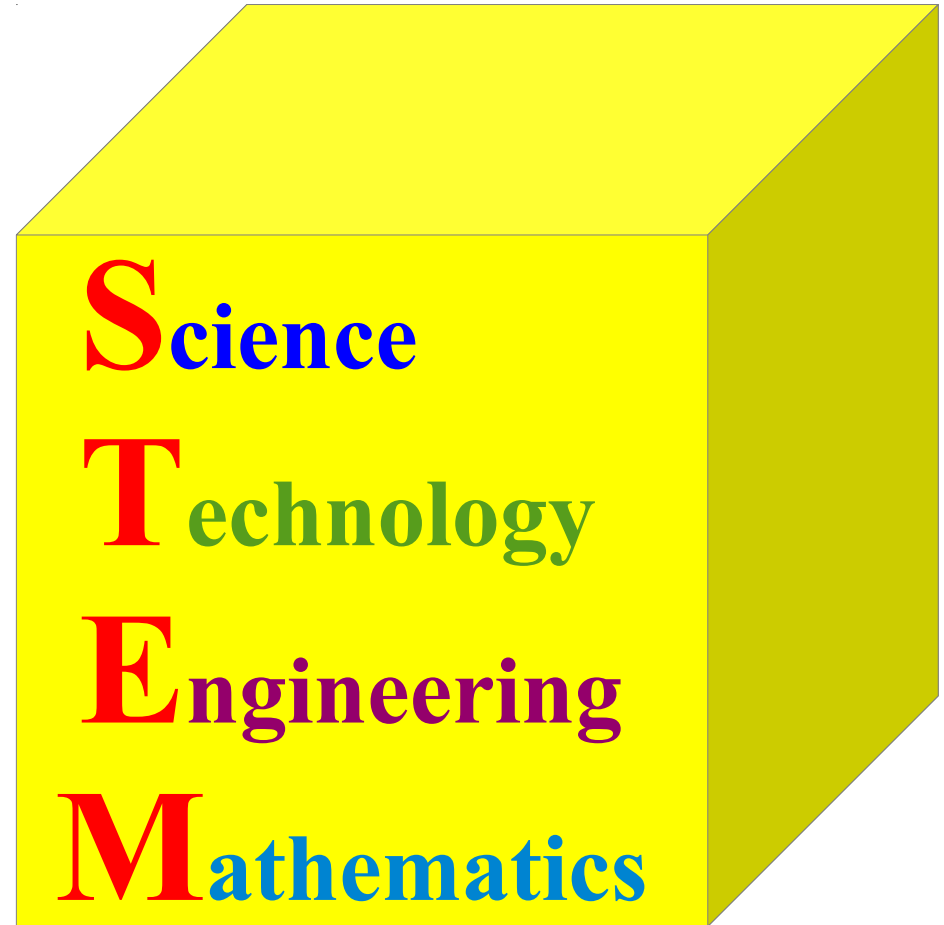
**Compound Interest**

**Black-Scholes Equation  
(LTCM)**



Also, for people in general:

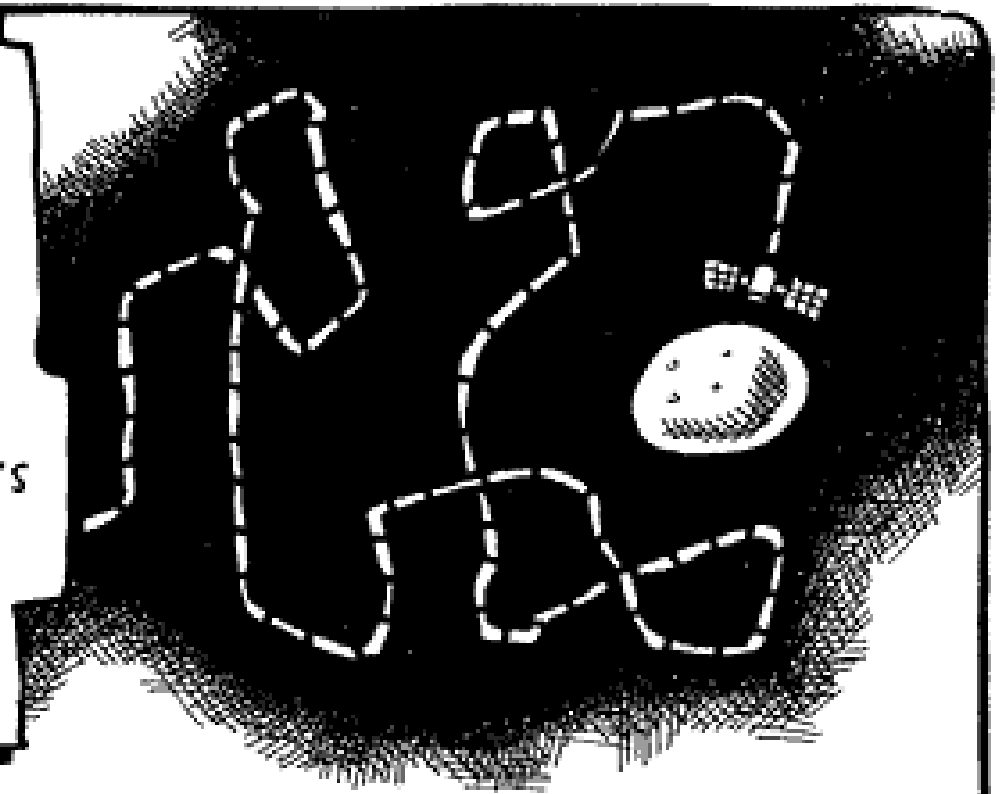
**Keep a Life**







TURN FOUR FURLONGS  
TO THE EAST, THEN  
TWO RODS TO THE RIGHT,  
SEVEN FATHOMS STRAIGHT  
AHEAD, A PECK TO THE  
SOUTH - NO, MAKE THAT A  
PENNYWEIGHT, THIRTEEN CUBITS  
SIDEWAYS, A HOGSHEAD  
DOWN TOWARD THE  
FINAL APPROACH TO THE  
MARTIAN SURFACE ...



