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Using YA Fiction to Build Interest in STEM with Teen Girls

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Footer Logo

Using YA Fiction to Build Interest in STEM with Teen Girls

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Why a difference?

- Girls and boys take sciences in elementary through high school education in equal numbers.
- High school girls and boys report that they intend to pursue STEM in college
- Female college students earn only 20% of STEM degrees.

Clark Blickenstaff, J. (2005). Women and science careers: leaky pipeline or gender filter? *Gender and education*, 17(4), 369-386.

Leaky Pipeline to STEM

Reviewed 20+
years of
literature on
girls & STEM

1. Biological differences.
2. Lack of academic preparation in science for girls.
3. Poor attitude toward science of girls.
4. Absence of role models.
5. Science curricula irrelevant to many girls.
6. Pedagogy of science classes favors male students.
7. A 'chilly climate' exists for girls/women in science classes.
8. Cultural pressure on girls/women towards traditional gender roles
9. An inherent masculine worldview in scientific epistemology.

Clark Blickenstaff, J. (2005). Women and science careers: leaky pipeline or gender filter? *Gender and education*, 17(4), 369-386.

Why it matters

- Workforce projections
 - 9/10 fastest growing fields in STEM
 - Biggest increases in Engineering and Computer Science (currently only 25% female)
- Innovation including female concerns
 - Early voice recognition programs not calibrated for female voices
 - Air bags were originally designed for males
- Wage gap
 - Women in STEM careers earn more than women in nonSTEM careers

Reasons

- Biology
 - No difference in brain size
 - Famous male scientists had small brains
 - Spatial abilities show a 2 to 1 ratio NOT the 20 to 1 ratio seen in classes
- Preparation
 - Girls with strong STEM prep in high school still drop out in significant numbers from STEM majors in college
- Attitude
 - Slight difference in attitude towards science between boys and girls in HS
 - Same interest but **girls less likely to see themselves as scientists** (Baker & Leary, 1995)

Reasons (continued)

- Role models
 - Critical mass: numbers of women in STEM too low to maintain a visible population
 - **Image of successful female scientists** as less likely to have children (Sonnert, 1995)
 - Path to success was so unique to each female scientist makes it hard for younger females to replicate
- Curricula (Tai & Sadler, 2001)
 - Female students more successful with algebra-based physics
 - Male students more successful with calculus-based physics
- Pedagogy
 - Teachers marked assignments perceived to have been done by a male student higher than if they perceived the assignment was done by a female student
 - Gave less feedback to female students (Eccles & Blumenfeld, 1985)

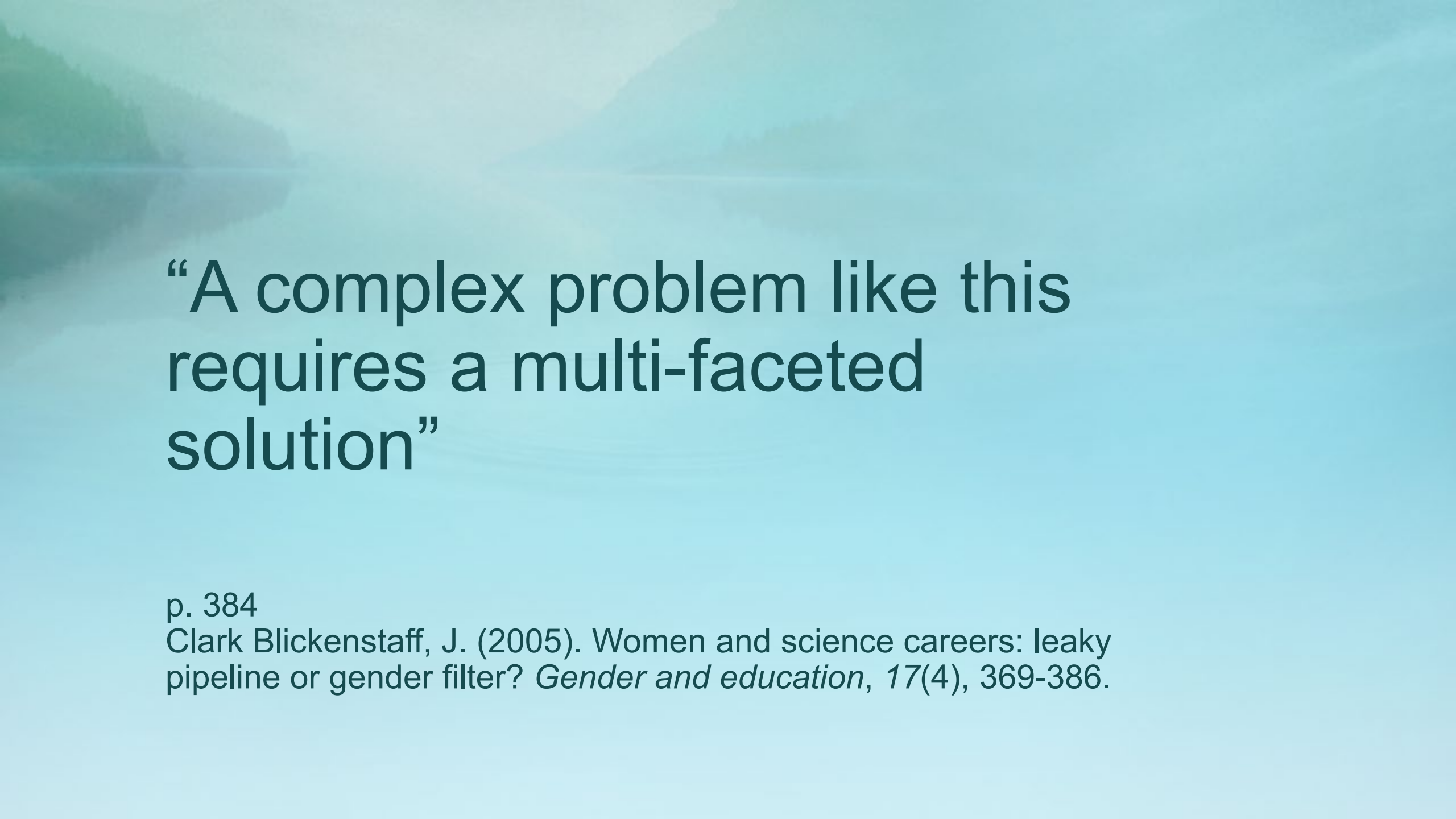
Reasons (continued)

- Chilly Climate
 - Teachers predicted higher performance of male students over female students and had **lower expectations for female students**
 - Teachers rewarded boys who didn't follow directions because they did more original work and **downgraded girls who followed directions** but assignments lacked “sparkle”
- Cultural pressure
 - Females report **conflict in dual roles** for being in the sciences and the primary care giver for their children
- Masculine worldview in science
 - Females historically excluded from clinical trials and **not seen** in research studies

Hill, C., Corbett, C., & St. Rose, A. (2010). Why so few? Women in science, technology, engineering, and mathematics. American Association of University Women. Retrieved from <https://www.aauw.org/files/2013/02/Why-So-Few-Women-in-Science-Technology-Engineering-and-Mathematics.pdf>

It's an image thing...

- Media featuring animated video of a female engineer (Plant et al., 2009)
- Growth mindset
 - When girls believe they can become smarter with practice, they are more likely to succeed in STEM
- Awareness of how STEM contributes to society
 - Females more likely to need to see a purpose for their work (Jozefowicz et al., 1993; Konrad et al., 2000; Margolis et al., 2002; Lubinski & Benbow, 2006; Eccles, 2006)

A misty, teal-toned landscape with mountains and a lake. The scene is hazy and atmospheric, with the mountains and water reflecting the soft light. The overall color palette is a range of blues and greens, creating a calm and serene mood.

“A complex problem like this
requires a multi-faceted
solution”

p. 384

Clark Blickenstaff, J. (2005). Women and science careers: leaky pipeline or gender filter? *Gender and education*, 17(4), 369-386.



One possible facet....

Help young women see themselves in
STEM using literature meant for them.