**Mars Climate Orbiter**  
**September 23, 1999**  
**R.I.P.**



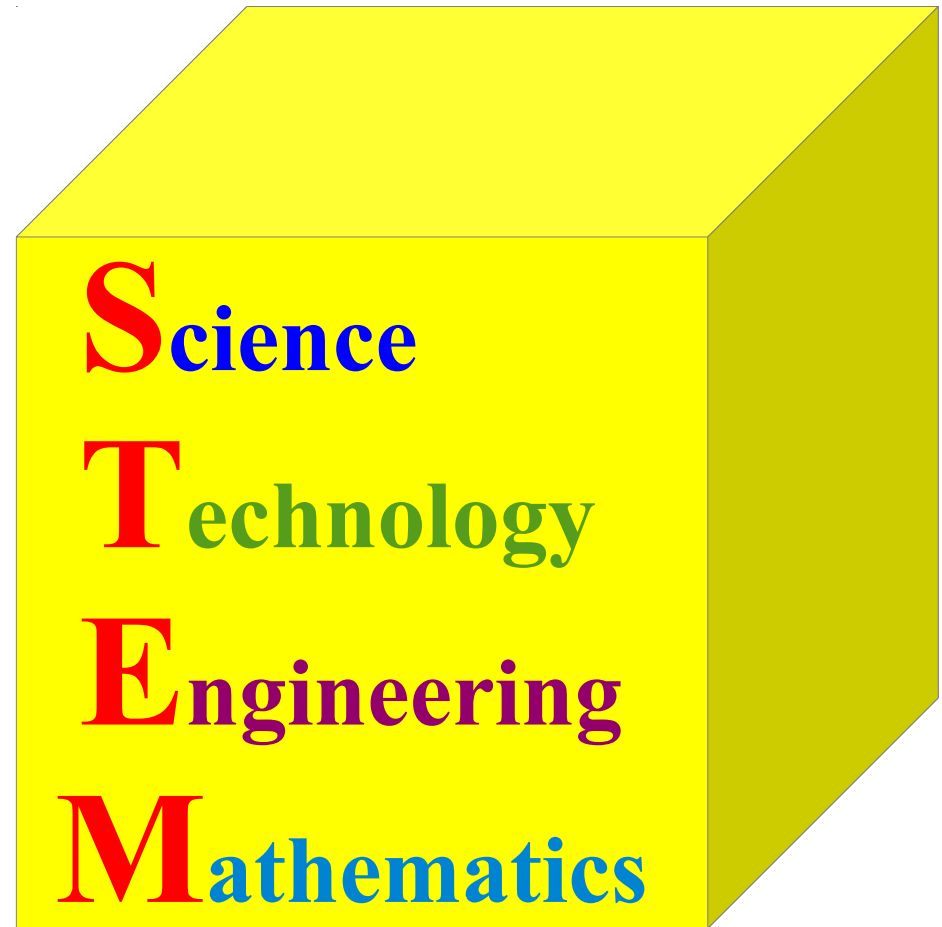
**TOLES**

UNIVERSAL PRESS SYND.  
10 ©1999 THE BUFFALO NEWS

WHAT'S A  
HOGSHEAD? ( THE GUY WHO WROTE  
THESE INSTRUCTIONS

To make this happen:

# Students Needed





# Beal Bank Dallas Regional Science and Engineering Fair

# DRSEF



# SMU

# FLUOR<sup>®</sup>



1000+



300+

\$100,000+



# The STEM PREP Project at SMU



Physician Scientist Training Program (PSTP)

Basic Scientist Training Program (BSTP)

Technology Engineering Math Program (TEMP)

Minority Trainee Research Forum (MTRF)



For more information about the Physician Scientist Training Program, contact Dr. Charles Knibb, Academic Director for the STMPREP Initiative at 214-768-2346 or visit [www.thedistancelearningcenter.org](http://www.thedistancelearningcenter.org)



**Distance Learning Center**

A revolutionary training paradigm generating new researchers for medicine, science, technology, engineering and math from underrepresented minority populations



To make this happen:

# Teachers Needed

#8	
STATS	
GOLD GLOVES	2
ALL-STAR GAMES	18
CONSECUTIVE GAMES	2,632

**CAL RIPKEN, JR**  
INFELDER

**topps**

#1	
STATS	
UNPAID HOURS SPENT GRADING PAPERS	7,821
RUNNY NOSES WIPED	6,002
HUGS GIVEN	12,480
LIVES FOREVER INFLUENCED	1,497

**OLGA Q. GLASRUD**  
TEACHER

**topps**

MIKE TH

Whose Amazing Career?

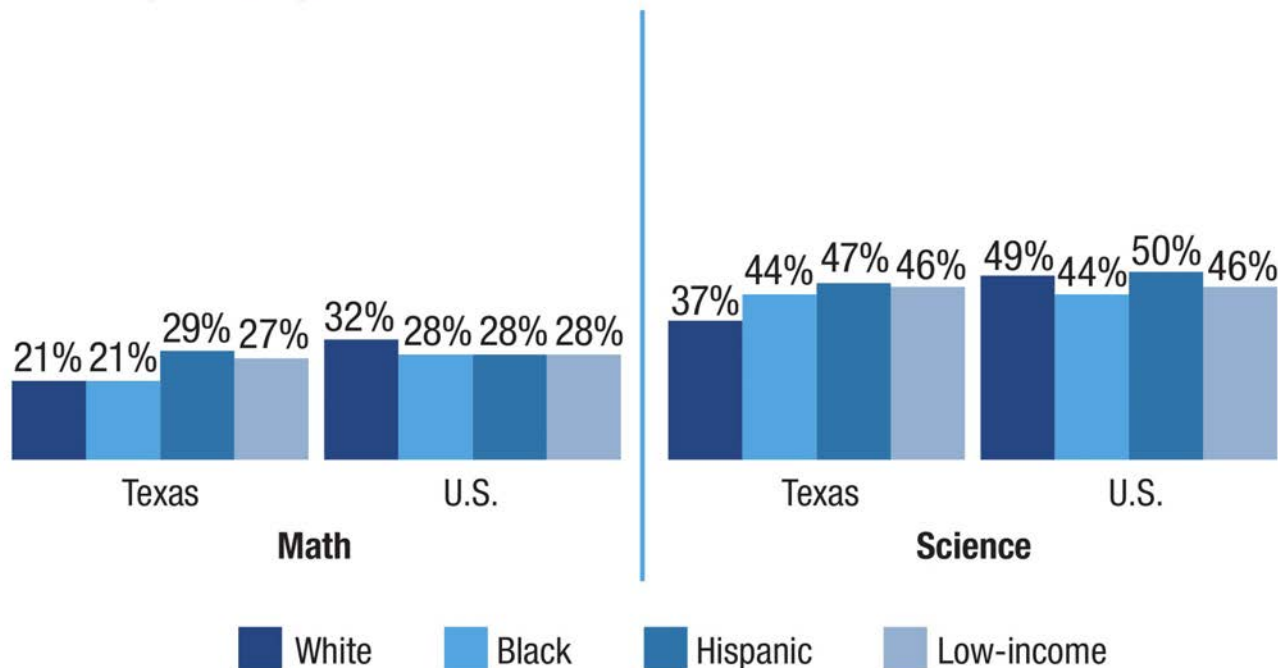


# ARE TEACHERS PREPARED TO TEACH TO HIGH STANDARDS?

Research shows that teachers' content knowledge and teaching experience can affect student performance.

## Teachers need deep content knowledge

8th graders whose teachers have an undergraduate major in the subject they teach, 2011



We need to provide the resources for our teachers

Professional development opportunities essential



# Master Physics Teacher Certificate

Department of Physics, Southern Methodist University

Science teachers seeking  
physics content training

New teachers seeking  
classroom ideas & resources

Physics teachers seeking  
deeper subject knowledge

**Mechanics**

**Electromagnetism**

**Modern Physics**

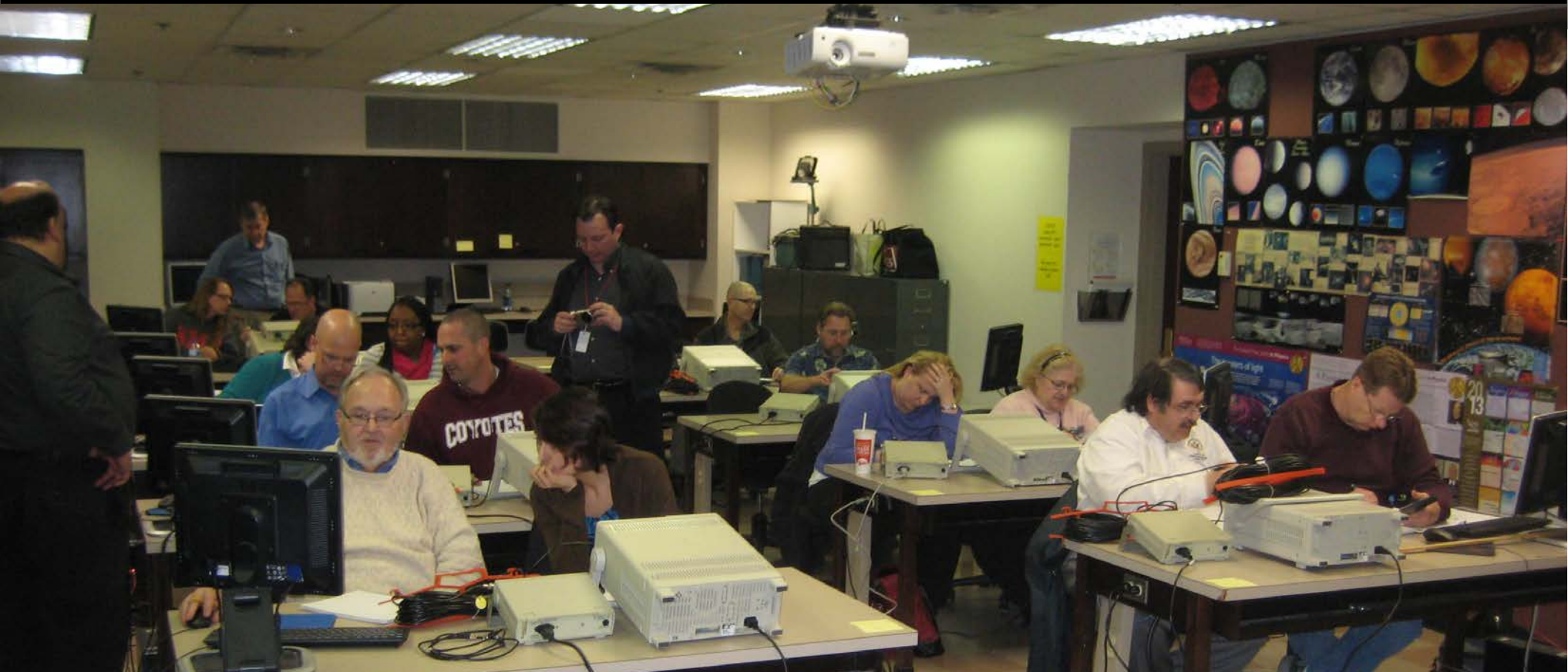
**Joint program  
with Simmons  
& Physics**



Beginning Fall 2012



# Master Physics Teacher Certificate Program



Jointly supported by **Dedman College** and the **Simmons School of Education & Human Development**

**2012 Pilot program w/ 20 Teachers**

No cost to teachers.

Commitment:

3 hours each Wednesday evening

**2013 Accepting applications now**

**SMU Lead Faculty:**

**Simon Dalley**

**Dara Williams-Rossi**

**Randall Scalise**

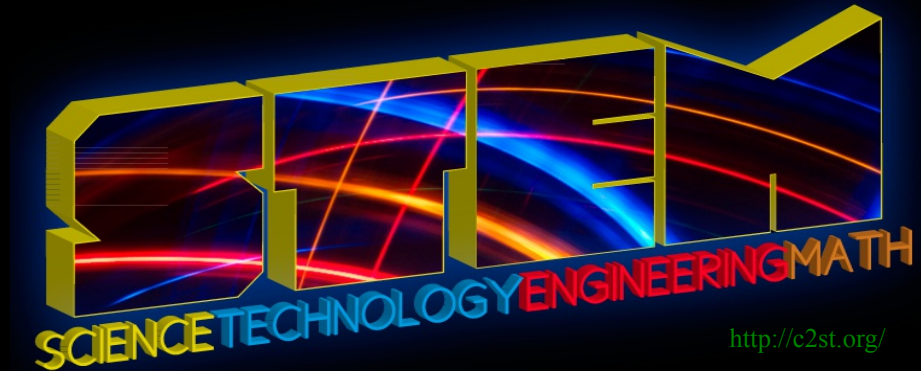
**Farley Ferrante**

"Why is science, technology, engineering, and mathematics (STEM) education so important and what must we do? The global economy has "flattened" the world in terms of skills and technology. A new workforce of problem-solvers, innovators, and inventors who are self-reliant and able to think logically is one of the critical foundations that drive a state economy's innovation capacity. State K-12 education systems, with the support of postsecondary education, the business sector, foundations, and governments, must ensure that

1) all students graduate from high school with the necessary science, technology, engineering, and math (STEM) competencies to become this workforce; and

2) a greater number of students graduate from high school as potential professionals in STEM fields."