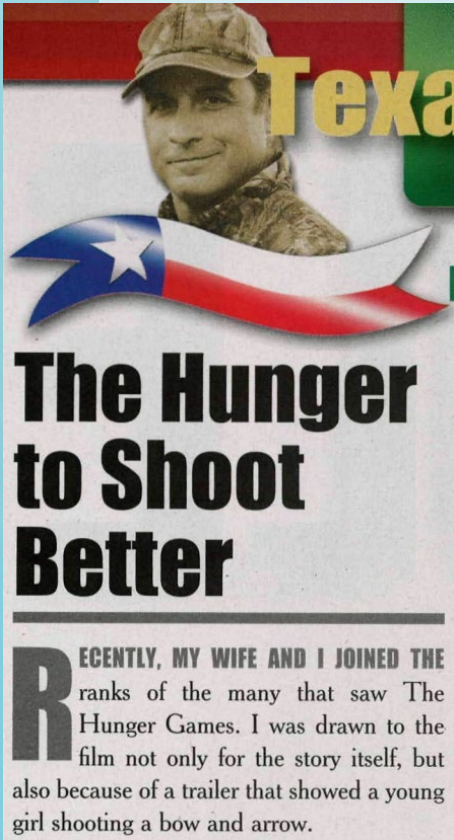


Figure 1: Headline from Marullo, L. (2012). The Hunger to Shoot Better. *Texas Fish & Game*, 29(4), 21.

Hunger Games Hysteria

The surging trend of archery in pop culture has spiked interest and participation in bow sports nationwide

Movie points teens toward archery

“Hunger Games” has been a boon to local industry.

good for business. The bad economy hasn't been very helpful, but we've recovered some of what we might have otherwise lost, thanks to that movie.”

Figure 2: Headline from Idema, J. (2012). Movie points teens toward archery. *Grand Rapids Business Journal*, 30(39), 9.

Figure 3: Taylor, D. (2015). Hunger Games hysteria. *Parks & Recreation*, 50(3), 16.

Figure 4: Headline from Reason, B. (2014, March 23). Archery ranges show influence of 'Hunger Games'. *Indystar*. Retrieved from <http://www.indystar.com/story/life/people/2014/03/23/archery-ranges-show-influence-hunger-games/6802699/>

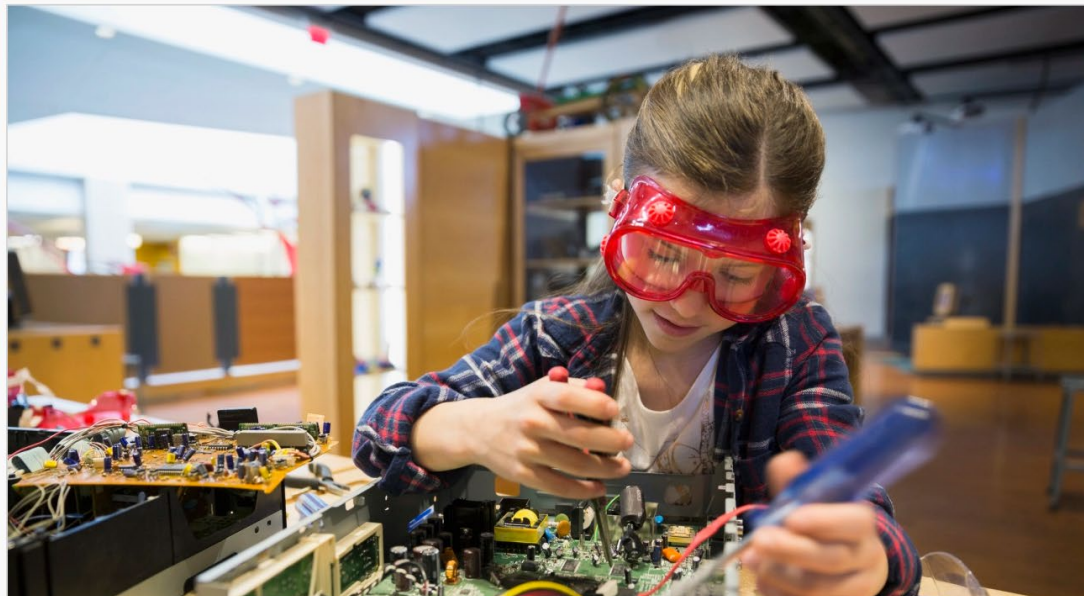
Screening of film 'Hidden Figures' ignites interest in STEM among students

Figure 5: Headline retrieved from DeRamos, C. (2017, February 17). Screening of film 'Hidden figures' ignites interest in STEM among students. *The notebook*, Philadelphia Public Schools. Retrieved from <http://thenotebook.org/articles/2017/02/17/screening-of-film-hidden-figures-ignites-interest-in-stem-among-students>

CRUNCH NETWORK


Hidden Figures: Inspiring STEM heroes for girls

Posted Jan 13, 2017 by Tracey Welton-Rossman



SAMSUNG

Pre-order the Galaxy and choose free accessories up to \$229.*



*Limited time offer through 9/14/17 while supplies last. Terms apply.

NEWSLETTER SUBS

Figure 6: Headline retrieved from Welton-Rossman, T. (2017, January 13). Hidden figures: Inspiring STEM heroes for girls. *Techcrunch*. Retrieved from <https://techcrunch.com/2017/01/13/hidden-figures-inspiring-stem-heroes-for-girls/>

Research

Hsu, C., Conrad, M., & Jacobs, A. M. (2014). Fiction feelings in Harry Potter: Haemodynamic response in the mid-cingulate cortex correlates with immersive reading experience. *Neuroreport: For Rapid Communication Of Neuroscience Research*, 25(17), 1356-1361.

Johnson, D. R., Cushman, G. K., Borden, L. A., & McCune, M. S. (2013). Potentiating empathic growth: Generating imagery while reading fiction increases empathy and prosocial behavior. *Psychology Of Aesthetics, Creativity, And The Arts*, 7(3), 306-312.

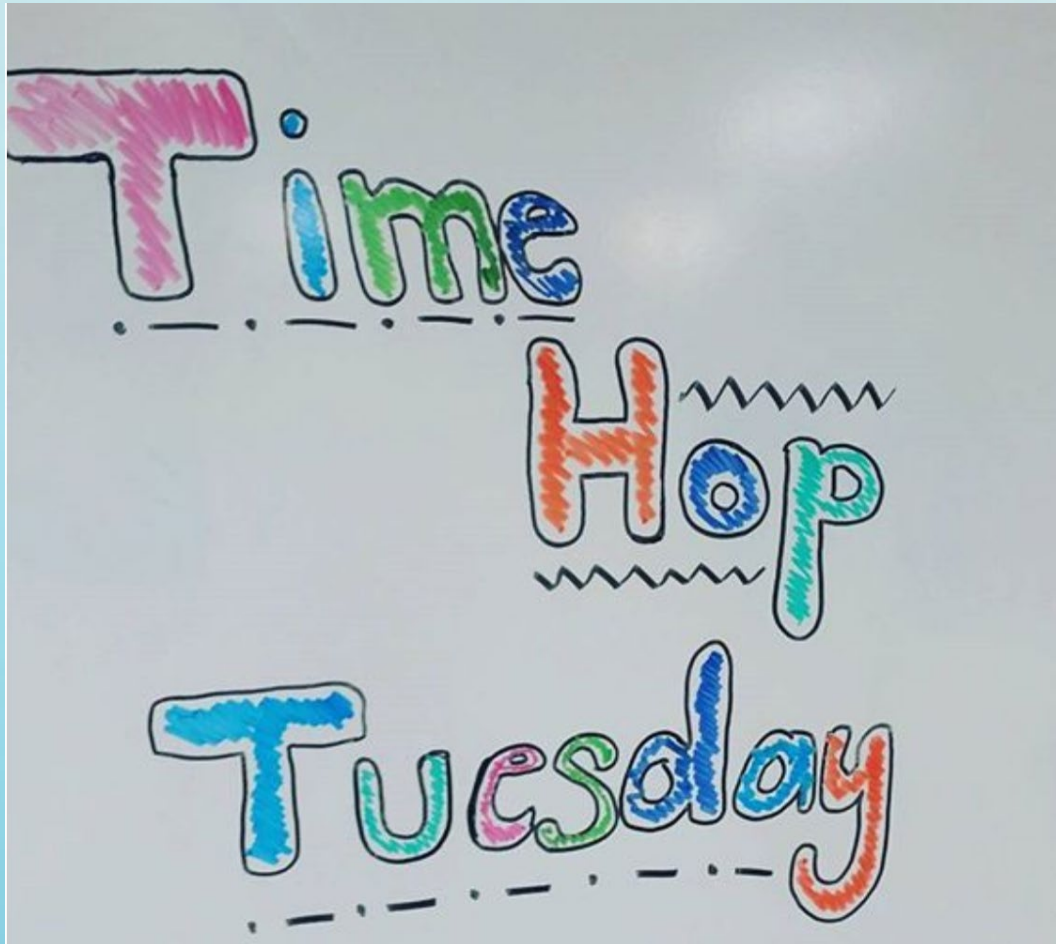
Djikic, M., & Oatley, K. (2014). The art in fiction: From indirect communication to changes of the self. *Psychology Of Aesthetics, Creativity, And The Arts*, 8(4), 498-505.

A misty, teal-toned landscape with mountains and a lake. The scene is hazy and atmospheric, with a color palette dominated by various shades of blue, green, and cyan. The mountains in the background are soft and indistinct due to the mist. In the foreground, a calm body of water reflects the surrounding environment. The overall mood is serene and quiet.

Review of books

With STEM-interested protagonists

Interactive Display



What day/year would you relive?

High or Lo Tech

- Twitter exchange
- Facebook
- Physical bulletin board
- Padlet or Linolt

Figure 11: Display image retrieved from Pinterest.

Physics

Woolston, B. (2010). *The freak observer*. Minneapolis: Carolrhoda Books.

2011 winner of the
William C. Morris Award

I didn't tell Mr. Banacek that I'd been using the problem of the Freak Observer like a bunch of jingling keys to distract my brain. I didn't tell him the Freak Observer is my space suit when I'm floating in the cold and the dark. I didn't tell him that I cry for the other Freak Observers. I didn't include that stuff, because that's emotion—and emotion doesn't belong in physics.

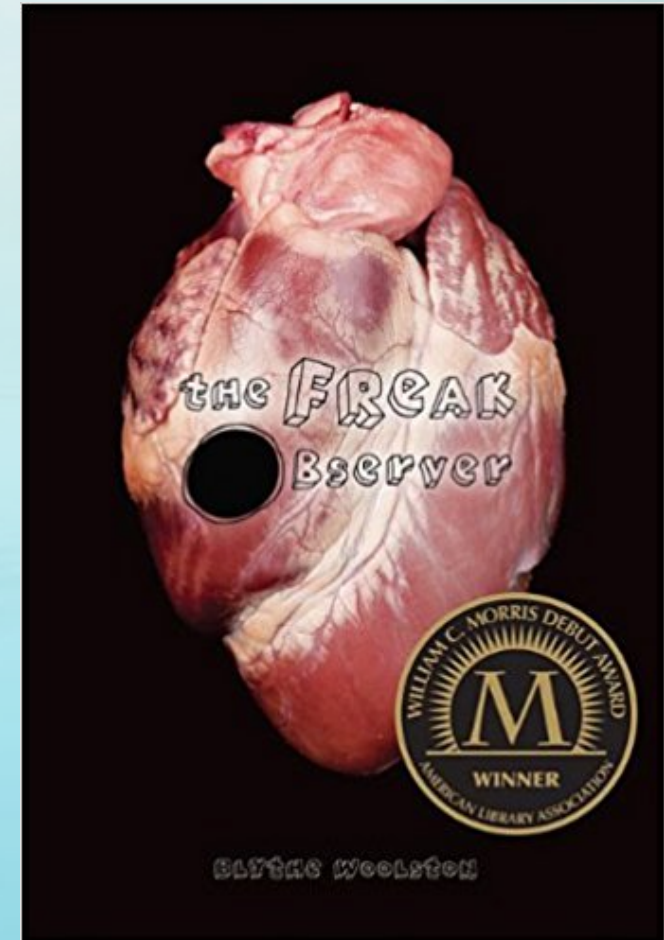


Figure 12: Book cover retrieved from publisher website

Citizen scientist event

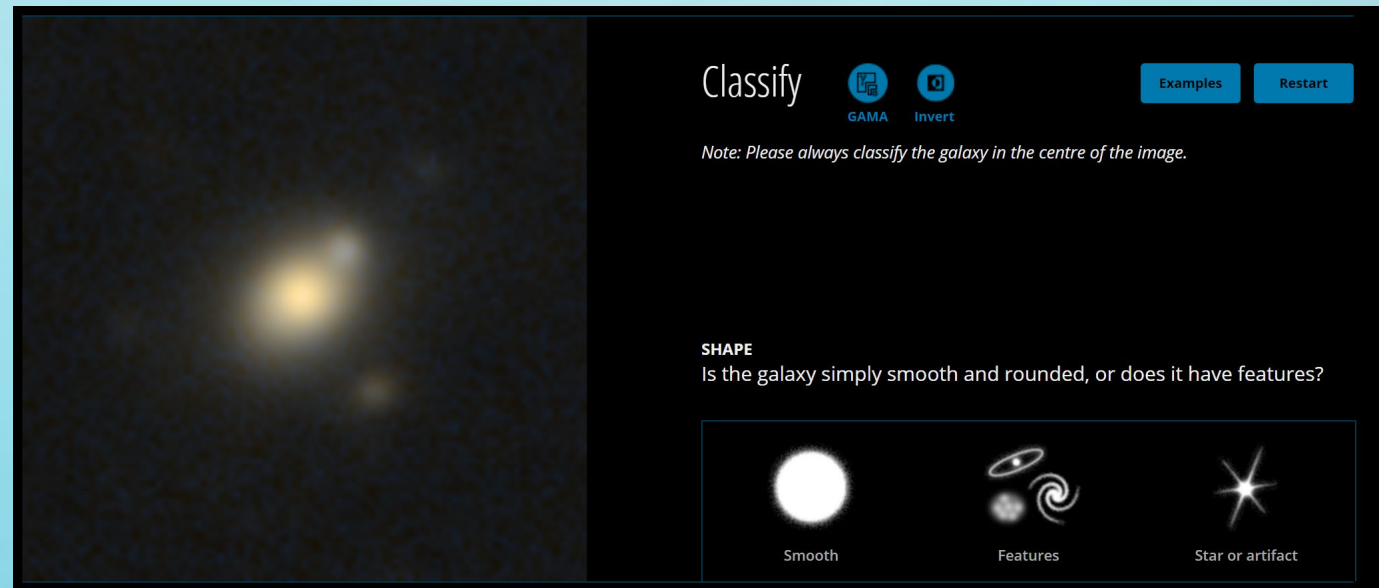
Freak Observer

A self-aware being created by a chance that tries to make sense out of chaos

Galaxy Zoo from Zooniverse

- <https://www.galaxyzoo.org/>
- Huge data set made up of a million images of galaxies that need classifying

Figure 13: Snippet of screen shot from GalaxyZoo.com



Computer Science

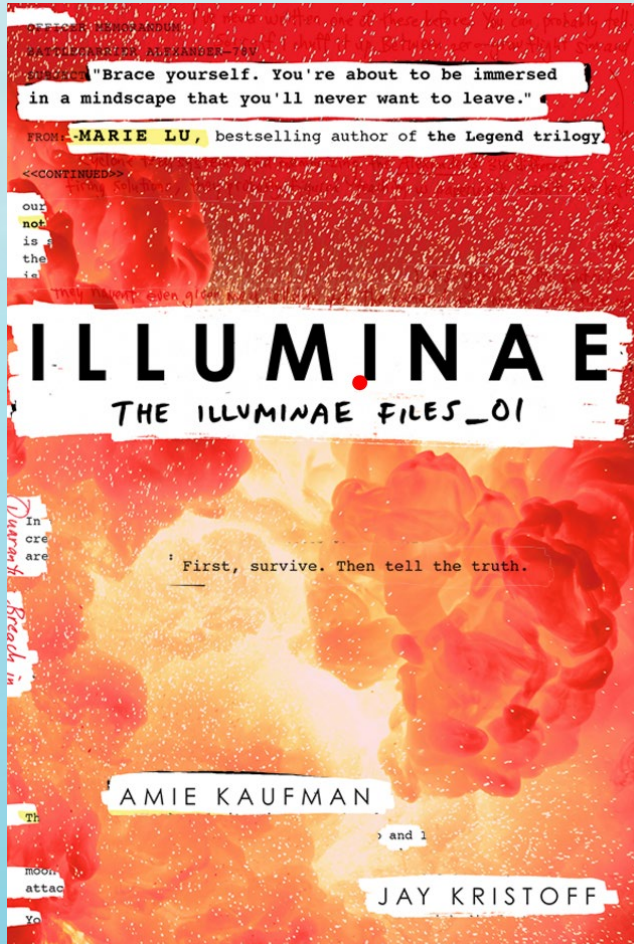


Figure 14: Book cover retrieved from author's website.