**National Governors' Association**



# From "oil and water" to brownies:



*Yum*

Mixing MATH & ENGLISH to  
promote achievement for  
English Learners

Dr. Yetunde Zannou







# Primary and Secondary School

I was an ace in mathematics. I ate mathematics for lunch.



Math



Me

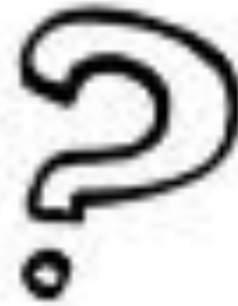


I just understood the language of math.



# College-bound

I majored in math because I loved it...until the Math Writing class, which threw me for a loop.





*Well that's not right.*

*Math and English don't mix.*

Turns out I didn't LOVE-LOVE it.  
(translation: I can do it, but I've seen enough)

I just never had to struggle to understand



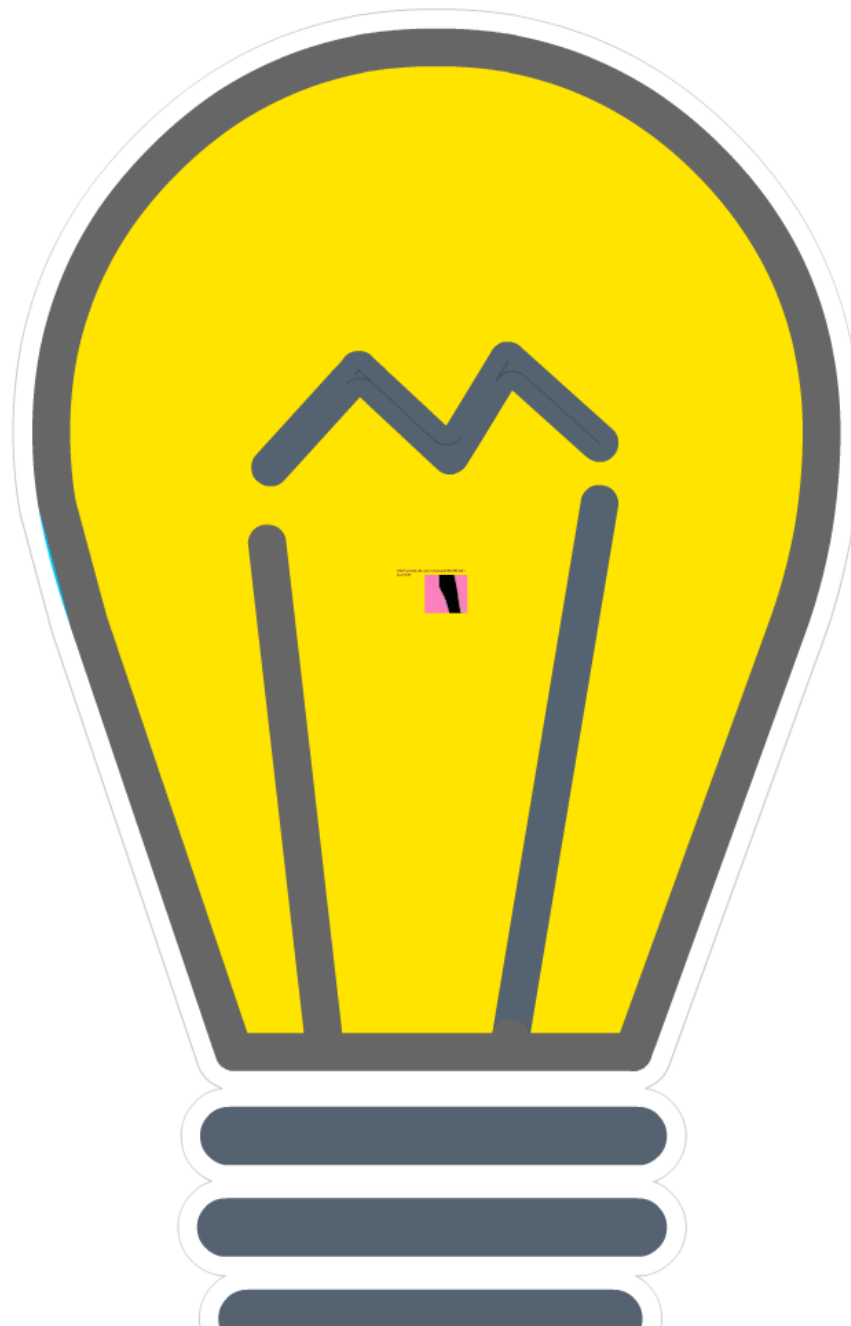
Turns out I didn't LOVE-LOVE it.

(translation: I can do it, but I've seen enough)