Kaufman, A., & Kristoff, J. (2015). *Illuminae*. New York: Alfred A. Knopf.

Lu, M. (2017). *Warcross*. New York: G.P. Putnam's Sons.

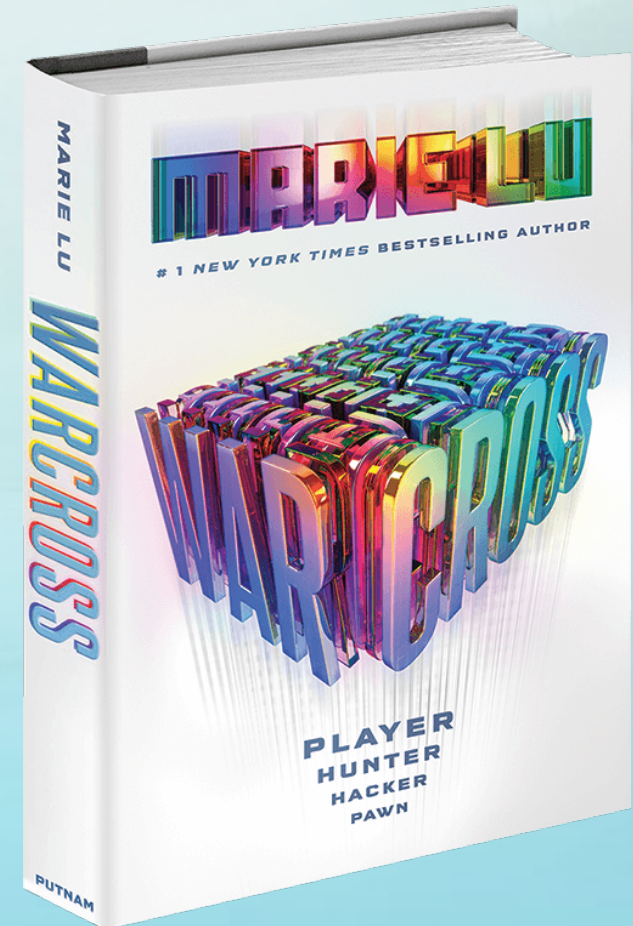
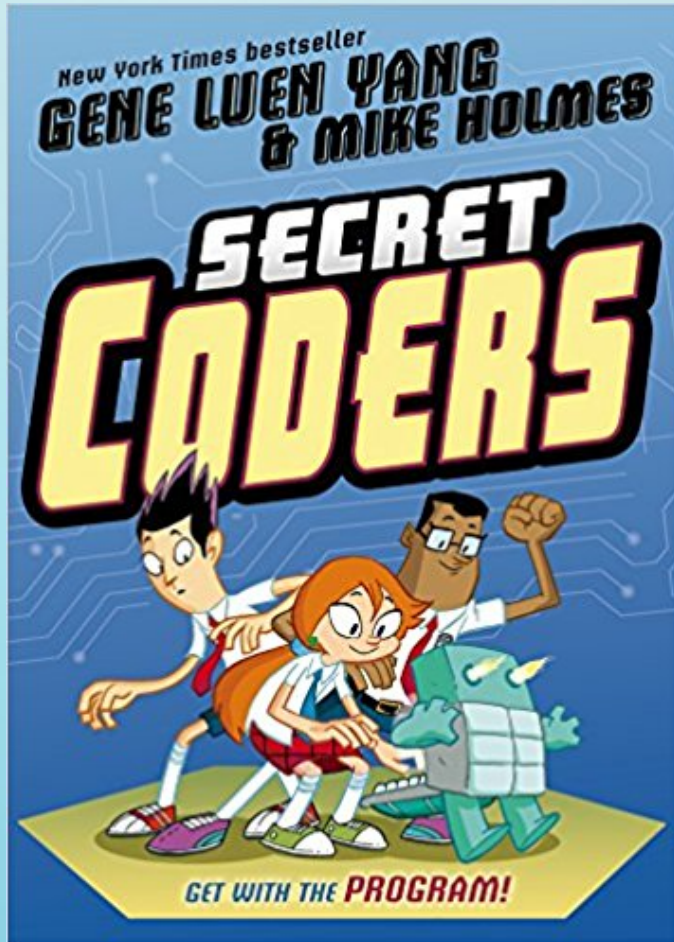


Figure 15: Image retrieved from <http://www.onetrueportal.com/marielu/>

Computer Science

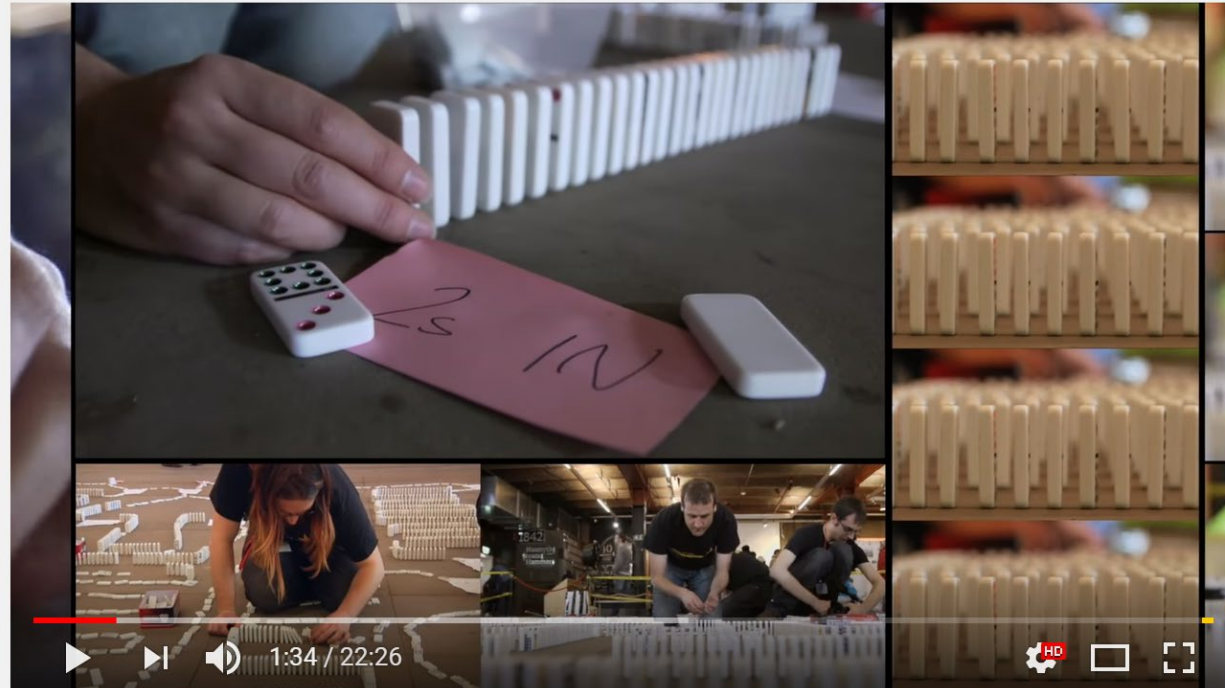


Yang, G., & Holmes, M. (2015). *Secret coders*. New York: First Second.