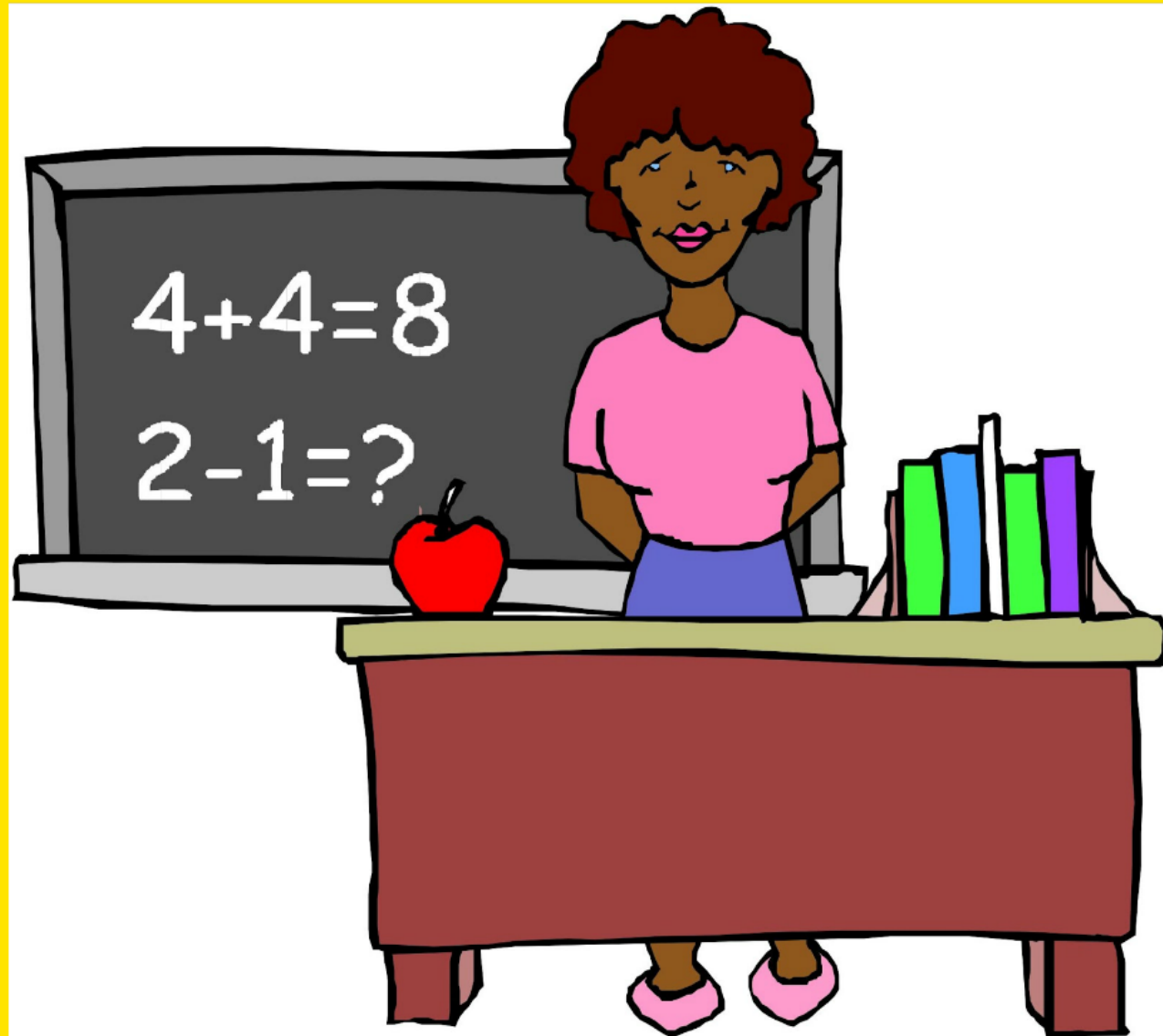
**I just never had to struggle to understand math.**



I had an idea...

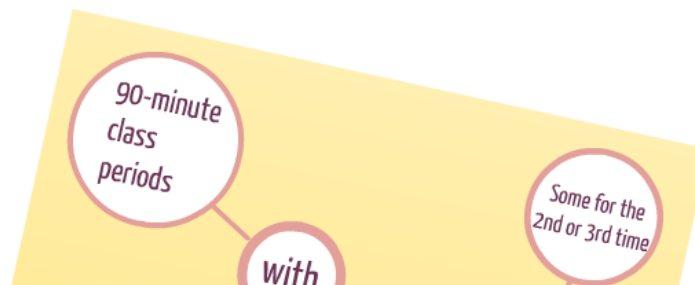


What if I could help others love (not necessarily LOVE-LOVE) math. I should TEACH!



# High School Math Teacher - Year 1

Like many first year teachers in inner cities, I had one of the most challenging teaching assignments

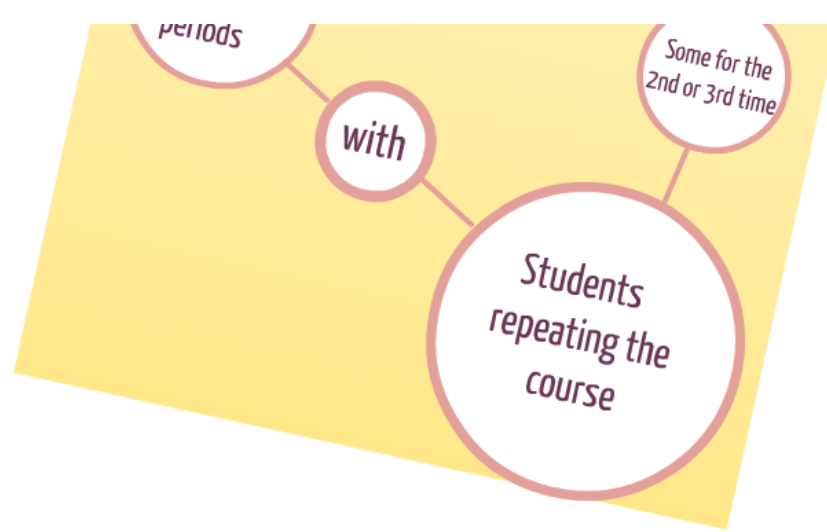


90-minute  
class  
periods

with

Some for the  
2nd or 3rd time

Students  
repeating the  
course



Most of my students, unlike me, DID struggle in math.





## Meanwhile in the Teacher's Lounge...

A frustrated colleague lamented their newly assigned English-as-a-Second Language class.

"They don't listen."



"They only want to speak Spanish!"



oo



Good thing all my  
kids speak English.



## High School Math Teacher - Year 2 and Beyond

My old school eventually closed due to persistently poor performance. I went to a nursing magnet school where students came from all over.