Figure 16 & 17: Book covers retrieved from Amazon.com.

Build a domino computer



The 10,000 Domino Computer



standupmaths

Subscribe 341K

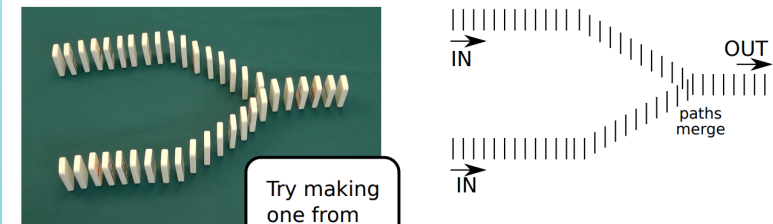
939,907 views

Figure 18: Image of scene from Youtube video by standmaths retrieved from https://www.youtube.com/watch?v=OpLU__bhu2w&feature=share

Figure 19: Image of snippet from Think Maths website. Retrieved from <http://www.think-maths.co.uk/downloads/domino-computer-worksheets>

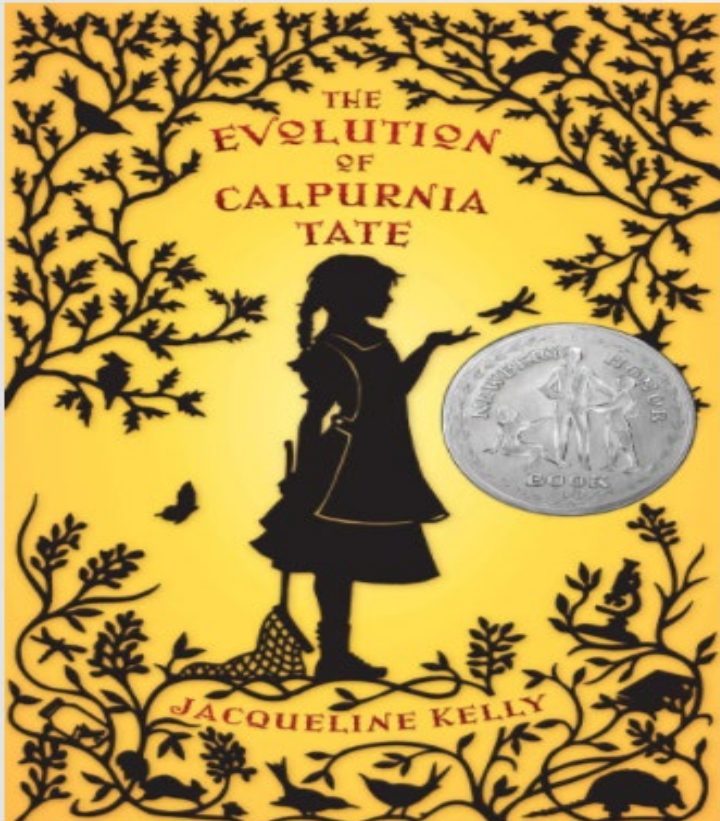
Domino OR

The OR gate is fairly easy to make from dominoes - we need two input chains, either of which will set off the output chain of dominoes. A domino OR gate looks like this:



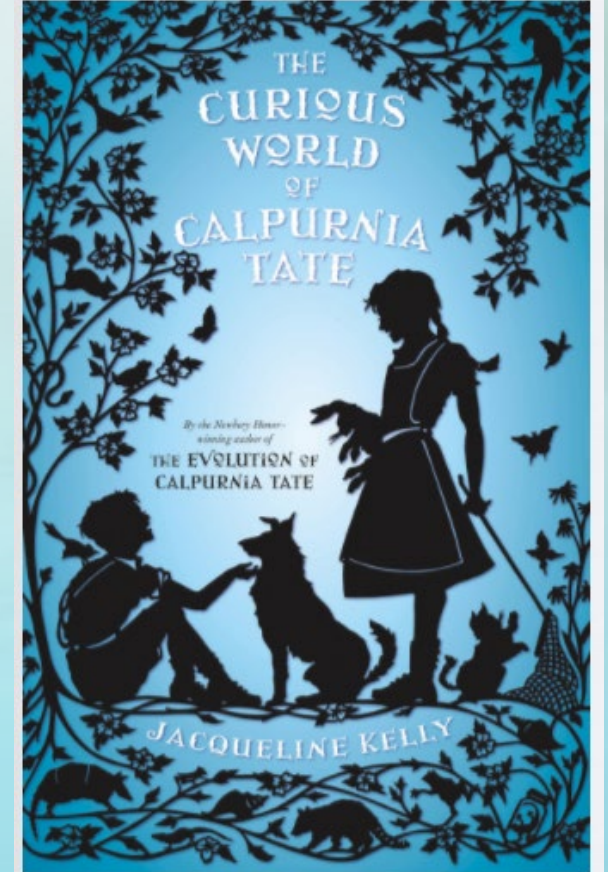
Try making one from dominoes!

Environmental Sciences



Kelly, J. (2011). *The evolution of Calpurnia Tate*. New York: Square Fish.

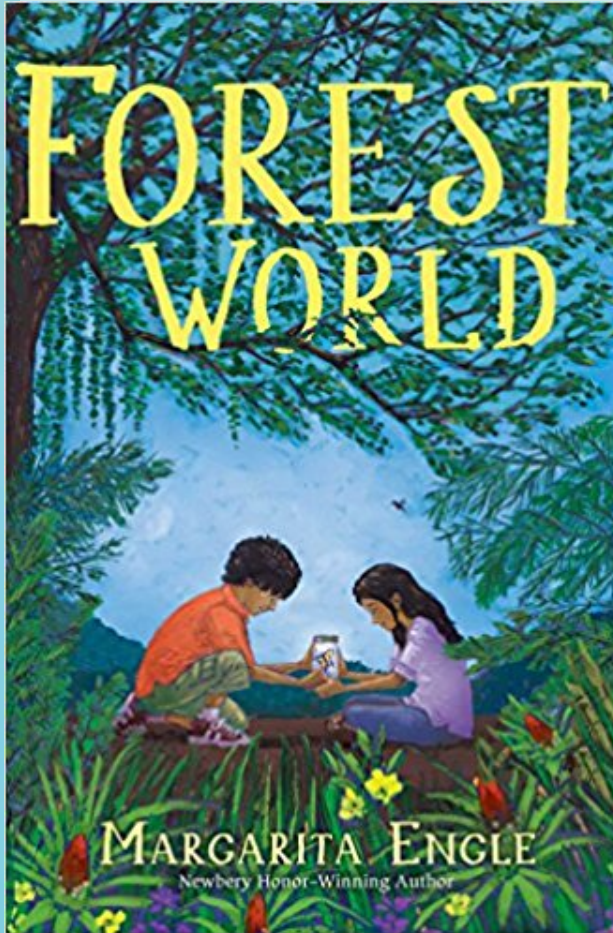
Kelly, J. (2015). *The curious world of Calpurnia Tate*. New York: Henry Holt.