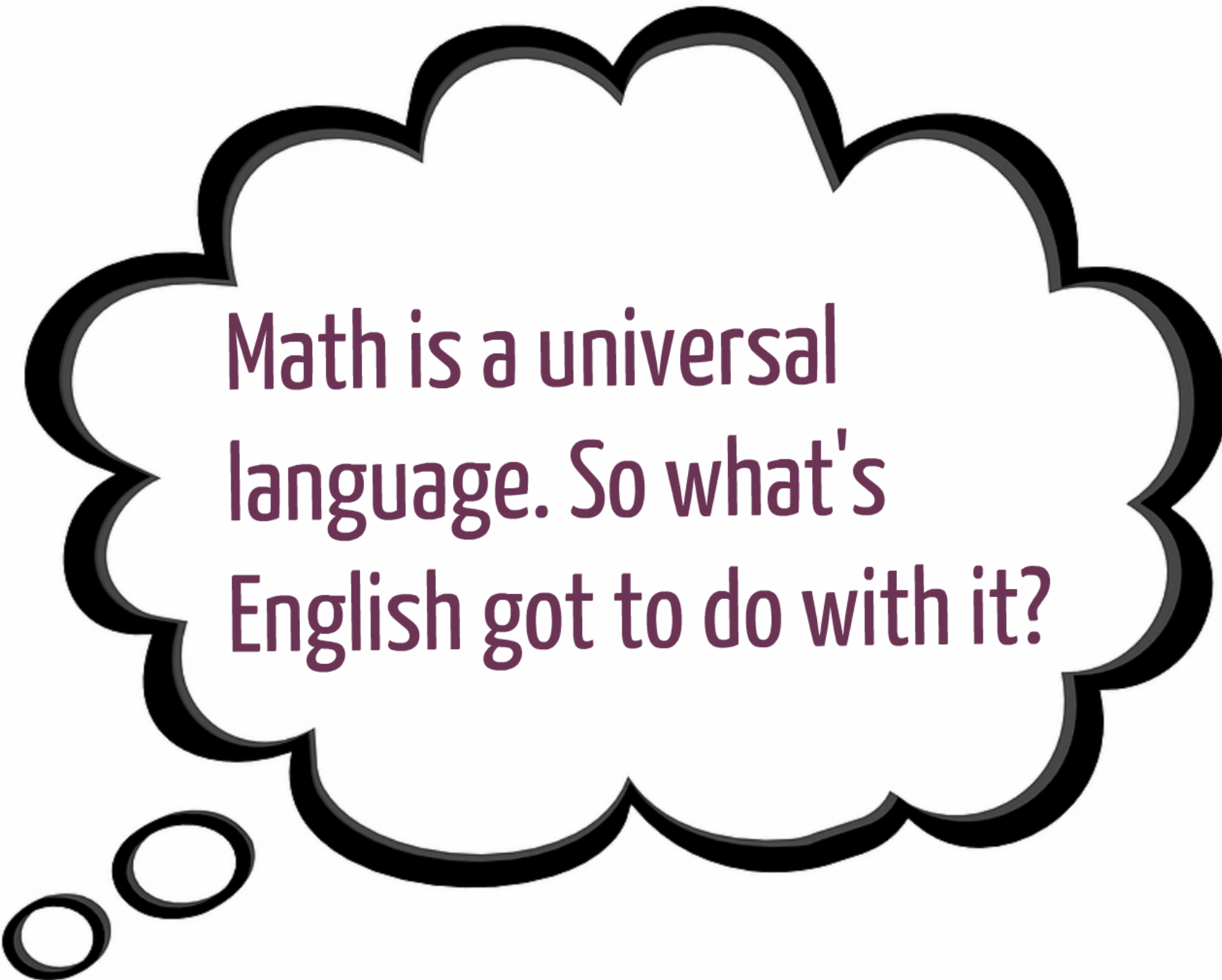
And I thought...

And I thought...

Good thing all my  
kids speak English.

But that wasn't exactly true. Some students were learning English, but it wasn't always obvious. Even if they were, I thought to myself...





Math is a universal  
language. So what's  
English got to do with it?

I eventually learned in graduate school (after leaving the classroom to pursue research),  
Students acquire a second language in parts:

Basic Interpersonal Communication Skills (BICS)

*which develop more quickly  
than and apart from their*

Cognitive Academic Language Proficiency (CALP)

de Jong & Harper (2005) say:  
Strong communication in the native language supports academic language proficiency in the target language. It's okay for students to "talk math" in the language they're comfortable while they learn English.

Basically, speaking English with seeming fluency does not signify understanding or academic language proficiency. Conversely, understanding does not require an ability to speak English fluently (Cummins, 1979).

## My "Post Teaching" Education

According to multicultural education scholar Sonia Nieto (I paraphrase):


"To disconnect language from education is to ask students to check their person and culture at the door."

**In many ways, our culture and language shape the way that we think, how we express ourselves, and understand the world around us.**



Some of you might be thinking

---

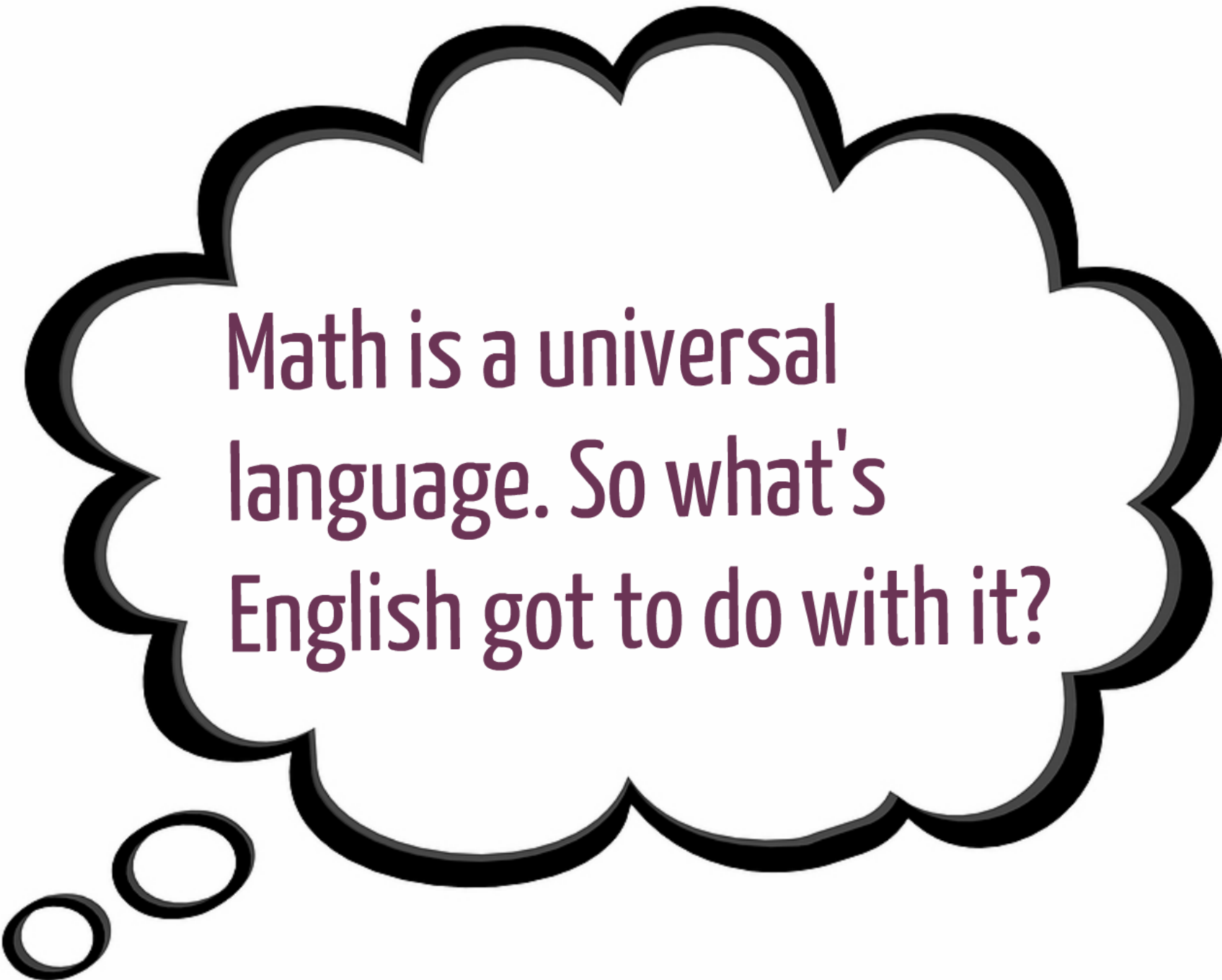


Well what's this  
got to do with math?

Well what's this  
got to do with math?

Math is a universal language. So what's English got to do with it?





Math is a universal  
language. So what's  
English got to do with it?





# The Power of Language:

Making Math (and STEM) Accessible to Language Learners



u might be thinking

# The Power of Language:

## Making Math (and STEM) Accessible to Language Learners



## Access:

To provide students with opportunities to engage and learn math through...

Listening

Reading

Speaking

Writing

Yes, even WRITING math. (I'm a believer!)

Yes, even **WRITING** math. I'm a believer!

# What things can hinder access for language learners?

A short list...

1. Rewarding students who respond the fastest. Others will learn over time to disengage.
2. Lowering expectations or standards based on language proficiency. Needing language support does not signify lack of understanding.
3. Evaluating learning in one way. Use a variety of assessments to see what students bring to the table.



## what acts of teaching PROMOTE access?

Another short list...

1. Pace your lessons.
2. Employ sufficient wait time.
3. Use multiple representations.
4. Diversify your assessment tools.
5. Scaffold language through direct instruction.



In SUM...

English and M

In Sum...

English and Math DO mix!

Math may be a universal language, but it is mediated by the language of instruction.

Math may be a universal language, but it is mediated by the language of instruction.

Math may be a universal language, but it is mediated by the language of instruction.

To make math (& STEM) accessible for all students, make brownies...mix language instruction with math instruction regularly. Repeat as often as needed until student cognitive academic language proficiency rises.







**The End**

# **STEM** *and* *the* **MATH** *importance of*

ONE PUBLIC EDUCATION VIEWPOINT  
STORMY LEMOND, M. ED.

ASSESSMENT SPECIALIST & SECONDARY MATHEMATICS  
INSTRUCTIONAL FACILITATOR  
FORNEY ISD

# A **TEACHER'S** VIEWPOINT

“Everything about STEM is a creative application of Math principles. The goal of engineering is to make something that doesn't already exist. Math is the tool that gives real shape to that creative process.”

**-WESLEY BENJAMIN,  
FORNEY ISD STEM TEACHER**

# A COMPANY'S VIEWPOINT

“Our future success—and our nation’s technological advantage—depend on a constant supply of highly trained, highly capable technical talent.”

-LOCKHEED MARTIN  
STEM EDUCATION OUTREACH

# AN **INVENTOR'S** VIEWPOINT

“I have not failed. I've just found 10,000 ways that won't work.”

“Our greatest weakness lies in giving up. The most certain way to succeed is always to try just one more time.”

**-THOMAS EDISON**



**I'M ALWAYS RIGHT!**



INNOVATION IS ...



# INNOVATION IS ...



# INNOVATION IS ...





# INNOVATION IS ...



INNOVATION IS...



INNOVATION IS ...





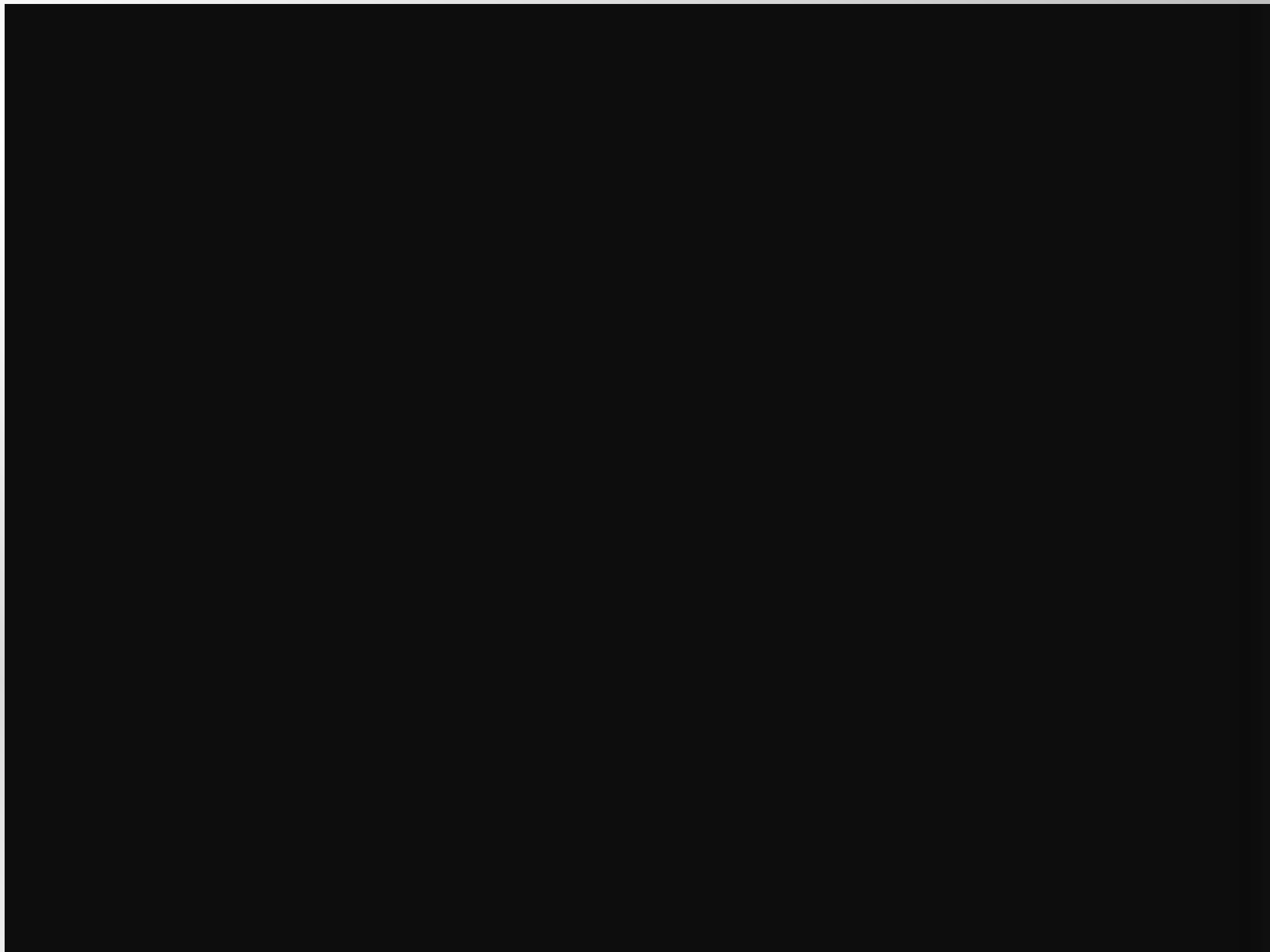
# INNOVATION IS ...