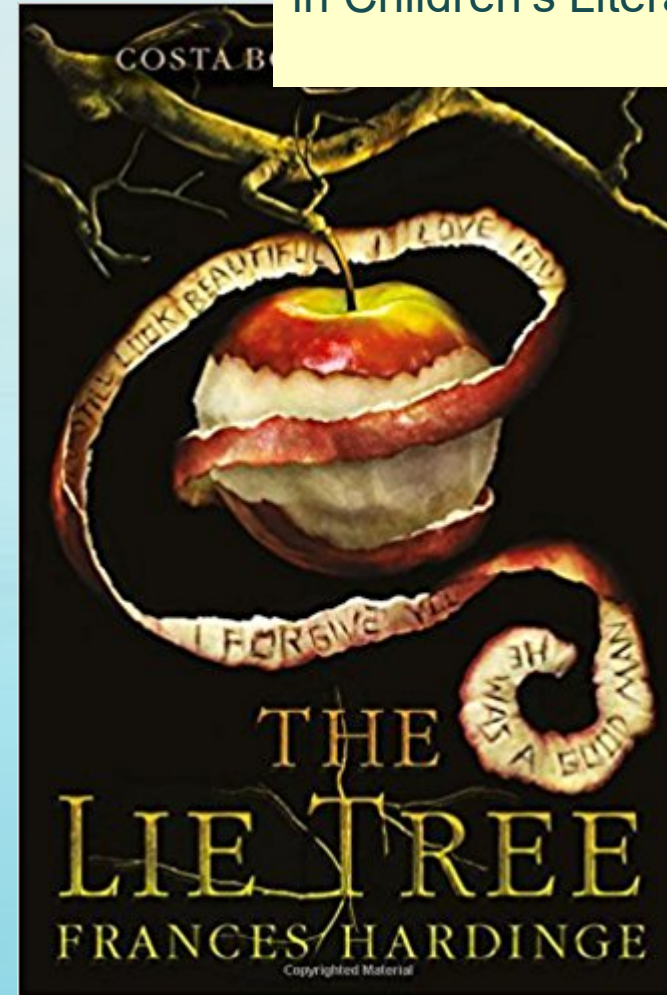
Figures 20 & 21: Book covers retrieved from author's website.

Environmental Sciences

Winner of the United Kingdom's Costa Book of the Year Award in Children's Literature.



Engle, M.
(2017). *Forest world*.
New York: Atheneum.



Hardinge, F. (2016). *The lie tree*. New York: Amulet Books.

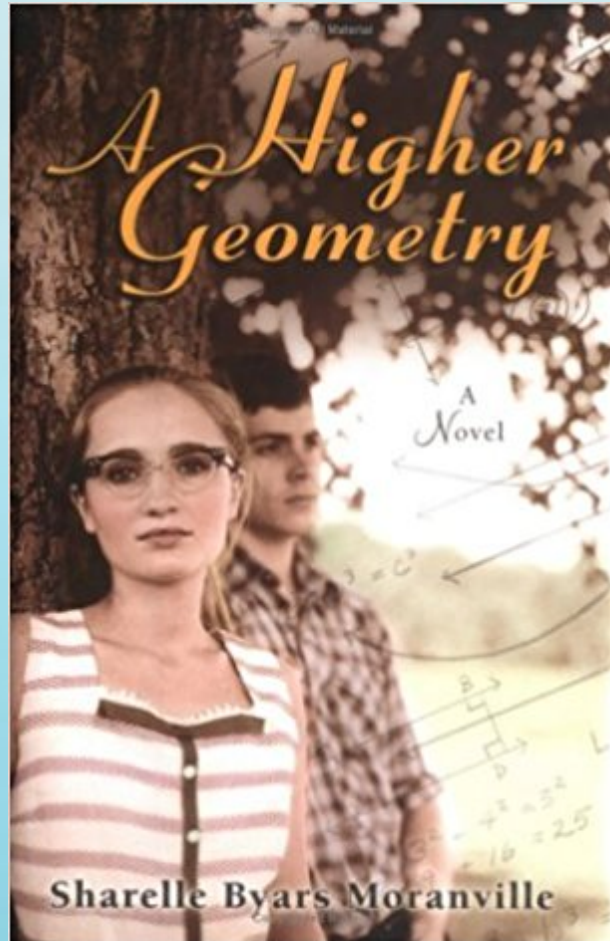
Figure 22: Image retrieved from author's website.

Figure 23: Book cover retrieved from Amazon.com

More citizen science opportunities

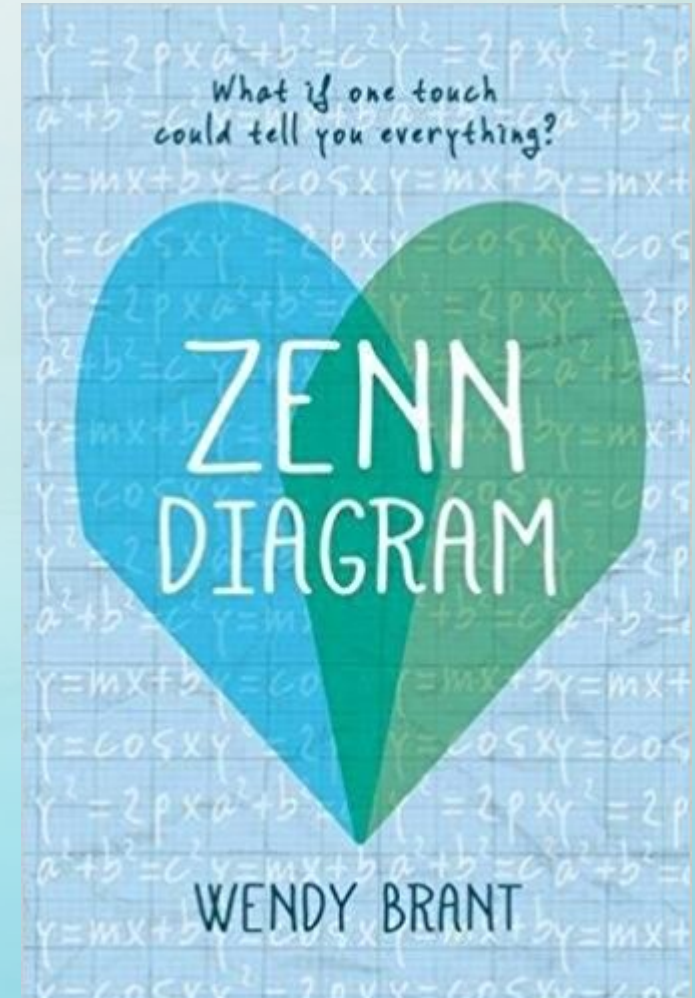
- Frogwatch USA - <https://www.aza.org/frogwatch>
- Project Budburst - <http://budburst.org/>
- Great Sunflower Project - <https://www.greatsunflower.org>

Mathematics



Moranville, S. B. (2016). *A higher geometry*. New York: Henry Holt.

We're off the map.... We're not where the world expects us to be...



Brant, W. (2017). *Zenn diagram* (K. Egan, Ed.). Toronto, ON: Kids Can Press.

Figures 24 & 25: Book covers retrieved from Amazon.com

Mathematics

Deeb, R.
(2016). *Seneca rebel*.
Brooklyn, NY: ATM
Publishing.

I didn't miss a beat between each "C" I'd marked off on the math test because, quite honestly, it's absurd. The school administrators think I'm some kind of genius sheep. That my only purpose is to elevate the test scores of a public school on the brink of losing funding from the federal government. The rest of the class, deep in calculus hell, didn't want to hear about me, what a great student I was and how I'd save their advanced math program. All they wanted were tickets to Endless Horizon concerts and to get bent on Mojo Sticks.

(Deeb, 2016, p. 4)

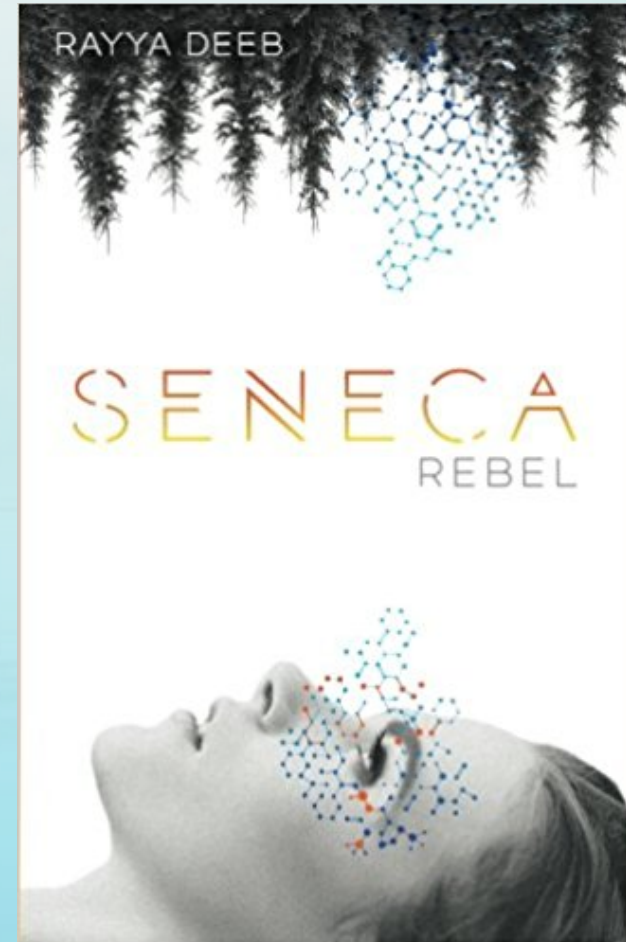


Figure 26: Book cover retrieved from Amazon.com

amp-theguardian-com.cdn.ampproject.org

Meet the mathekniticians - and their amazing woolly maths creations | Science | The Guardian

Meet the mathekniticians - and their amazing woolly maths creations | Science | The Guardian



Meet the mathekniticians - and their amazing woolly maths creations

Meet the mathekniticians - and their amazing woolly maths creations.



Knitted Hexaflexagon Cushions, by "Mathekniticians" Pat Ashforth & Steve Plummer

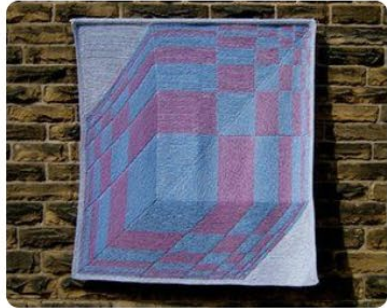


Meet the mathekniticians - and their amazing woolly maths creations



Meet the mathekniticians - and their amazing woolly maths creations

Curve of Pursuit: Ashforth and Plummer's most popular pattern. The edges of the squares represent four points that are each moving towards each other. Each point is closing in on the next point clockwise to it.



Meet the mathekniticians - and their amazing woolly maths creations

Mathekniticians! This one a Fiboptic: Fibonacci sequence in two directions on the face of a cube



Meet the mathekniticians - and their amazing woolly maths creations



Meet the mathekniticians - and their amazing woolly maths creations

Steve Plummer and Pat Ashforth: mathekniticians.



Meet the mathekniticians -



Knitting anyone?

Figure 27 : Screen shot of Pinterest search result for knitting and math



Meet the mathekniticians -

Woolly Thoughts
<http://www.woollythoughts.com>

Forensic Sciences



Maniscalco, K.
(2016). *Stalking Jack the Ripper*. New York: Little, Brown and Company.



Maniscalco, K.
(2017). *Hunting prince Dracula*. New York: Jimmy Patterson Books.

Figures 28 & 29: Book cover s
retrieved from Titlewave.com

Forensic Science Activities

Blood Spatter Drop

- Drop fake blood from different heights and angles
 - How height impacts the size of the spatter
 - How angle impacts the shape of the spatter

International Exhibition of Sherlock Holmes. (2013). *A matter of spatter*. Retrieved from <http://sherlockholmesexhibition.com/wp-content/uploads/A-Matter-of-Spatter-6-8th-Final.pdf>

Fingerprinting on different surfaces

- Dusting
- Fuming

Home Science Tools. (2017). *Crime scene science: Fingerprinting*. Retrieved from <https://learning-center.homesciencetools.com/article/forensics-science/>

Geography

Fawcett, H. (2017). *Even the darkest stars*. New York: Balzer & Bray.

How, when my mother was alive, I had begged her to take me along on her expeditions, and how I still spent many evenings poring over her maps of strange and distant lands, tracing the faded lines of ink with my fingers.

Fawcett, 2017, p. 12

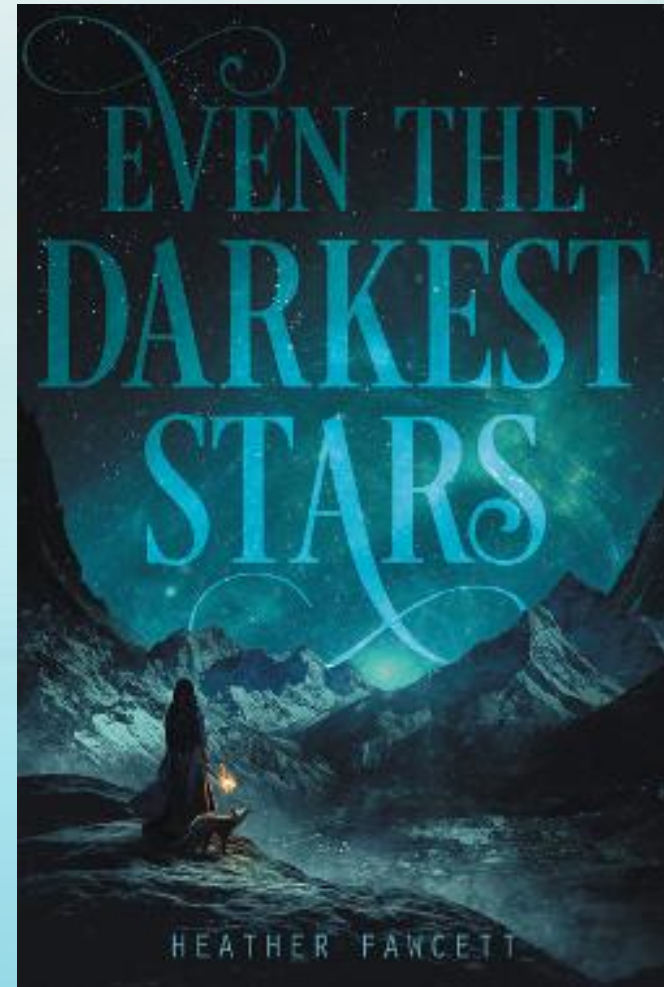


Figure 30: Book cover retrieved from *Booklist*.