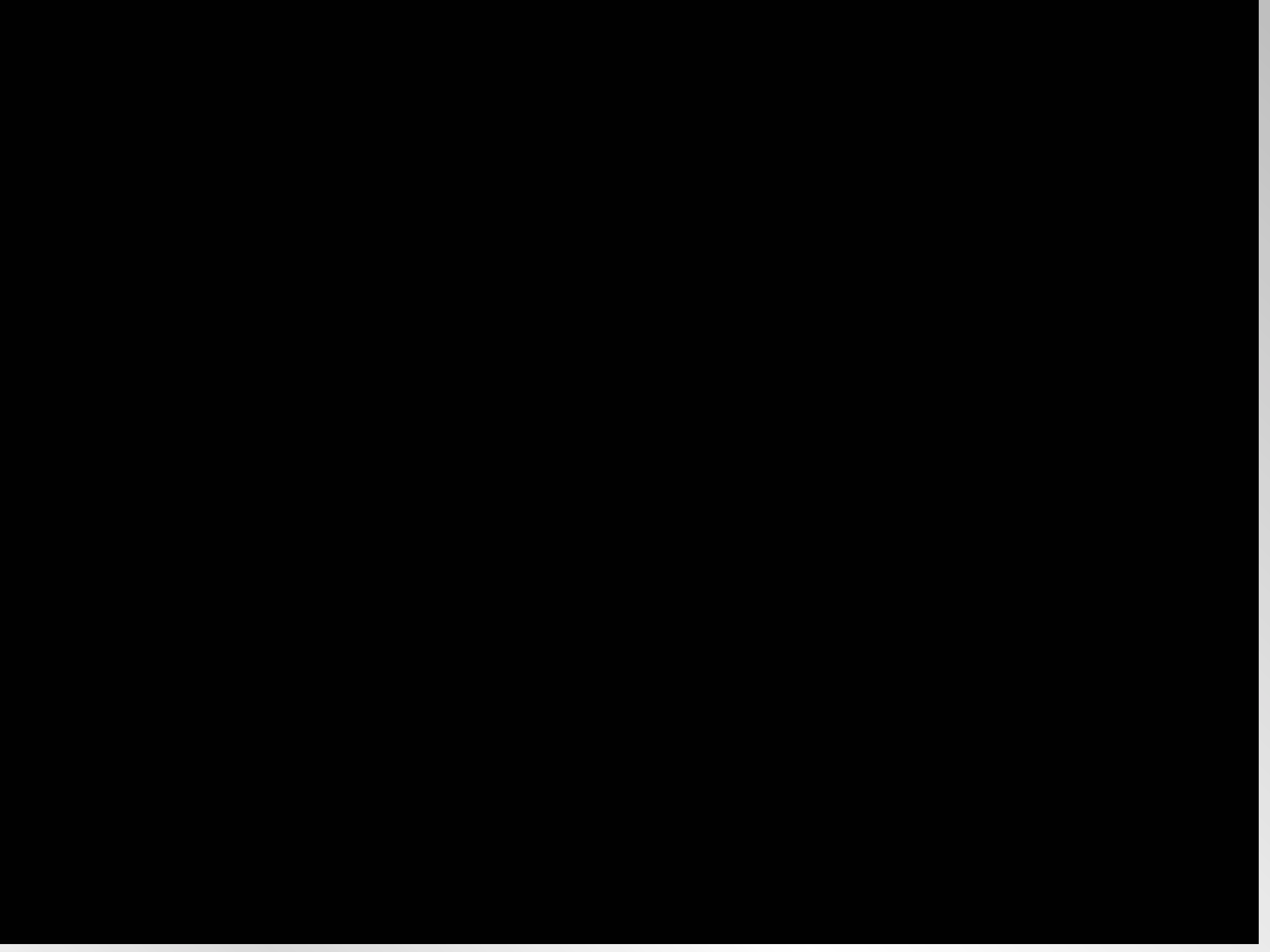
- Tanning Bed
- Newspaper
- Facebook
- Landlines
- Flip Phone
- Digital Cameras
- Yellow Pages
- Watches
- Nail polish
- Checkbook
- Car Keys
- Post Office

# WHY IS **MATH** IMPORTANT?

“...all jobs of the future will require a basic understanding of math and science. The most recent ten year employment projections by the U.S. Labor Department shows that of the 20 fastest growing occupations projected for 2014, 15 of them require significant mathematics or science preparation to successfully compete for a job.”

**-BUREAU OF LABOR STATISTICS**





# HOW CAN WE **ENGAGE** STUDENTS?

- STEM: encouragement of problem solving in a non teacher-centered environment
- PLTW: Project Lead the Way
- David Kelley—founder of IDEO
  - Design thinking – building on the ideas of others using diversity, culture, and collaboration by focusing on being empathetic for the user

# EXPLORE: What is STEM and Why is it Important? What Role Does Mathematics Play?

Thank You!



SMU.

ANNETTE CALDWELL SIMMONS  
SCHOOL OF EDUCATION  
& HUMAN DEVELOPMENT

**CHANGING MINDS**