The Humanitarian OpenStreetMap

Virtually volunteer to help map areas affected by disaster

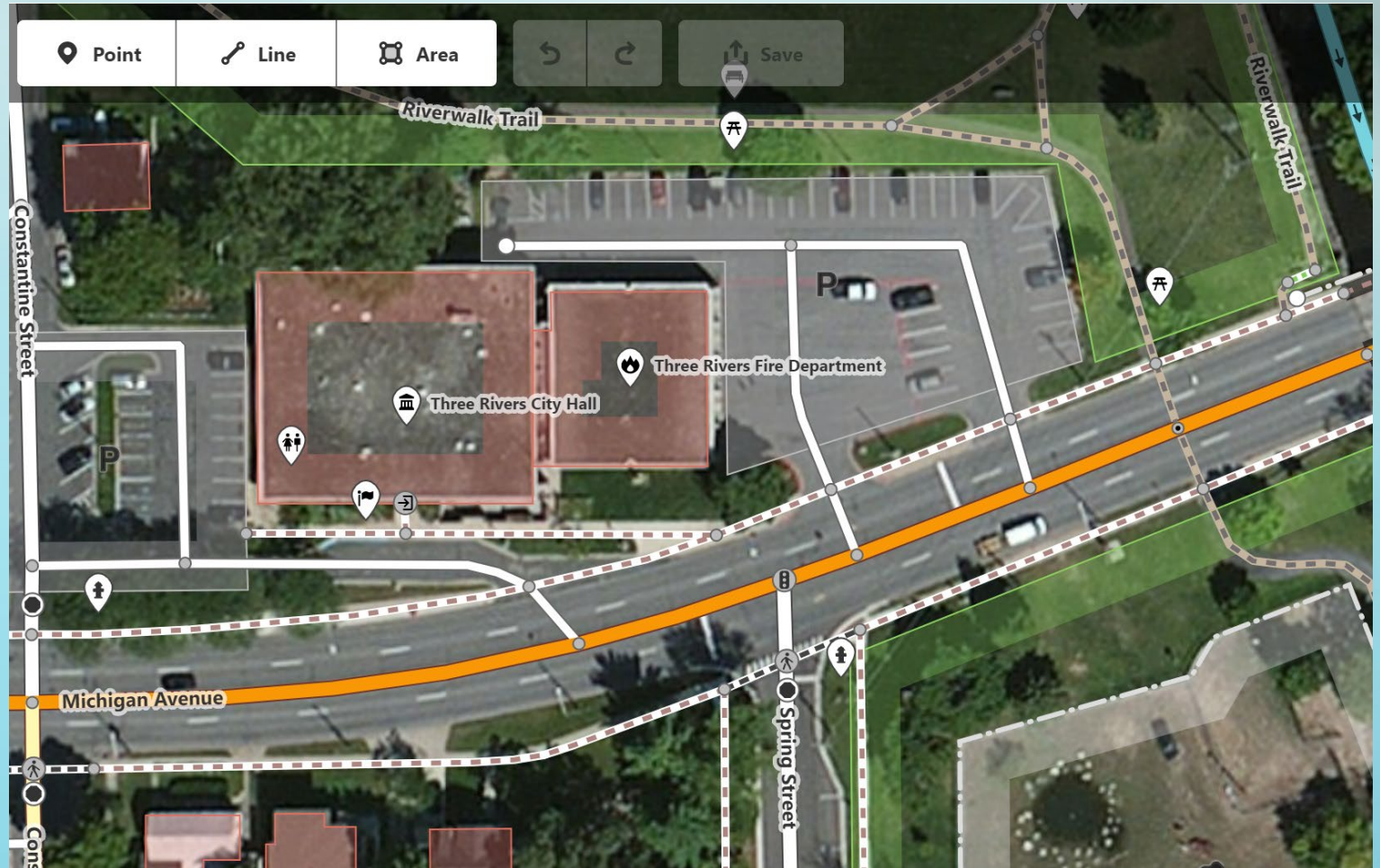


Figure 31 : Image from training walk through at Openstreetmap.org

Chemistry

Table of Contents

2.0 Delayed Reaction

2.1 Acid

2.2 Transition Element

2.2.1 Base

2.3 Caustic

2.4 Crucible

2.5 Reactants

2.6 Boron

“Toby and I are the proton and neutron of our atomic family unit. Dad is the loosely bonded electron, negatively charged, zooming around us in his own little shell”

Anderson, 2014, p. 17

Anderson, L.
(2014). *Catalyst*.
London: Scholastic.

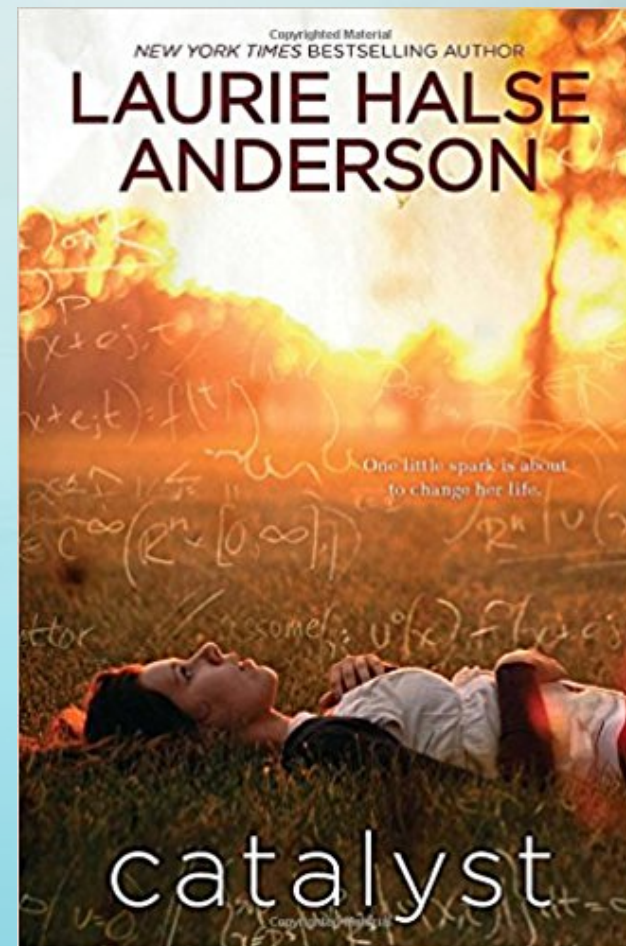


Figure 32: Book cover retrieved from Amazon.com

Chemical reactions

- Borax snowflakes
- Sun printing t-shirts or scarves
- Elephant toothpaste
- Pill dissolving
- Test ph using red cabbage

Engineering

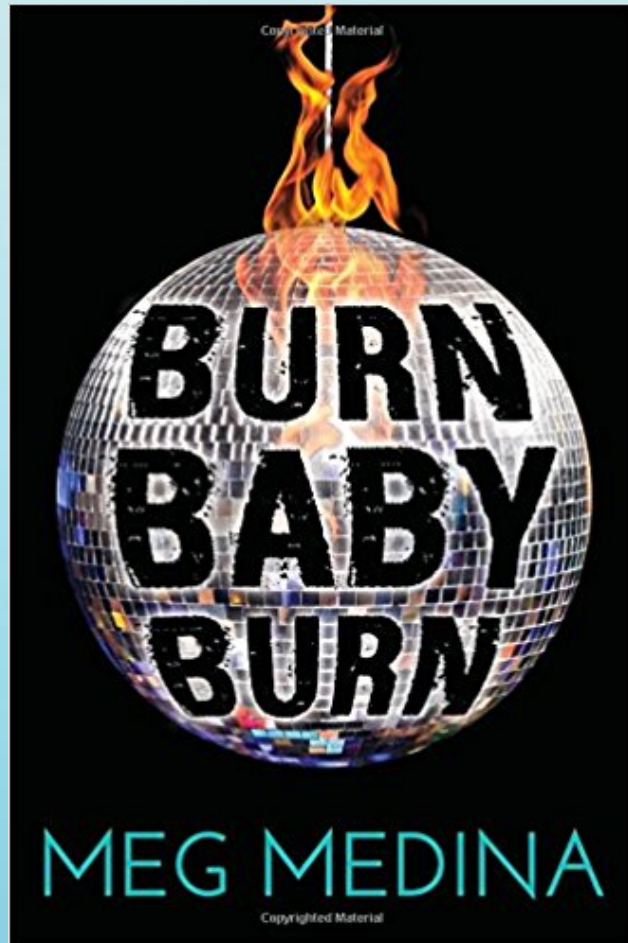


Figure 33: Book cover retrieved from Amazon.com

“Go to each corner of the bins, measure three inches, and make a mark.” I demonstrate. “At the opposite side of each corner, like so, measure *four* inches and make another one.” I draw another line. “If the distance between the two points is five, they’re square. Go check.”

Medina, 2016, p. 106

Medina, M. (2016). *Burn baby burn*. Somerville, MA: Candlewick Press.

Engineering

- Junk Drawer Engineering
- TeachEngineering.org
 - Able Sports – Design a new sport around a disability
 - Elephant Rail Car
 - Skateboard crashes (momentum)
 - Spinner competitions
 - Tightrope trials



It doesn't have to be a STEM-themed book

Mysteries & the Scientific Method

- **Observation**
- **Question**
- **Review information**
- **Hypothesis**
- **Testing**
- **Conclusion**
- **Communicate**



Figure 34: Book cover retrieved from Amazon.com

Bringing Makerspaces to Literature, or Bringing Literature to Makerspaces

- Novel Engineering: <http://www.novelengineering.org>
 - Tufts University
 - Apply engineering approach to literature
- Tension-filled text
 - Brainstorm the problems being faced
 - Design a solution
 - Develop a prototype of the solution
 - Test it

Novel Engineering Example

Schwartz, K. (2017, August 22). A literacy-based strategy to help teacher integrate science skills. Mind/Shift. Retrieved from <https://ww2.kqed.org/mindshift/2017/08/22/a-literacy-based-strategy-to-help-teachers-integrate-science-skills>

- *Burn Baby Burn*
- Problem: Nora worried that her abusive brother will steal her money
- Design Solution: Create an alarm system; Build a better door lock; Camouflage a hiding place
- Prototype: Built it / Test it

Observations

- Science as a tool for understanding their world.
- Science is their ticket out of hometown.
- Lack of diversity

Questions? Comments?

Slides available at [**http://tinyurl.com/ybhcqucr**](http://tinyurl.com/ybhcqucr)

Melissa Cast-Brede

mcast@unomaha.edu